REPLACING PAGE ADDENDUM
Filing Instructions:

1. REMOVE FROM THE SECTION THE PAGES NUMBERED THE SAME AS THOSE ATTACHED TO THIS PINK SHEET.
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ADDENDUM 040-236-701
Issue 2, November 1968
AT&TCo Standard

RELAYS

221, 222, 223, 224, 225, 247, 248, 251, 252, 305, 307 AND 309 TYPES

REQUIREMENTS AND ADJUSTING PROCEDURES

1. GENERAL

1.001 This addendum supplements Section 040-236-701, Issue 8-D. The attached pages must be inserted in the section in accordance with the filing instructions above.

1.002 This addendum is reissued to revise Part 3, adding three new tools and their use.

1. GENERAL

The following change applies to Part 1 of the section:

(a) 1.08—Revised

2. REQUIREMENTS

The following changes apply to Part 2 of the section:

(a) 2.09—Table C revised

(b) 2.18(e)—revised

3. ADJUSTING PROCEDURES

The following changes apply to Part 3 of this section:

(a) 3.001—List of tools revised

(b) 3.08—Revised

Attached:

Page 1 dated January 1965, revised
Page 2 dated January 1965, reissued
Page 9 dated January 1965, reissued
Page 10 dated January 1965, revised
Page 13 dated November 1968, reissued
Page 14 dated November 1968, revised
Page 51 dated November 1968, revised
Page 52 dated November 1968, reissued
Page 55 dated November 1968, revised
Page 56 dated November 1968, revised
Page 56.1 dated November 1968, added

RELAYS
221, 222, 223, 224, 225, 247, 248, 251, 252, 305, 307, AND 309 TYPES
REQUIREMENTS AND ADJUSTING PROCEDURES

1. GENERAL

1.01 This section covers the following relays.

(a) All 221-, 222-, 223-, 224-, 225-, 247-, 248-, 251-, 252-, 305-, 307-, and 309-type relays.

(b) AECo relays similar to those covered in (a) and shown on Bell System drawings.

(c) AECo relays similar to those covered in (a) and shown on non-Bell System drawings, provided they are listed in Section 040-236-711.

1.02 The section is reissued to add information covering 305-, 307-, and 309-type relays; to revise the List of Tools and Gauges; and to revise the information covering modification of the 207 offset screwdriver. Detailed reasons for reissue will be found at the end of the section.

1.03 The 305-, 307-, and 309-type relays are similar to 221- or 222-type relays except that they are equipped with a thermal time-delay unit. The thermal unit of these relays consists of two bimetallic springs with a heater winding mounted on one of these springs. The spring on which the winding is mounted makes contact with its mating spring when current is connected to the heater winding for a sufficiently long interval to deflect the spring. The 305-, 307-, and 309-type relays should meet all the requirements for 221- and 222-type relays in addition to the thermal unit requirements included in requirements 2.04, 2.11, and 2.18.

1.04 ***Supplementary Requirements:*** Circuit requirement tables contain the necessary supplementary requirements except in the following cases where reference must be made to the BSP sections indicated.

(a) Where the circuit requirement table still shows a schematic of the spring combination (see Section 005-120-101), reference must be made to Section 040-236-711 for supplementary mechanical requirements.

(b) Where modified 221- and 222-type or similar AECo relays (see 1.05) or replacing 247- and 248-type relays are not covered in the circuit requirement table, reference must be made to Section 040-236-711 for supplementary electrical and mechanical requirements.

(c) Where timing requirements are to be applied to B, C, E, and similar functioning relays of selectors, connectors, repeaters, and test distributors and these requirements are not specified in the circuit requirement table, reference must be made to Section 040-013-711 for timing, residual, and electrical requirements.

1.05 Where existing 221- and 222-type and corresponding AECo relays have been modified to employ a 1:1 ratio armature, such relays for the purpose of this section shall be regarded as 247- and 248-type relays, respectively.

1.06 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.

1.07 The definitions given in 1.08 through 1.22 do not apply to the thermal units of 305-, 307-, and 309-type relays. The definition of operate given in 1.23 applies only to the thermal unit of these relays.

1.08 ***Operate:*** A relay is said to operate if, when current is connected to its winding the armature moves all the way up to the core except where a residual airgap is specified, and all normally closed contacts break, and all normally open contacts make. Where a residual airgap is specified, the residual screw instead of the armature touches the core.

Note: Certain relay codes, as noted on circuit requirement tables, do not require that the armature or residual screw, if used, touch the core on the specified operate current. All contacts, however, must fully operate on this current.

1.09 ***Nonoperate:*** A relay is said to nonoperate if, when current is connected to its winding, the armature does not move sufficiently to close any normally open contacts or to reduce the contact pressure on normally closed contacts enough to cause an unreliable contact.

1.10 ***Hold:*** A relay is said to hold if, after it has operated and the current is reduced abruptly to the hold value or is interrupted momentarily, the armature does not move sufficiently from its operated position to cause normally open contacts to become unreliable or to cause normally closed contacts to make.

1.11 ***Release:*** A relay is said to release if the armature moves from its operated position sufficiently to cause normally open contacts to break and normally closed contacts to make reliably.

1.12 ***Heelpiece airgap*** is the gap between the end of the heelpiece and the nearest point on the armature when the relay is electrically operated.

1.13 ***Residual airgap*** is the gap between the face of the relay core and the nearest point on the armature with the relay electrically operated and the residual screw touching the core.

1.14 ***Armature travel*** is the gap between the core and the armature (or the core and the residual screw where a residual airgap is specified) with the relay in the normal (unoperated) position. The value specified in the ARM TRVL column in the circuit requirement table applies as follows.

(a) ***Where the first lever spring is a normally open contact spring or a balancing spring*** (or in the case of 223- and 224-type relays where the first lever spring of one or both spring assemblies is a normally open contact spring or a balancing spring), the value specified in the ARM TRVL column in the circuit requirement table is the test armature travel.

Note: On special make-before-break contact springs per Fig. B, the first contact is considered a normally open contact.

(b) ***Where the first lever spring is a normally closed contact spring*** (or in the case of 223- and 224-type relays where the first lever spring of both assemblies are normally closed contact springs), the value specified in the ARM TRVL column in the circuit requirement table is not armature travel as defined above, but is the test value on which the first contact (or contacts) should not break. Information for gauging this test value is covered in requirement 2.08(b). However, no armature travel is specified for these relays.

1.15 ***Armature stud gap*** is the clearance between the armature stud and the first lever spring when the armature is resting against the backstop or backstop screw.

1.16 ***Spring assembly*** is an arrangement of all the springs operated by one armature lever of a relay having either one or two armature levers.

1.17 ***Spring combination*** consists of all spring assemblies of a relay.

1.18 ***Standard make-before-break contact springs*** are an arrangement of springs where the lever spring makes contact when the relay is operated (see Fig. A).

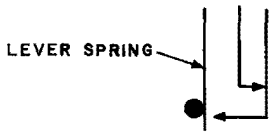


Fig. A—Standard Make-Before-Break Contact Springs

1.19 ***Special make-before-break contact springs*** are an arrangement of springs where the lever spring breaks contact when the relay is operated (see Fig. B).

Fig. B—Special Make-Before-Break Contact Springs

1.20 ***Preliminary break contacts*** are early breaking contacts for which separate electrical requirements are specified in the circuit requirements table or in Section 040-236-711.

1.21 ***Spring combination figures*** are for readjust only, and the values specified on them are expressed in thousandths of an inch.

1.22 ***When relays having two armature levers are equipped with two armature backstops,*** only the top stop should be used for adjusting purposes and the lower stop should be made ineffective.

1.23 ***Operate*** (thermal units of 305-, 307-, and 309-type relays): The thermal unit is said to operate if, when current is connected to the heater winding, the associated spring moves sufficiently to close the normally open contacts.

1.24 ***Use of No. 510C Test Lamp:*** In general, the No. 510C test lamp, equipped with a No. 561A straight tip or No. 562B curved tip and held so as to illuminate the contact springs adjacent to the contacts, may be used to facilitate adjustment and gauging operations.

2. REQUIREMENTS

2.01 ***Cleaning:*** The contacts and other parts shall be cleaned when necessary in accordance with Section 069-306-801.

2.02 ***Relay Mounting:*** Relays shall be fastened securely to the mounting plate.

Gauge by feel.

2.03 ***Vertical Clearance Between Relays***

(a) There shall be a clearance between the armature or springs of any relay and the armature, springs, or heelpiece of the relay above or below it of

Min 1/32 inch

Gauge by eye.

(b) There shall be a clearance between the armature backstop and the heelpiece of the relay above it.

Gauge by eye.

2.04 ***Contact Alignment*** (including thermal units of 305-, 307-, and 309-type relays)

(a) ***Relays Having Round-Type Contacts:*** Fig. C(1) — Contacts shall not be out of alignment more than 40 per cent of their base diameter.

Gauge by eye.

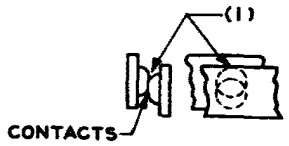


Fig. C — Maximum Permissible Contact Misalignment

(b) ***Relays Having Heavy Bar Contacts:*** Fig. D — On relays equipped with bar contacts, the contact alignment shall be within the limit indicated in Fig. D.

Gauge by eye.

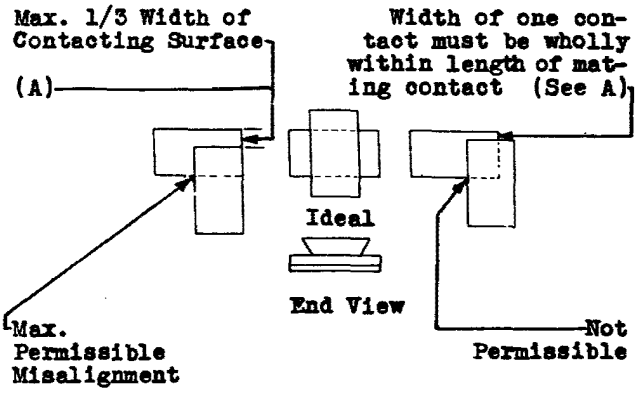


Fig. D — Alignment of Heavy Bar Contacts — Plan View of Contacting Surfaces

2.05 ***Armature Movement***

(a) ***Pin-Type Armatures:*** Fig. E(1) — The armature shall move freely on its bearings and the endplay shall be

Max 0.030 inch

Gauge by eye and feel.

To check the endplay, hold the armature against one of the bearing lugs and observe the clearance between the other side of the armature and the other bearing lug.

(b) ***Pivot-Type Armatures:*** Fig. F(1) — The armature shall move freely on its bearings and shall have perceptible endplay.

Gauge by eye and feel.

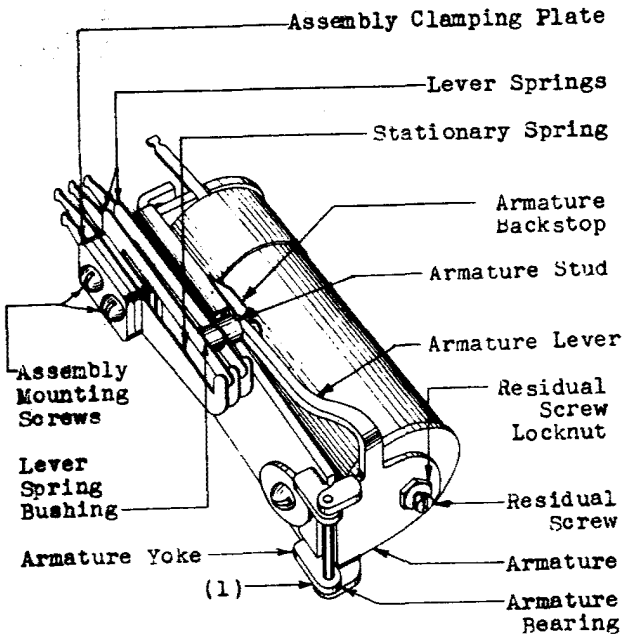


Fig. E – 221-Type Relay

2.06 ***Residual Airgap***: Fig. G(1) — With the relay electrically energized, it shall meet the residual airgap requirement specified in the **RESID** column in the circuit requirement table or in Section 040-013-711. The designations S, SL, or Slight, specified on the circuit requirement table, shall be interpreted in accordance with Table A.

TABLE A

RESIDUAL SPECIFIED ON CIRCUIT	MINIMUM	MAXIMUM
SL or Slight	The armature shall not touch core	0.002 inch (See exception below.)
S	The armature shall not touch core	As specified

Exception: Where timing requirements are applied, the maximum 0.002-inch limit does → not apply as a test requirement to B-, C-, or → E-position relays of local selectors, connectors, and repeaters, and similarly functioning relays of other circuits. For these relays the maximum limit is controlled by timing requirement 2.18.

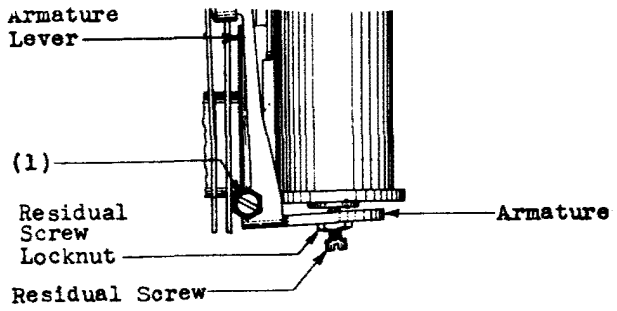


Fig. F – Illustrating Armature Movement Requirement for Pivot-Type Relays

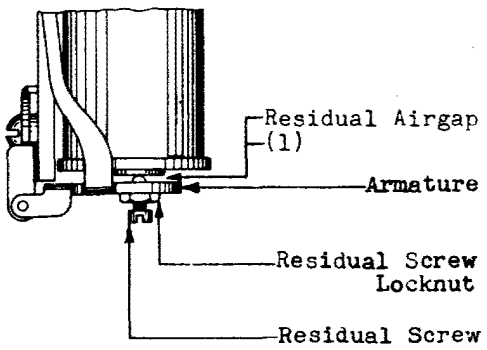


Fig. G – Illustrating Residual Airgap

Check the residual airgaps as follows.

(a) ***Residual Airgaps of Zero (0); Minimum Limit S, SL, or Slight:*** Insert a strip of KS-7187 Bell Seal bond paper between the armature and core. Electrically energize the relay, and when necessary, supplement the energizing force of the relay by pressing the armature toward the core by hand sufficiently for a dot or impression to appear on the paper if a residual airgap is present. Release the relay and withdraw the paper. Absence of a dot or impression on the bond paper indicates zero (0) residual airgap. Presence of a dot or impression indicates that the residual screw protrudes beyond the face of the armature and, therefore, that the minimum requirements for S, SL, or Slight residual airgaps are met.

(b) ***Residual Airgap of 0.003 Inch or Less; Maximum Limit or SL or Slight:*** Insert the proper KS-6909 gauge between the armature and core as shown in Fig. H so that the residual screw is free to touch the core through the hole in the gauge. Then, holding the gauge

against the armature, insert a strip of KS-7187 Bell Seal bond paper between the gauge and core so that the paper is back of the hole in the gauge as viewed from in front of the relay. Electrically energize the relay, and when necessary, supplement the energizing force by pressing the armature toward the core by hand with sufficient force to cause a dot or impression to appear on the paper if the residual airgap is greater than the thickness of the gauge. Release the relay and withdraw the paper and the gauge. Absence of a dot or impression on the paper indicates that the residual airgap is less than the thickness of the gauge. Presence of a dot or impression on the paper indicates that the gap is greater than the thickness of the gauge.

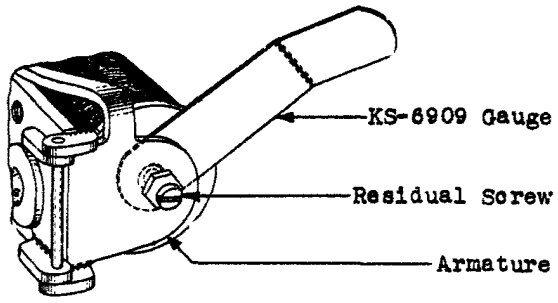


Fig. H – Checking the Residual Airgap

(c) ***Residual Airgaps of 0.004 Inch or More:*** Insert the proper KS-6909 gauge between the armature and core as shown in Fig. H so that the residual screw is free to touch the core through the hole in the gauge. Electrically energize the relay. When the gauge is tight, the residual airgap is less than the thickness of the gauge. When the gauge is not tight, the gap is greater than the thickness of the gauge.

(d) ***Examples***

(1) ***Specified Residual Airgap S-4:*** The S gap (minimum) is checked in accordance with (a) and is met if a dot appears on the bond paper. The 4 gap (maximum 0.004 inch) is checked in accordance with (c) and is met if the 0.004-inch gauge is tight.

(2) ***Specified Residual Airgap 7-11:*** Both the minimum 0.007-inch and the maximum 0.011-inch gaps are checked in accordance with (c). The minimum 0.007-inch requirement is met if the 0.007-inch gauge is not tight, and the maximum 0.011-inch requirement is met if the 0.011-inch gauge is tight.

2.07 ***Heelpiece Airgap*** (relays with pin-type armatures only)

(a) ***All Relays Except 247 and 248 Types:*** Fig. I(1) — When the relay is electrically operated with the specified residual airgap:

(1) There shall be no observable difference in the heelpiece airgap at both ends of the heelpiece.

Gauge by eye, using the P-220366 dental mirror.

(2) The clearance between the armature and heelpiece measured at the closest point shall be

Min — Armature shall not touch the heelpiece

Max — 0.004 inch

Use gauges and checking methods covered in (c).

Note: On B-position and similar functioning relays and C-position relays, it may be necessary to readjust the heelpiece airgap toward the minimum value to facilitate meeting the pulsing tests.

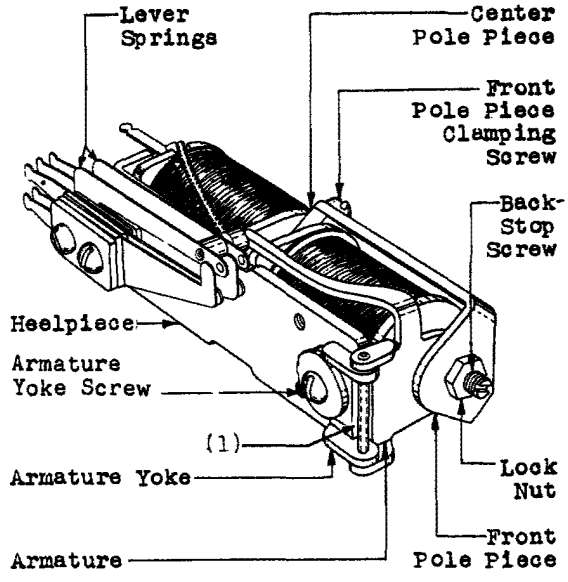


Fig. I – Heelpiece Airgap Requirement — 251-Type Relay Shown

(b) ***247- and 248-Type Relays:*** Fig. J(1) — When the relay is electrically operated with the specified residual airgap [except as noted in (2)]:

(1) The armature shall be parallel to the heelpiece.

Gauge by eye.

(2) The clearance between the armature and heelpiece measured at the closest point shall be

Test — Min 0.0015 inch, Max 0.007 inch

Readjust — Min 0.0015 inch, Max 0.004 inch

Readjust requirements shall be met with zero residual airgap (armature touching core).

Use gauges and checking methods covered in (c).

Note: On B-position and similar functioning relays and C-position relays, it may be necessary to readjust the heelpiece airgap toward the minimum value to facilitate meeting the pulsing tests.

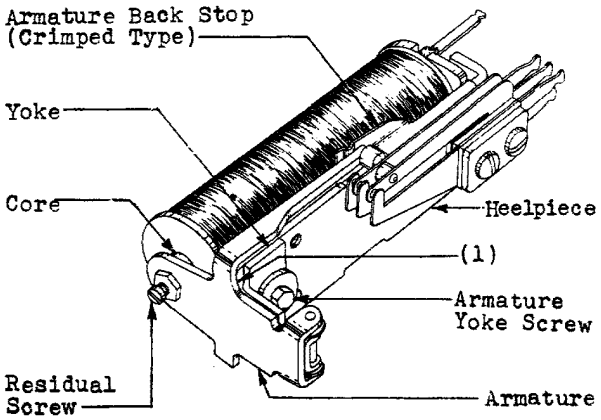


Fig. J – Heelpiece Airgap Requirement — 248-Type Relay Shown

(c) ***Checking Methods for Requirements 2.07(a)(2) and (b)(2):*** To check for these requirements, insert the gauge specified for the individual relay in Table B between the armature and heelpiece as shown in the figures referred to in Table B. Take care not to extend the gauge between the armature and the core. When checking 247- and 248-type relays as shown in Fig. M and N, take care not to extend the gauge beyond the heelpiece adjacent to the yoke. Electrically operate the relay. The requirement for minimum gap is met if the gauge does not bind. The requirement for maximum gap is met if the gauge is tight. Be sure to check the gap over the entire width of the heelpiece.

TABLE B

TYPE OF RELAY	GAP	USE		REFER TO	
		GAUGE	BLADE (INCH)	FIG.	NOTES
221, 222	Min	KS-6909	0.0015	L	1
	Max	KS-6909	0.004	K	
223, 224	Min	KS-6909	0.0015	K	1,2
	Max	KS-6909	0.004	K	2
225	Min	No. 75F	0.002		1,3
	Max	No. 75C	0.004		3
247, 248	Test Min	KS-6909	0.0015	N	
	Test Max	No. 129A	0.007	M	
	Readj Min	KS-6909	0.0015	N	4
	Readj Max	KS-6909	0.004	N	4
251, 252	Min	KS-6909	0.0015	L	1
	Max	KS-6909	0.004	K	

Notes

1. This requirement is also met if light can be observed between the armature and heelpiece throughout the entire width of the heelpiece. Use the P-220366 dental mirror.
2. On the 223BN relay, use the No. 92R gauge (minimum requirement) and the No. 75C gauge (maximum requirement) inserted at an angle from the right.
3. Insert the gauge from the right just above the relay armature arm. In checking these relays it may be necessary in some cases to remove the relay from the mounting plate.
4. Before readjusting for this requirement, set the residual airgap to zero (armature touching core).

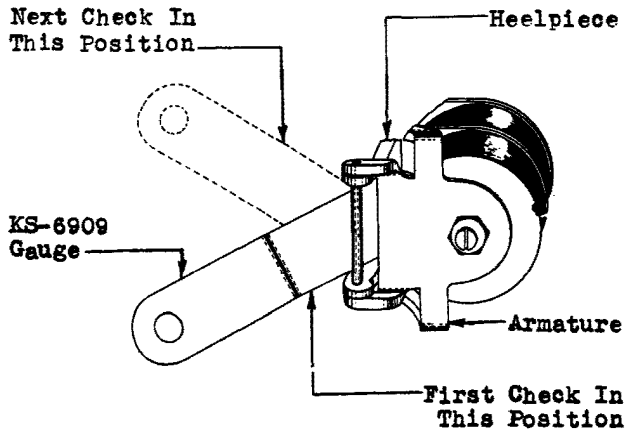


Fig. K – Checking Minimum and Maximum Heelpiece Airgap on 223- and 224-Type Relays and the Maximum Gap on 221-, 222-, 251-, and 252-Type Relays

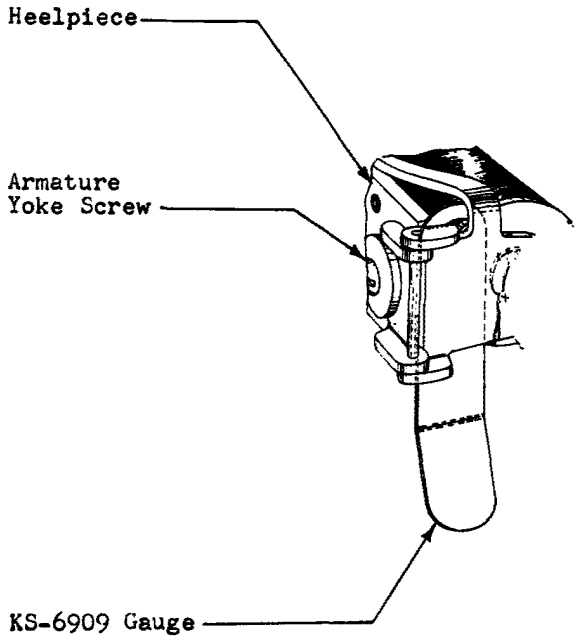


Fig. L – Checking Minimum Heelpiece Airgap on 221-, 222-, 251-, and 252-Type Relays ←

2.08 *Armature Travel* (See 1.14)

(a) ***221-, 222-, 225-, 247-, and 248-Type Relays Where the First Lever Spring Is a Normally Open Contact Spring or a Balancing Spring, and 223- and 224-Type Relays Where the First Lever Spring of One or Both Assemblies Is a Normally Open Contact Spring or a Balancing Spring, and all 251- and 252-Type Relays***

Test — When the relay is in its normal position, a gauge of the value specified in the ARM TRVL column in the circuit requirement table or in Section 040-236-711 shall not enter between the core and the armature, or between the core and the residual screw where a residual airgap is specified.

Use the 187A, KS-6909, and KS-6938 gauges. ←

Attempt to insert the gauges as described in (c) or (d). If the gauge just enters, the requirement is considered met if the armature does not leave the backstop or backstop screw when the relay is electrically energized against the gauge.

Readjust

Min — The armature shall leave the backstop or backstop screw when the relay is electrically energized against the gauge of the smaller value specified for armature travel on the individual figure of the spring combination figures herein.

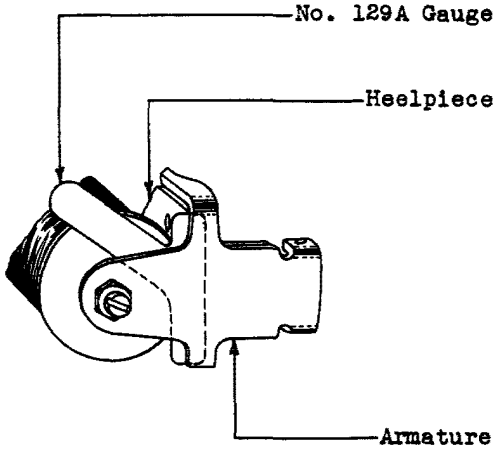
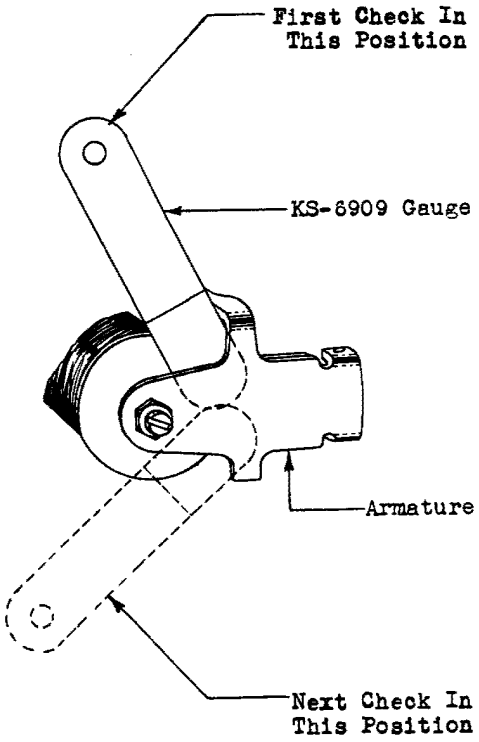


Fig. M – Checking Maximum Test Heelpiece Airgap on 247- and 248-Type Relays

Use the 187A, KS-6909, and KS-6938 gauges. ←

Insert the gauges as covered in (c) or (d) and energize the relay electrically. Observe the position of the armature lever with respect to the backstop or backstop screw.



→Fig. N – Checking Minimum Test, and Minimum and Maximum Readjust Heelpiece Airgap on 247- and 248-Type Relays

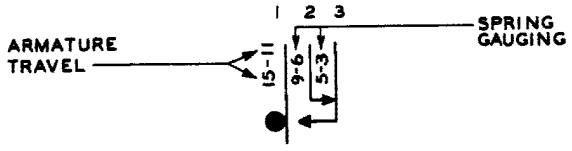


Fig. P – Typical Spring Combination Figure Showing Armature Travel and Spring Gauging Values

Max — When the relay is in its normal position, a gauge of the larger value specified for armature travel on the individual figure of the spring combination figures herein shall not enter between the core and the armature, or the residual screw where a residual airgap is specified.

→ Use the 187A, KS-6909, and KS-6938 gauges.

Attempt to insert the gauges as described in (c) or (d). If the gauge just enters, the requirement is considered met if the armature does not leave the backstop or backstop screw when the relay is electrically energized against the gauge.

Example: In the case of a spring combination similar to that shown in Fig. P the armature must not leave the stop when electrically energized against the gauge of 0.015 inch, but it must leave the stop when the relay is electrically energized against a gauge of 0.011 inch.

(b) ***221-, 222-, 225-, 247-, and 248-Type Relays Where the First Lever Spring Is a Normally Closed Contact Spring, and 223- and 224-Type Relays Where the First Lever Springs of Both Assemblies Are Normally Closed Contact Springs***

Test — The first contact (or contacts) shall not break when the relay is electrically energized against a gauge of the value specified in the ARM TRVL column in the circuit requirement table or in Section 040-236-711.

→ Use the 187A, KS-6909, and KS-6938 gauges.

Insert the gauges as covered in (c) and energize the relay electrically. Observe whether the normally closed contacts are open or closed.

Note: In order to determine whether pitted contacts are open or closed, it may be necessary to apply the KS-6320 orange stick to the lever spring and attempt to move this spring.

Readjust — Values as covered in requirement 2.16.

(c) ***Method of Inserting Gauges on all Relays Except 251 and 252 Types:*** Insert the gauge between the nearest point on the core and the armature where no residual airgap is specified, or between the core and residual screw where a residual airgap is specified. Insert the gauge approximately vertically so that it completely covers the core and rests against the armature lever as shown in Fig. R. The armature lever acts as a stop for the gauge on all relays except 247 and 248 types. In the case of 247- and 248-type relays, no satisfactory stop is available as a guide in positioning the gauge. In this case and where springs or other parts of the switch interfere with positioning the gauge as shown in Fig. R, insert the gauge approximately at the angle shown

in Fig. S. Take care to insert the gauge so that it completely covers the core but does not project more than 1/16 inch beyond the core toward the heelpiece as gauged by eye. When inserted in this way, the bend in the blade will coincide approximately with the circumference of the relay spoolhead. If the gauge is inserted so that it extends beyond the core, the armature rather than the residual screw may contact the gauge as shown in Fig. T. This is most likely to occur when gauging relays having low residual airgap and high armature travel requirements. In such cases, insert the gauge only far enough to engage the residual screw.

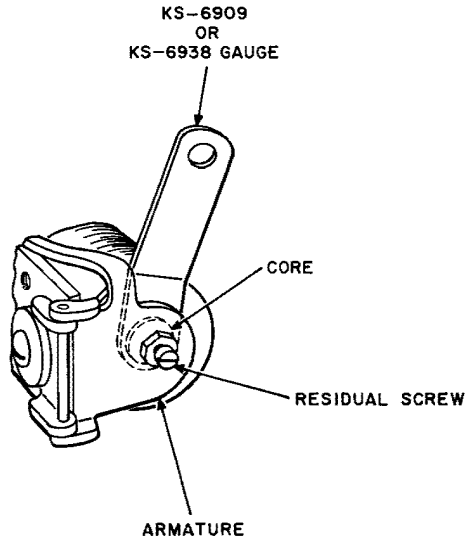


Fig. R—Checking Armature Travel and Spring Gauging On All Relays Except 251 and 252 Types

(d) ***Method of Inserting Gauges on 251- and 252-Type Relays.*** Insert the gauge from the bottom of the relay so that it rests against the lower arm of the front pole piece at a slight angle as shown in Fig. U. Observe the position of the armature with respect to the backstop screw.

2.09 ***Armature Stud Gap:*** (position of first lever spring with respect to armature stud) Fig. V(1)—With the armature resting against the backstop or backstop screw, the gap between the first lever spring and the armature stud shall be as shown in Table C.

Gauge by eye.

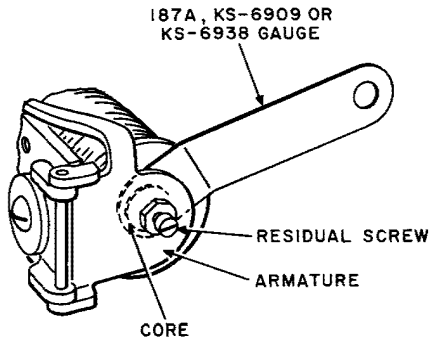


Fig. S—Checking Armature Travel and Spring Gauging on all Except 251- and 252-Type Relays Where Method Illustrated in Fig. R Cannot Be Applied

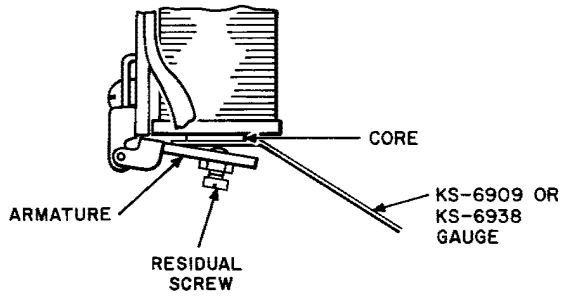


Fig. T—Incorrect Method of Checking Armature Travel and Spring Gauging

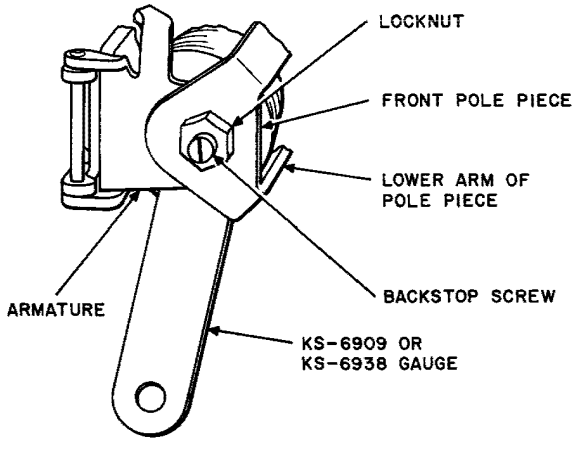


Fig. U—Checking Armature Travel and Spring Gauging on 251- and 252-Type Relays

TABLE C

TYPE OF RELAY	TYPE OF FIRST LEVER SPRING	ARMATURE STUD GAP (SEE 1.15)
221, 222, 225, 247, 248, 251, 252	Balancing or Normally Open Contact Spring	See Note 1
	Normally Closed Contact Spring	Min — Perceptible, Max — 0.016 Inch
	Special Make-Before-Break Contact Springs per Fig. B	
223 and 224	Normally Open Contact Springs on Both Assemblies	See Note 2
	Normally Closed Contact Springs on Both Assemblies	Min — Perceptible, on Each Assembly
	Normally Closed Contact Spring on One Assembly and Special Make-Before-Break Contact Springs per Fig. B on Other Assembly	Max — 0.016 Inch on at Least One Assembly
	Normally Open Contact Spring on One Assembly and	See Note 1
	Normally Closed Contact Spring or Special Make-Before-Break Contact Springs per Fig. B on Other Assembly	Min 0.004 Inch

Note 1: The spring shall rest against the stud with sufficient pressure to hold the armature against the backstop or backstop screw.

Note 2: Each spring shall rest against its associated stud, and the combined tension of the two springs shall hold the armature against the backstop.

Exception: Where one of the normally open contact springs is associated with a stop spring such as spring X of Fig. 267, there shall be a 0.008-inch gap between the stud and the associated No. 1 spring.

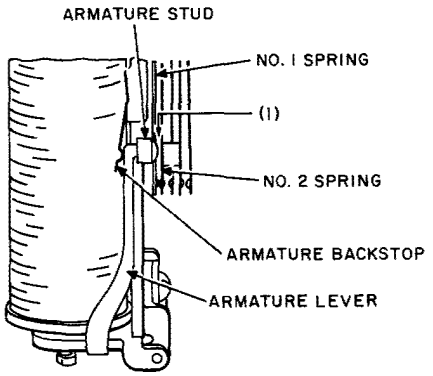


Fig. V—Illustrating Armature Stud Requirement

2.10 ***Armature Backstop Screw Position:*** (251- and 252-type relays only)—With the armature resting against the backstop screw, there shall be a clearance between the armature and the front pole piece, at the closest point, of

Min 0.030 inch

Use the KS-6938 gauge.

To check, insert the 0.030-inch blade of the KS-6938 gauge from the side of the armature away from the hinge pin and from the top and bottom of the armature. The gauge should enter in any of these positions without moving the armature away from the backstop screw.

2.11 ***Straightness of Springs***

Except Thermal Units of 305-, 307-, and 309-Type Relays

(a) All springs from the point where they leave the assembly clamping plates and insulators to the ends of the springs shall be free of sharp bends or kinks due to adjustment, but a maximum 1/32-inch bow in the springs is permissible.

Gauge by eye.

Thermal Units of 305-, 307-, and 309-Type Relays

(b) The bimetallic contact springs shall be free of sharp bends or kinks due to adjustment. A gradual bow in the springs is permissible.

Gauge by eye.

2.12 ***Contact Separation***

Test — Unless otherwise specified in the circuit requirement table or in Section 040-236-711, the contact separation between all normally closed contacts with the relay electrically operated, and between all normally open contacts with the relay in the normal position shall be

Min 0.005 inch

Gauge by eye.

Readjust — As covered in requirement 2.16.

2.13 ***Contact Sequence*** (normally closed contacts, except those of standard make-before-break contact springs per Fig. A)

Test — (1) All normally closed contacts of each spring assembly, considered separately, shall break in sequence beginning with the normally closed contacts nearest the heel-piece.

(2) Unless otherwise specified in the circuit requirement table or in Section 040-236-711, all the normally closed contacts of each spring assembly, considered separately, shall break before any normally open contacts make.

Gauge by eye.

To check this requirement, operate the relay manually. The check will be facilitated by using lamps to indicate the contact sequence.

Readjust — As covered in requirement 2.16.

2.14 ***Contact Pressure*** (make-before-break contacts only)

Test — Unless otherwise specified in the circuit requirement table, the pressure of the normally closed contacts of make-before-break springs per Fig. A with the relay in the normal position, and normally open contacts of make-before-break springs per Fig. B with the relay operated shall be

Min 25 grams

Use the No. 68C gauge as shown in Fig. W.

Readjust — As covered in requirement 2.16.

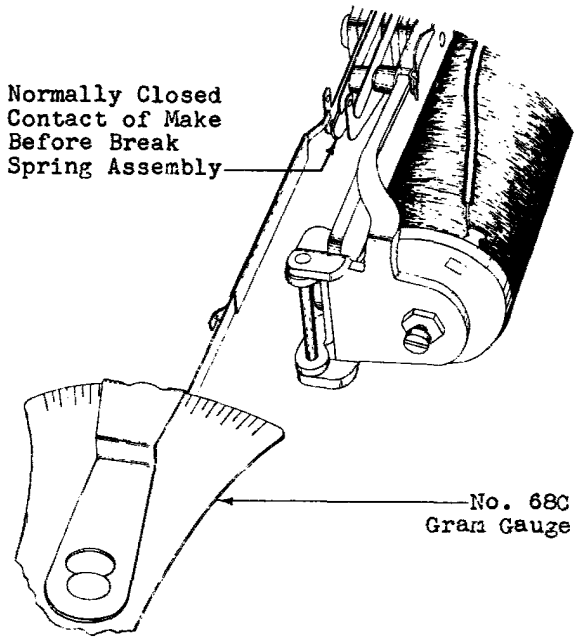


Fig. W – Measuring Contact Pressure on Make-Before-Break Spring Combination

2.15 ***Contact Follow***

(a) ***Normally Open Contacts***

Test — The contact follow of normally open contacts shall be as covered in Table D.

TABLE D

APPLICATION OF REQUIREMENT	STANDARD FOLLOW REQUIREMENT (SEE NOTE)	SPECIAL FOLLOW REQUIREMENT (CIRCUIT REQUIREMENT TABLE SPECIFIES 0.008 INCH) (SEE NOTE)
Manufacturing Department on Wired Equipments	Min 0.010 Inch	Min 0.008 Inch
Before and After Turnover in Field	Min 0.008 Inch	Min 0.006 Inch (This supersedes the 0.008 inch in the circuit requirement table.)

Gauge by eye with the relay operated manually.

These requirements are considered met if the contacts close when the relay is electrically energized against the KS-6909 gauge, specified in Table E, inserted between the armature and core, as described in requirement 2.08.

TABLE E

APPLICATION OF REQUIREMENT	FOR CHECKING REQUIREMENT	KS-6909 GAUGE INSERTED TO CHECK CONTACT MAKE (SEE NOTE)	
		247- AND 248-TYPE RELAYS (INCH)	ALL OTHER RELAYS (INCH)
Manufacturing Department on Wired Equipments	Standard	0.010	0.004
	Special	0.008	0.003
Before and After Turnover in Field	Standard	0.008	0.003
	Special	0.006	0.002

Note: Different gauging values are specified for checking the requirement on wired equipments by the manufacturing department and before and after turnover in the field. These differences allow margin for slight changes in adjustment caused by changes in humidity and temperature.

Readjust — As covered in requirement 2.16.

(b) ***Normally Closed Contacts:*** Normally closed contacts shall have follow when the armature is operated sufficiently to break the contacts. This requirement is waived for contacts on extra heavy springs (such as 0.050-inch springs on A relays of selectors) and on preliminary break contacts (see 1.20). In these cases, the nonoperate electrical requirement specified in the circuit requirement table or in Section 040-236-711 insures satisfactory operation.

Gauge by eye.

This requirement is considered met if the contact pressure of the contacts is minimum 15 grams, measured at the contacts with the No. 68C gauge just as the contacts break, with all the lower gauged normally closed contacts as shown on the particular assembly of the spring combination figure closed.

2.16 ***Spring Gauging:*** (readjust only) Fig. P — All the spring gauging limits as specified on spring combination figures or in the circuit requirement table shall be met.

(a) Normally open contacts shall not make and normally closed contacts shall not break when the relay is electrically energized against a gauge, equal to the larger specified value, inserted between the armature and core at the closest point.

Check as described in (c).

(b) Normally open contacts shall make and normally closed contacts shall break when the relay is electrically energized against a gauge, equal to the smaller specified value, inserted between the armature and the core at the closest point.

Check as described in (c).

→ ***Note:*** All normally closed contacts shall
→ break in the order of the maximum gauging values specified in the spring combination figures, the one with the highest gauging value breaking first.

(c) To check for the spring gauging requirement, use the 187A, KS-6909, and KS-6938 gauges inserted between the armature and core as described in requirement 2.08. Electrically energize the relay and determine visually whether the contacts are open or closed.

Note: In order to determine whether pitted contacts are open or closed, it may be necessary to apply the KS-6320 orange stick to the lever spring and attempt to move this spring.

2.17 ***Electrical Requirements***

DC Requirements

(a) ***Soak:*** Where the circuit requirement table refers to the BSP or a soak is specified in the circuit requirement table, the relay shall be soaked before applying the electrical test or readjust requirements by passing through the winding or windings under test the maximum current (not to exceed 0.700 ampere) permitted by the specified test clip data with minimum resistance in the relay test set.

(b) ***Relays not Having Timing Requirements Shown in the Circuit Requirement Table or in Section 040-013-711:*** The relay shall meet the electrical requirements shown in the circuit requirement table.

Use the 35-type test set.

Note: Since the release current flow values of 251-and 252-type relays are applied in the reverse direction from the soak, operate, nonoperate, and hold values, the release key should not be operated when applying these requirements.

(c) ***Relays Having Timing Requirements Shown in the Circuit Requirement Table or in Section 040-013-711, and Which Are to Be Checked on a Timing Basis:*** The relay shall meet the nonoperate electrical requirement shown in the circuit requirement table or in Section 040-013-711.

Use the 35-type test set.

(d) ***Relays Having Timing Requirements Shown in the Circuit Requirement Table or in Section 040-013-711, but Which Are not to Be Checked on a Timing Basis***

Operate

Test

(1) ***Relays Having the Test Hold Timing Requirement Shown in Terms of Loop and Leak:*** The relay shall meet the loop and leak pulsing tests specified for the office involved instead of the test operate electrical requirement specified in the circuit requirement table.

Use the J34717A pulsing test set or other locally approved apparatus for making the pulsing tests.

(2) ***Relays Having the Test Hold Timing Requirement Shown in Terms of Time Interval:*** The relay shall meet the test operate electrical requirement shown in the circuit requirement table.

Use the 35-type test set.

Readjust: The relay shall meet the readjust operate electrical requirement shown in the circuit requirement table.

Use the 35-type test set.

Nonoperate

Test and Readjust: The relay shall meet the nonoperate electrical requirements shown in the circuit requirement table.

Use the 35-type test set.

AC Requirements (full selective ring trip relays only)

(e) The relay shall meet the ac requirements specified in the circuit requirement table for specific maximum subscriber external loop range over which the relay is intended to function.

Use the connector test set or test line provided for making routine operation tests on connectors.

2.18 *Timing Requirements*

Except Thermal Units of 305-, 307-, and 309-Type Relays ←

(a) ***When Relays Are to Be Checked on a Timing Basis:*** The relay shall meet the timing requirements specified in the circuit requirement table or in Section 040-013-711. These requirements may be met with the cover on or off, except in the case of C-position relays, where the test requirement shall be met with the cover on.

Use the J94713A timing test set where requirements are specified in terms of time intervals, and the J34717A pulsing test set or other locally approved test apparatus for making pulsing tests where requirements are specified in terms of loop and leak conditions. Check the requirement as covered in (b) and (c).

(b) Using the proper test set, make connections in accordance with the information specified in the test clip data in the circuit requirement table if the table covers timing requirement, or otherwise in accordance with Section 040-013-711.

(c) Also refer to the proper testing section covering the methods of making timing and pulsing tests for the particular relay. These

sections primarily cover methods of checking test requirements. However, they can be used for checking readjust requirements wherever the test and readjust requirements are both pulsing requirements or both timing requirements. When checking hold timing requirements of relays in accordance with tests covered in these sections, the performance of relays may usually be judged by the reaction of the associated switch. On some circuits and on individually mounted relays where no circuit function is available to indicate the satisfactory performance of the relay, this can be determined by checking the reliability of the relay contacts as described in Section 020-010-711.

(d) ***When Relays Are not to Be Checked on a Timing Basis:*** See 2.17(d).

Thermal Units of 305-, 307-, and 309-Type Relays

(e) The thermal units shall meet the timing requirements specified in the circuit requirement table. In checking the requirements the minimum time between operations shall be 4 minutes unless otherwise specified in the circuit requirement table.

> ***Note:*** ▶The timing measurements for these relays are affected by the surrounding temperature and air currents. Fans or unusual air movements should be avoided when checking these relays.◀

2.19 ***Pulse Repeating Requirement:*** The relay shall meet the percent break limits specified for the pulse repeating requirement in the circuit requirement table.

Check under the conditions covered for the specified pulse repeating requirement in Section 040-012-711, using the J34720A pulse repeating test set, and Section 040-011-711, using the J64722A pulse repeating test set.

> ***Note:*** The pulse repeating requirements specified in the circuit requirement table need not be applied by the installer if the requirement is waived by the telephone company or where the J34720A or J64722A pulse repeating test set or other testing equipment is not furnished by the telephone company.

Spring Combination Figures Are for Readjust Only

FIG. 1

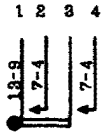


FIG. 2

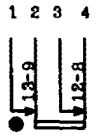


FIG. 2A

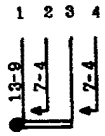


FIG. 3

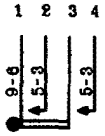


FIG. 3A

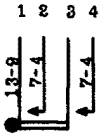


FIG. 4

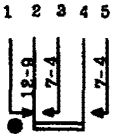


FIG. 4A

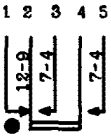


FIG. 5

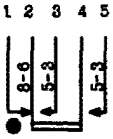


FIG. 5A

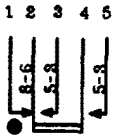


FIG. 6

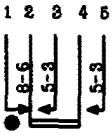


FIG. 7

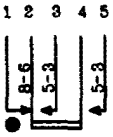


FIG. 8

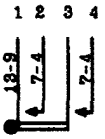


FIG. 9

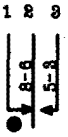


FIG. 10

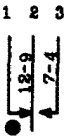


FIG. 11

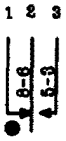


FIG. 12

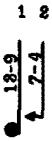


FIG. 13

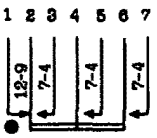


FIG. 13A

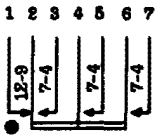


FIG. 14

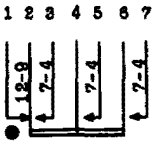


FIG. 15

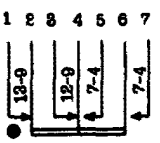


FIG. 16

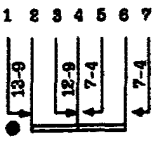


FIG. 17

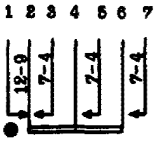


FIG. 18

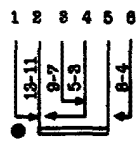
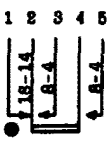


FIG. 19



Spring Combination Figures Are for Readjust Only

FIG. 20

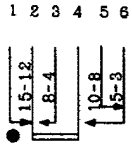


FIG. 20A

REPLACED BY FIG. 20

FIG. 21

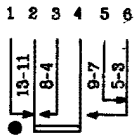


FIG. 22

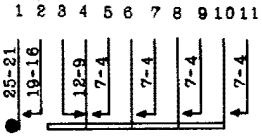


FIG. 23

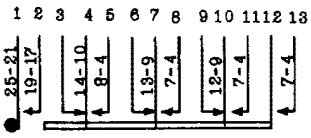


FIG. 24

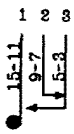


FIG. 25

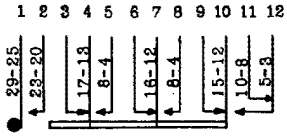


FIG. 26

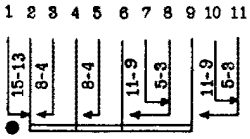


FIG. 26A

REPLACED BY FIG. 26

FIG. 27

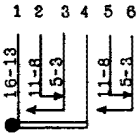


FIG. 28

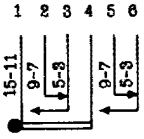


FIG. 29

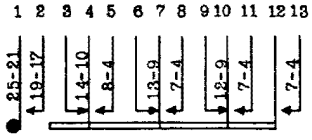


FIG. 30

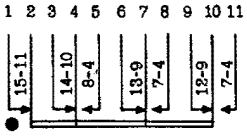


FIG. 31

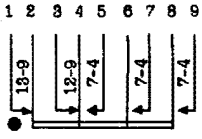


FIG. 32

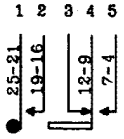


FIG. 33

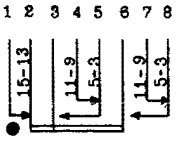


FIG. 34

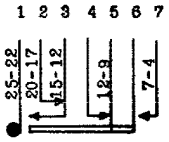


FIG. 35

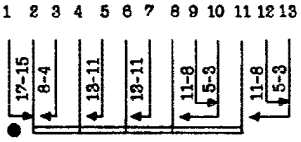


FIG. 36

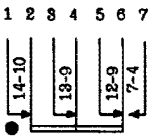


FIG. 37

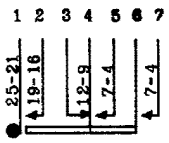


FIG. 38

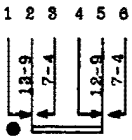


FIG. 39

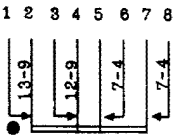


FIG. 40

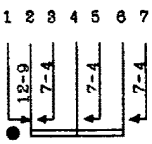
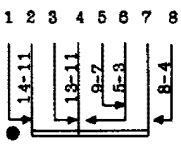


FIG. 41



Spring Combination Figures Are for Readjust Only

FIG. 42

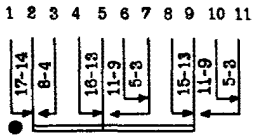


FIG. 43

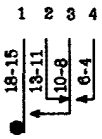


FIG. 44

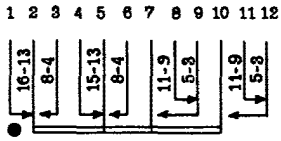


FIG. 45

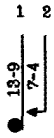


FIG. 45B

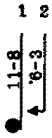


FIG. 46

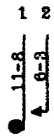


FIG. 46A

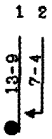


FIG. 47

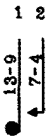


FIG. 48

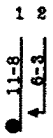


FIG. 48A

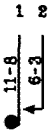


FIG. 49

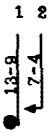


FIG. 50

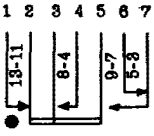


FIG. 51

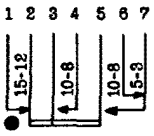


FIG. 52

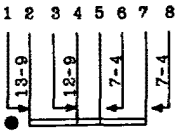


FIG. 53

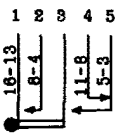


FIG. 54

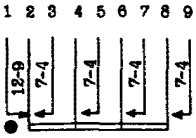


FIG. 55

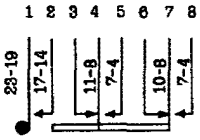


FIG. 56

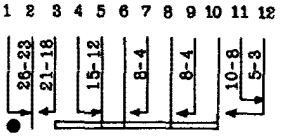


FIG. 57

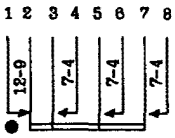


FIG. 58

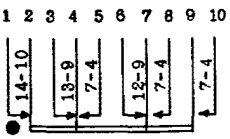


FIG. 59

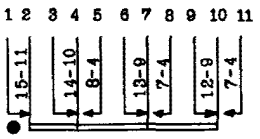


FIG. 60

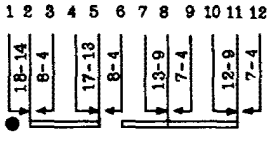


FIG. 61

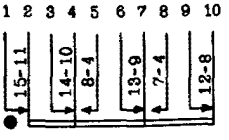
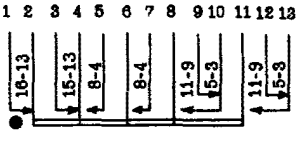


FIG. 62



Spring Combination Figures Are for Readjust Only

FIG. 63

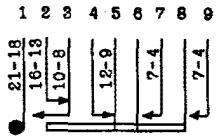


FIG. 64

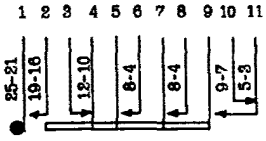


FIG. 65

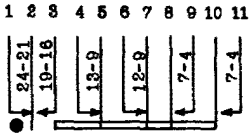


FIG. 66

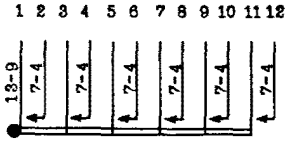


FIG. 67

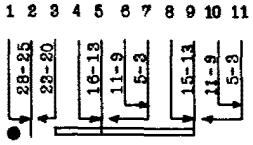


FIG. 68

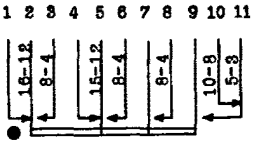


FIG. 69

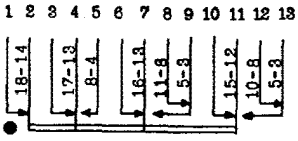


FIG. 70

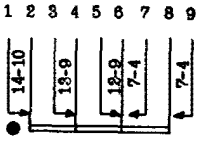


FIG. 71

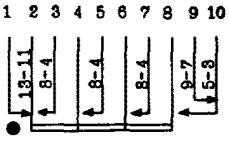


FIG. 72

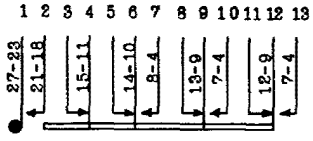


FIG. 73

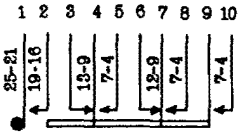


FIG. 74

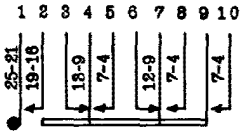


FIG. 75

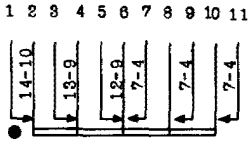


FIG. 76

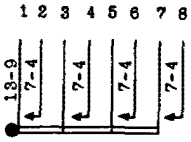


FIG. 77

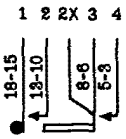


FIG. 78

FIG. 79

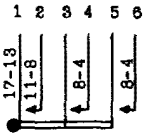


FIG. 80

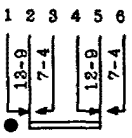


FIG. 81

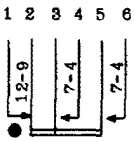


FIG. 82

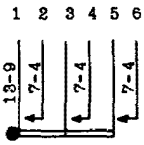


FIG. 83

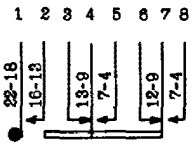


FIG. 84

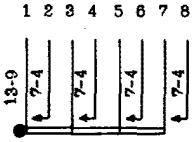


FIG. 85

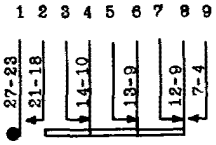
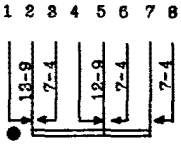


FIG. 86



Spring Combination Figures Are for Readjust Only

FIG. 86A

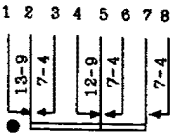


FIG. 87

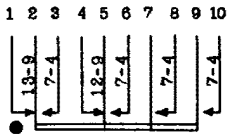


FIG. 88

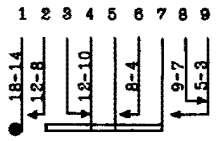


FIG. 89

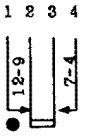


FIG. 90

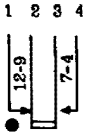


FIG. 91

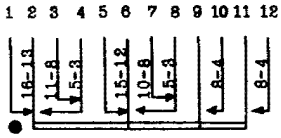


FIG. 92

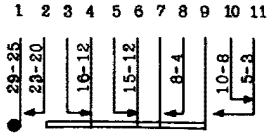


FIG. 93

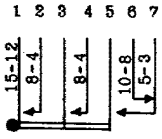


FIG. 93A

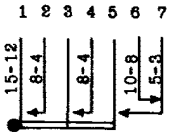


FIG. 94

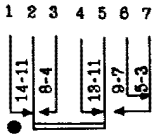


FIG. 95

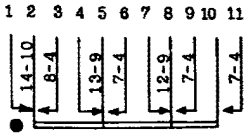


FIG. 96

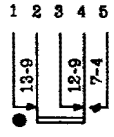


FIG. 97

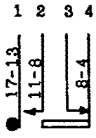


FIG. 98

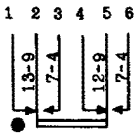


FIG. 99

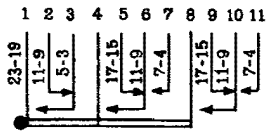


FIG 100

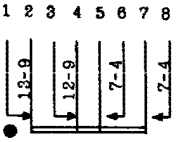


FIG. 101

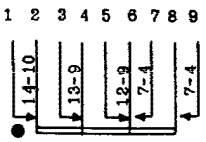


FIG. 102

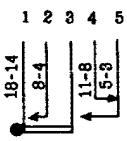


FIG. 103

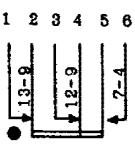


FIG. 104

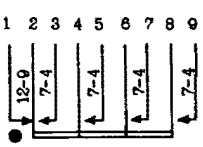


FIG. 105

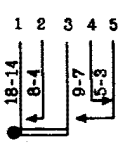


FIG. 106

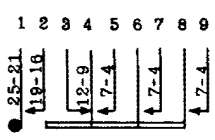


FIG. 107

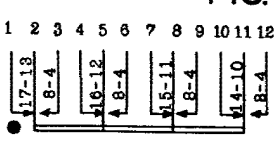
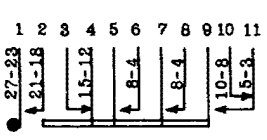


FIG. 108



Spring Combination Figures Are for Readjust Only

FIG. 109

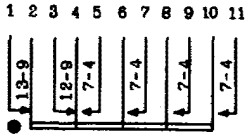


FIG. 110

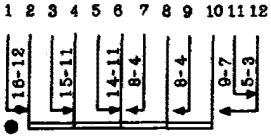


FIG. 111

FIG. 112

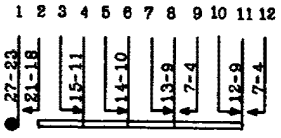


FIG. 113A

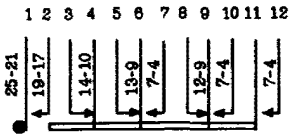


FIG. 114

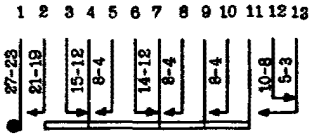


FIG. 115

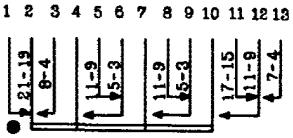


FIG. 116

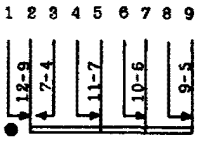


FIG. 117

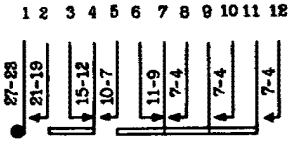


FIG. 118

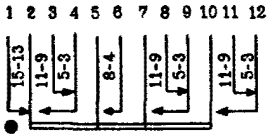


FIG. 119

FIG. 120

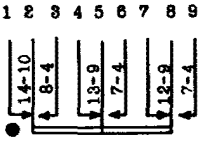


FIG. 121

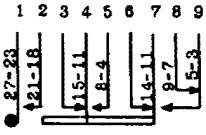


FIG. 122

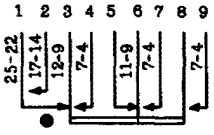


FIG. 123

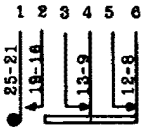


FIG. 124

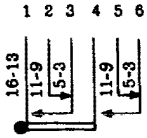


FIG. 125

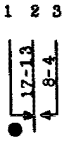


FIG. 126

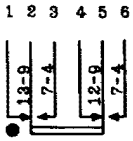


FIG. 127

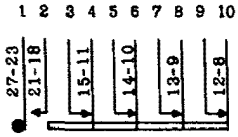


FIG. 128

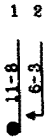


FIG. 129

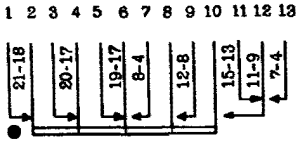


FIG. 130

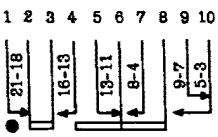


FIG. 131

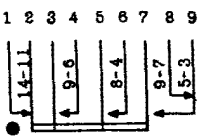
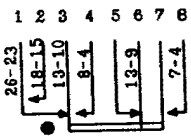


FIG. 132



Spring Combination Figures Are for Readjust Only

FIG. 133

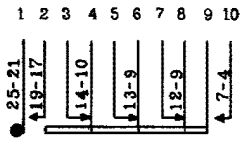


FIG. 134

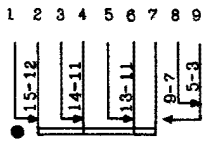


FIG. 135

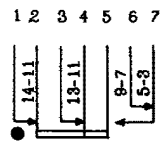


FIG. 136

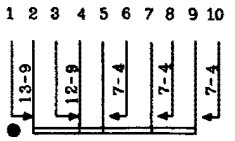


FIG. 137

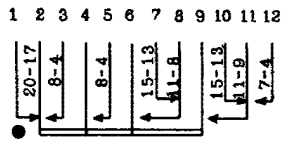


FIG. 138

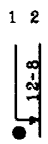


FIG. 138A

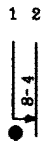


FIG. 139

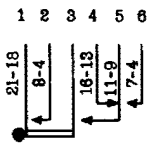


FIG. 140

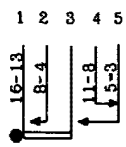


FIG. 141

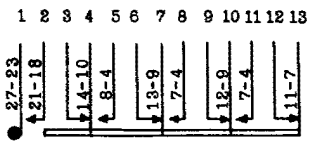


FIG. 142

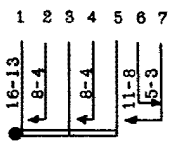


FIG. 143

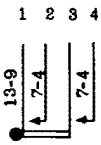


FIG. 144

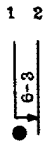


FIG. 145

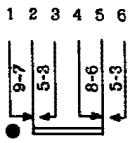


FIG. 146

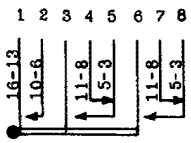


FIG. 147

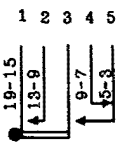


FIG. 148

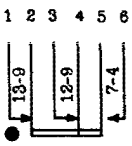


FIG. 149

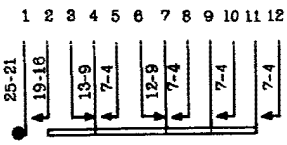


FIG. 150

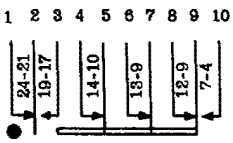


FIG. 151

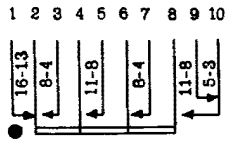


FIG. 152

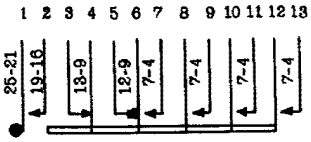


FIG. 153

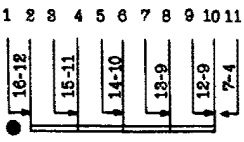


FIG. 154

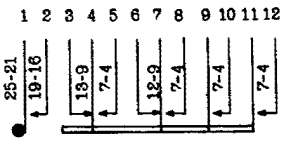
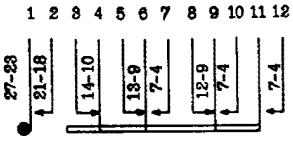


FIG. 155



Spring Combination Figures Are for Readjust Only

FIG. 156

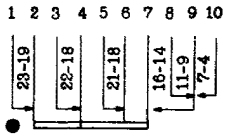


FIG. 157

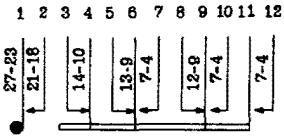


FIG. 158

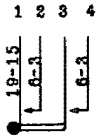


FIG. 159

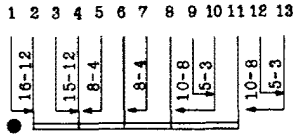


FIG. 160

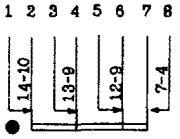


FIG. 161

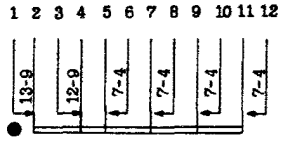


FIG. 162

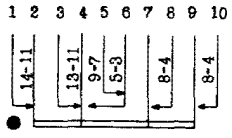


FIG. 163

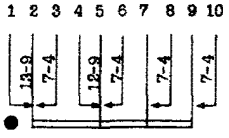


FIG. 164

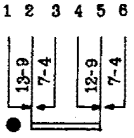


FIG. 165

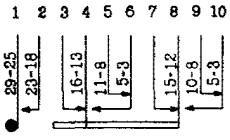


FIG. 166

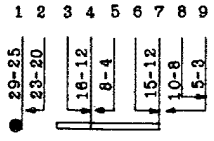


FIG. 167

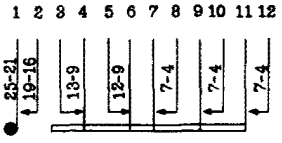


FIG. 168

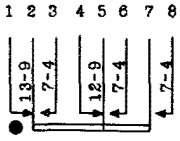


FIG. 169

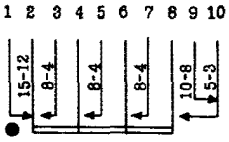


FIG. 170

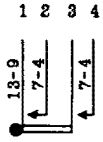


FIG. 171

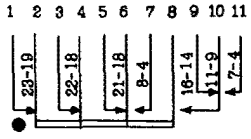


FIG. 172

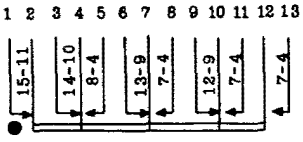


FIG. 173

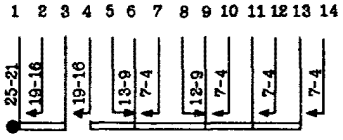


FIG. 174

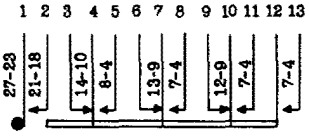


FIG. 175

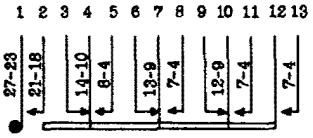
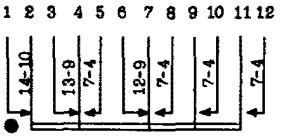


FIG. 176



Spring Combination Figures Are for Readjust Only

FIG. 177

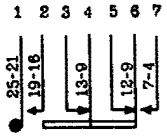


FIG. 178

FIG. 179

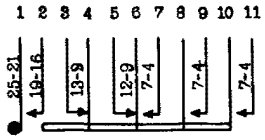


FIG. 180

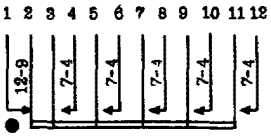


FIG. 181

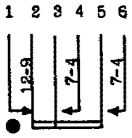


FIG. 182

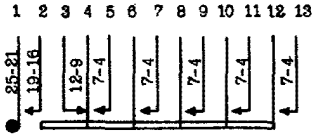


FIG. 183

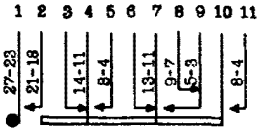


FIG. 184

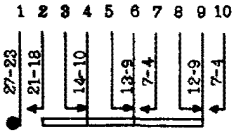


FIG. 185

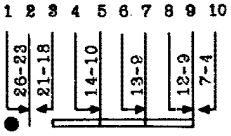


FIG. 186

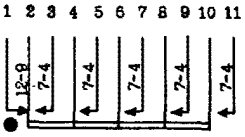


FIG. 187

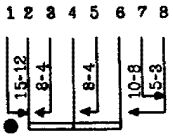


FIG. 188

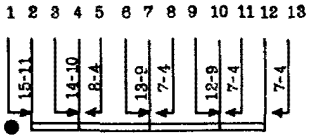


FIG. 189

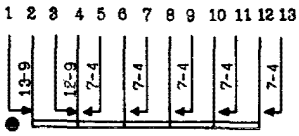


FIG. 190

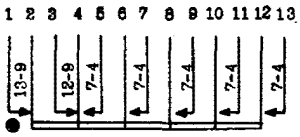


FIG. 191

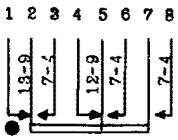


FIG. 192

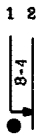


FIG. 193

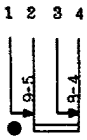


FIG. 194

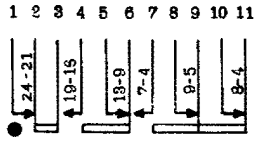


FIG. 195

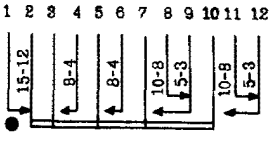


FIG. 196

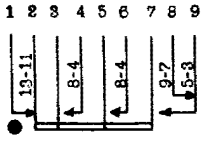
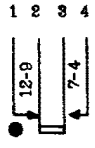


FIG. 197



Spring Combination Figures Are for Readjust Only

FIG. 198

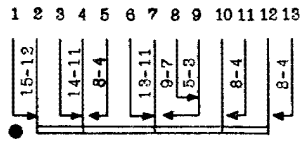


FIG. 199

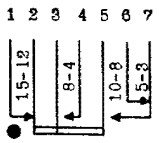


FIG. 200

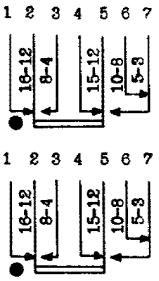


FIG. 201

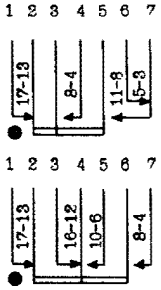


FIG. 202

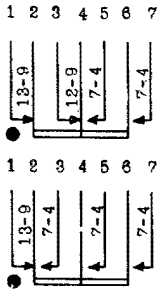


FIG. 203

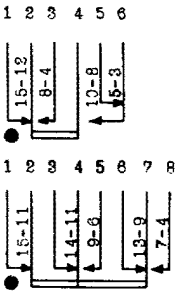


FIG. 204

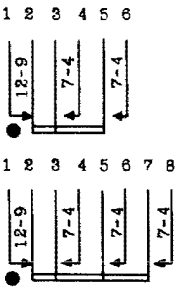


FIG. 205

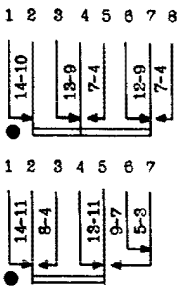


FIG. 206

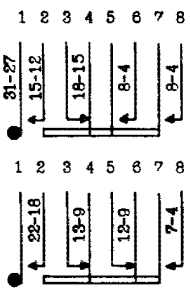


FIG. 207

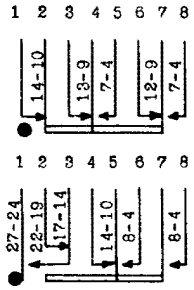


FIG. 208

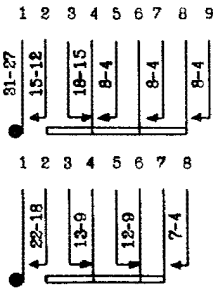
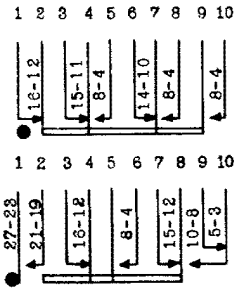
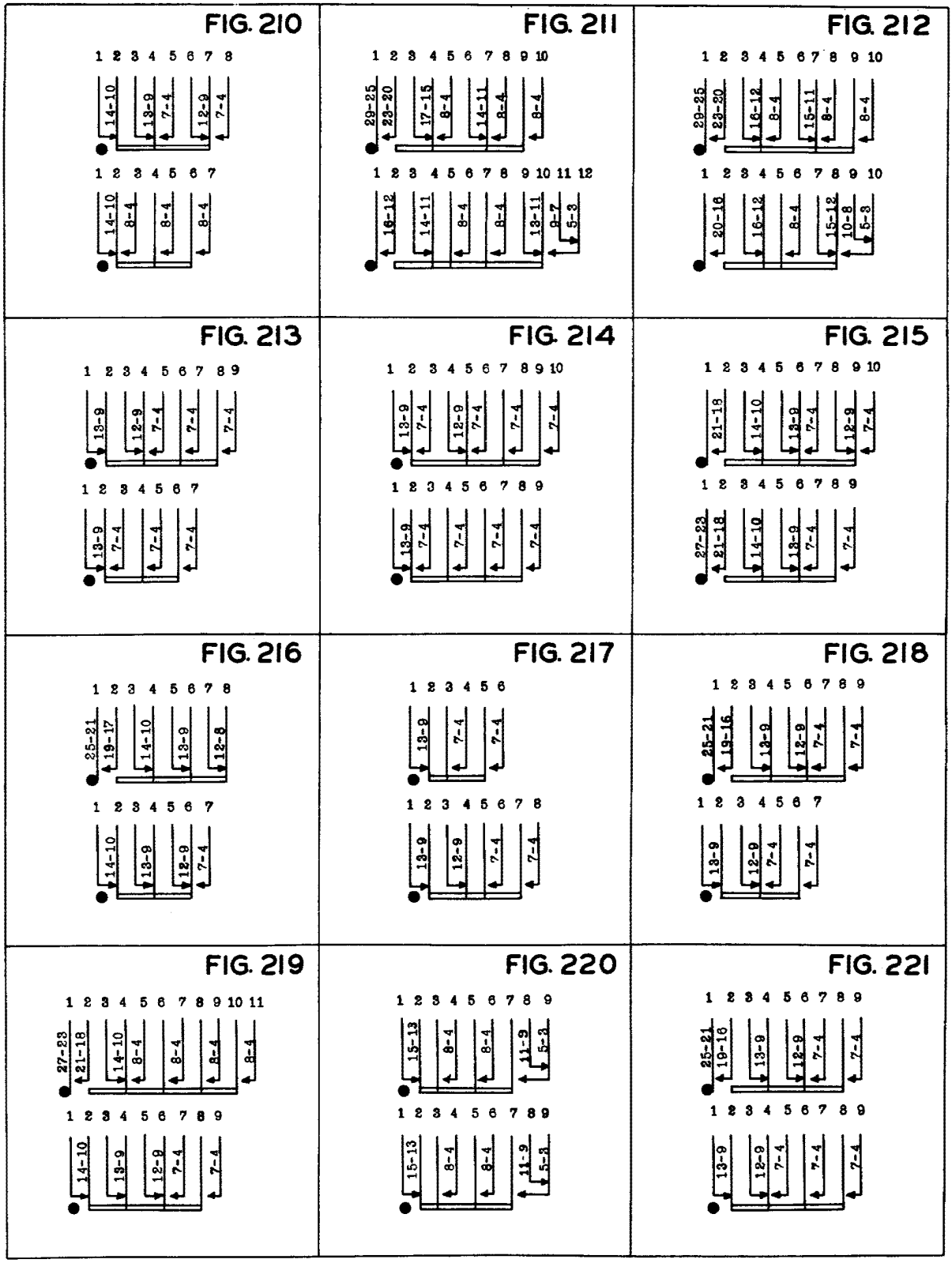


FIG. 209



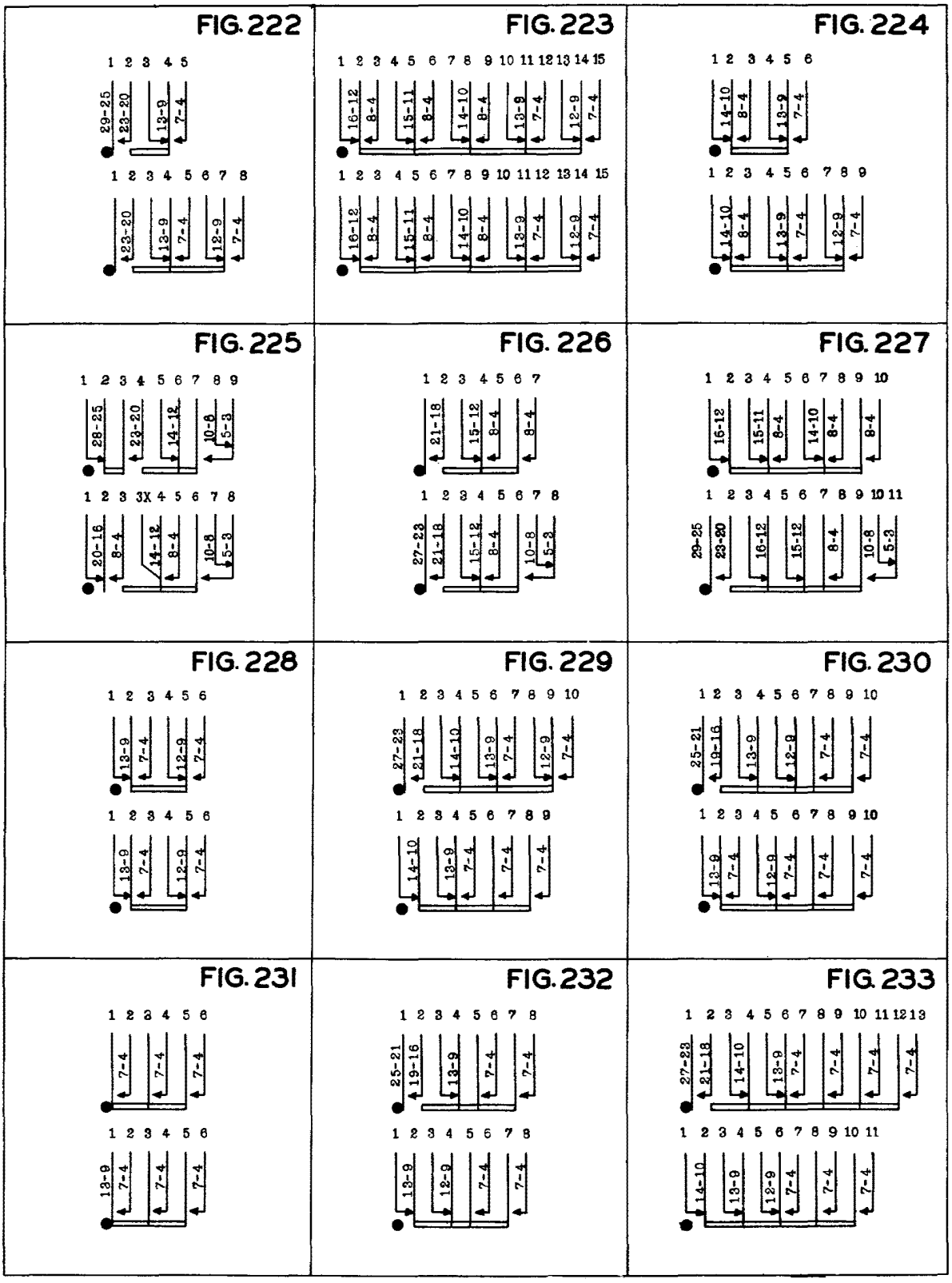
On 224-type relays, double spring assemblies are arranged as shown in the spring combination figures. On 223 types, the top and bottom assemblies shown in the figures are interchanged.

Spring Combination Figures Are for Readjust Only



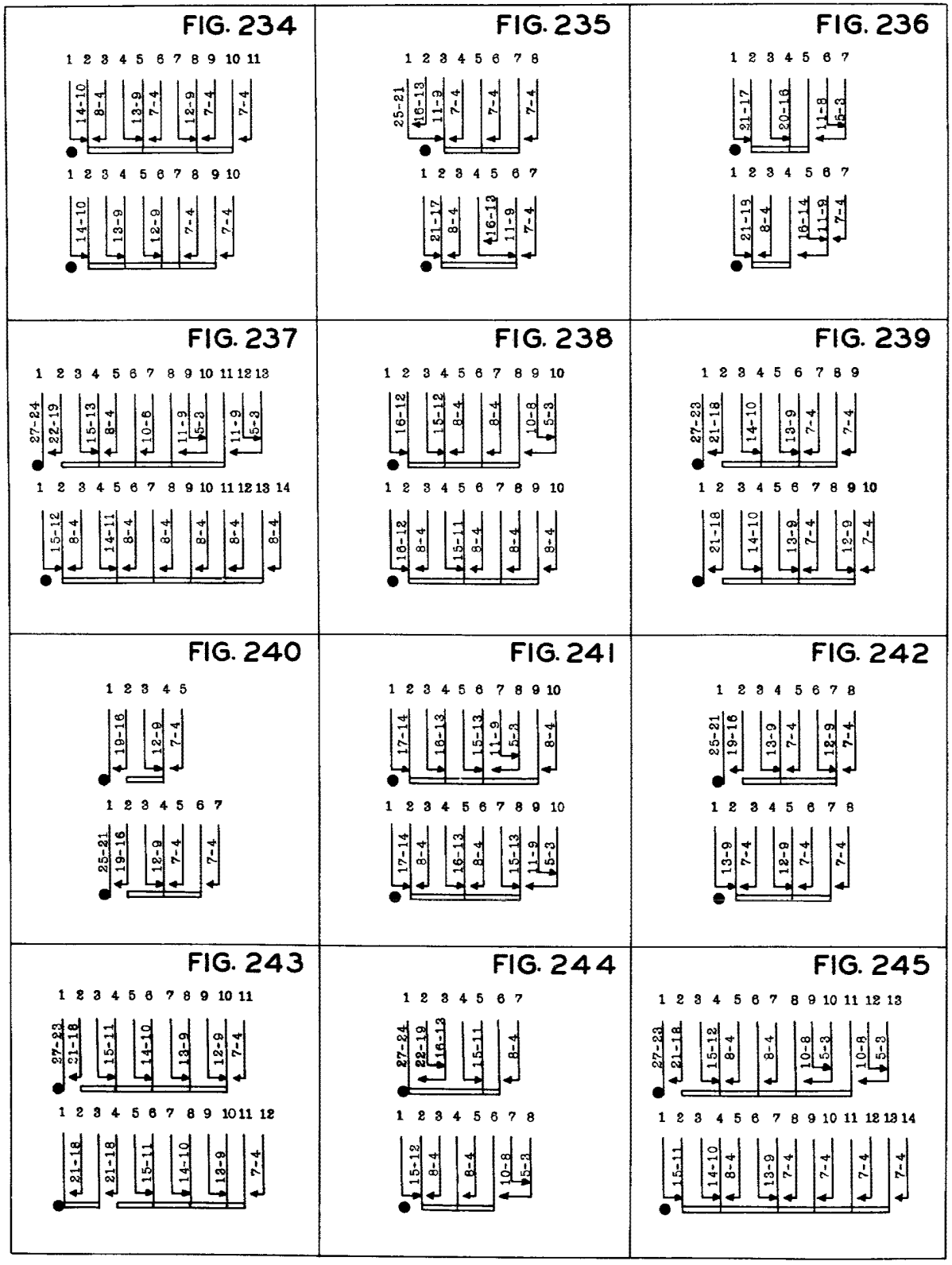
On 224-type relays, double spring assemblies are arranged as shown in the spring combination figures. On 223 types, the top and bottom assemblies shown in the figures are interchanged.

Spring Combination Figures Are for Readjust Only



On 224-type relays, double spring assemblies are arranged as shown in the spring combination figures. On 223 types, the top and bottom assemblies shown in the figures are interchanged.

Spring Combination Figures Are for Readjust Only



On 224-type relays, double spring assemblies are arranged as shown in the spring combination figures. On 223 types, the top and bottom assemblies shown in the figures are interchanged.

Spring Combination Figures Are for Readjust Only

FIG. 246

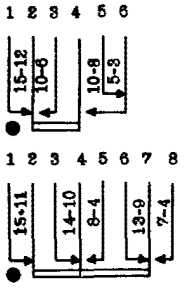


FIG. 247

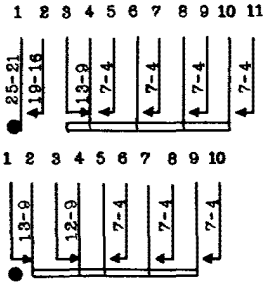


FIG. 248

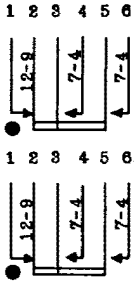


FIG. 249

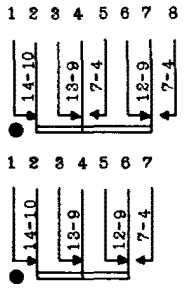


FIG. 250

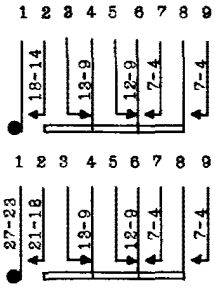


FIG. 251

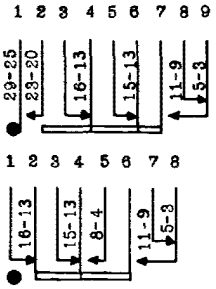


FIG. 252

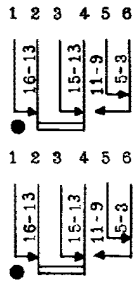


FIG. 253

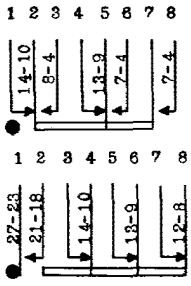


FIG. 254

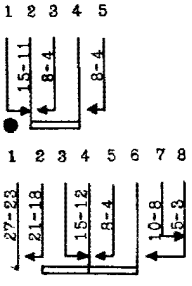


FIG. 255

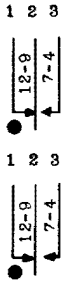


FIG. 256

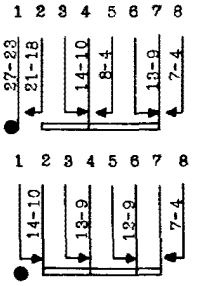
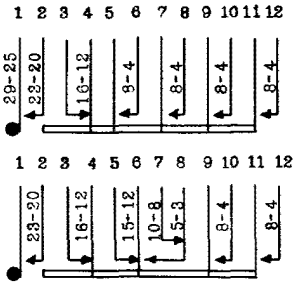


FIG. 257



On 224-type relays, double spring assemblies are arranged as shown in the spring combination figures. On 223 types, the top and bottom assemblies shown in the figures are interchanged.

Spring Combination Figures Are for Readjust Only

FIG. 258

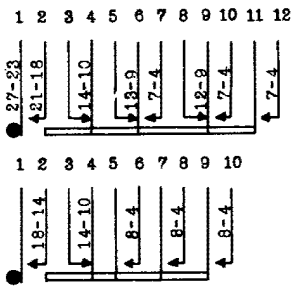


FIG. 259

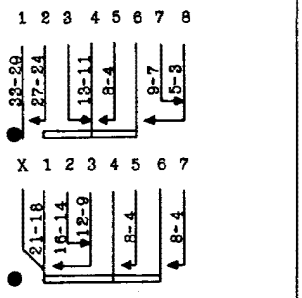


FIG. 260

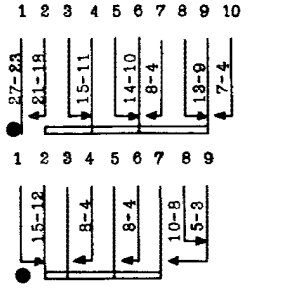


FIG. 261

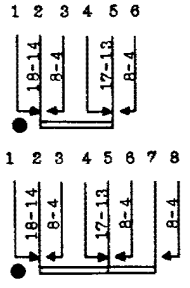


FIG. 262

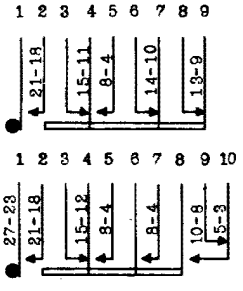


FIG. 263

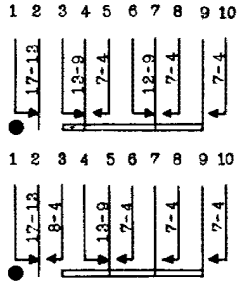


FIG. 264

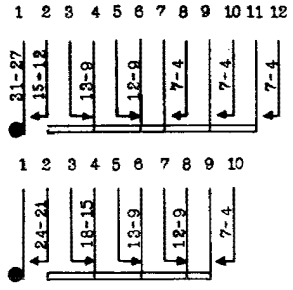


FIG. 265

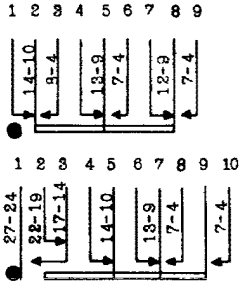


FIG. 266

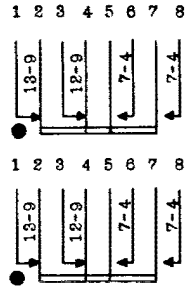


FIG. 267

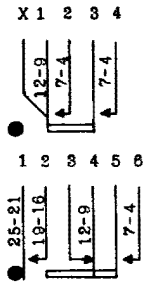


FIG. 268

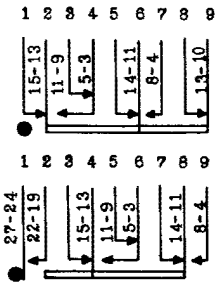
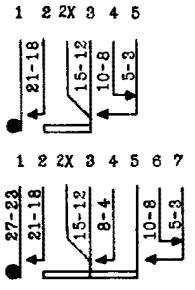


FIG. 269



On 224-type relays, double spring assemblies are arranged as shown in the spring combination figures. On 223 types, the top and bottom assemblies shown in the figures are interchanged.

Spring Combination Figures Are for Readjust Only

FIG. 270

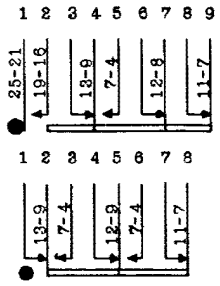


FIG. 271

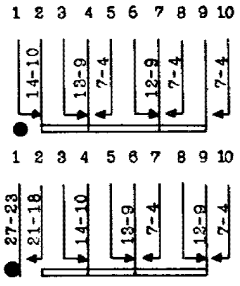


FIG. 272

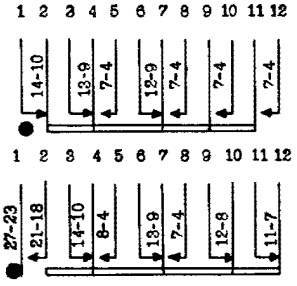


FIG. 273

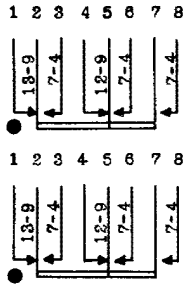


FIG. 274

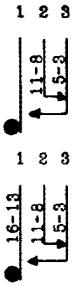


FIG. 275

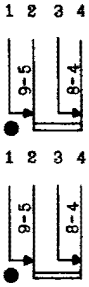


FIG. 276

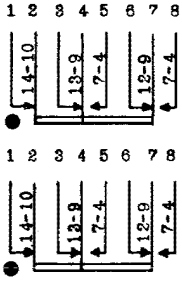


FIG. 277

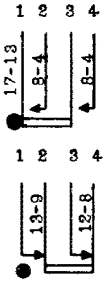


FIG. 278

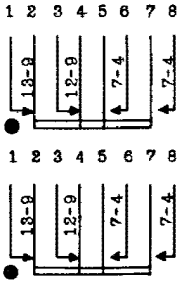


FIG. 279

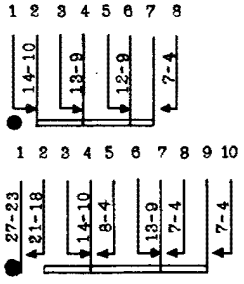


FIG. 280

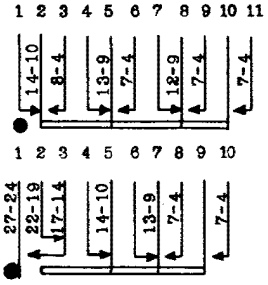
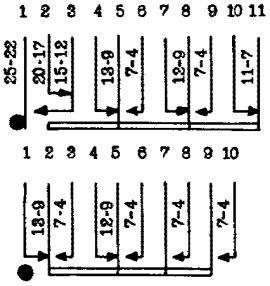
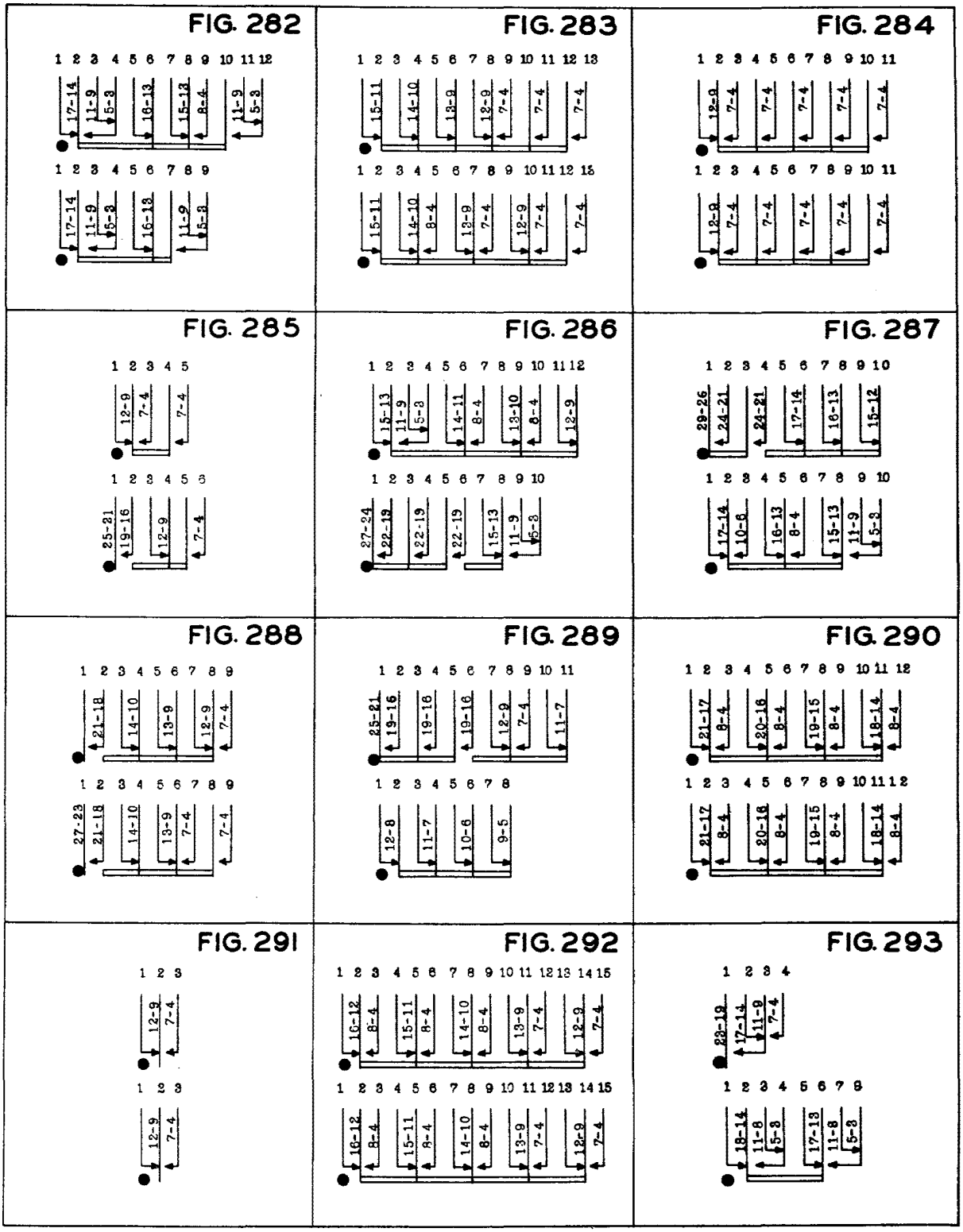


FIG. 281



On 224-type relays, double spring assemblies are arranged as shown in the spring combination figures. On 223 types, the top and bottom assemblies shown in the figures are interchanged.

Spring Combination Figures Are for Readjust Only



On 224-type relays, double spring assemblies are arranged as shown in the spring combination figures. On 223 types, the top and bottom assemblies shown in the figures are interchanged.

Spring Combination Figures Are for Readjust Only

FIG. 294

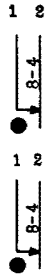


FIG. 295

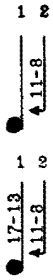


FIG. 296

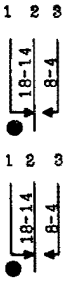


FIG. 297

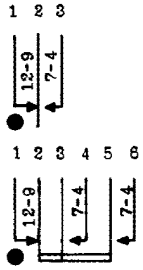


FIG. 298

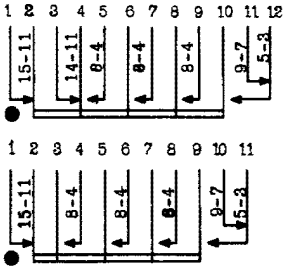


FIG. 299

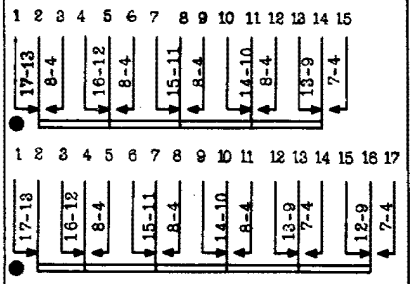


FIG. 300

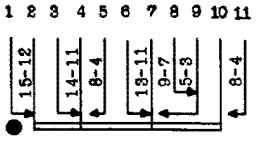


FIG. 301

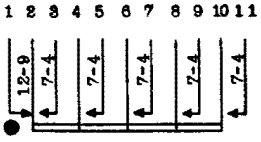


FIG. 302

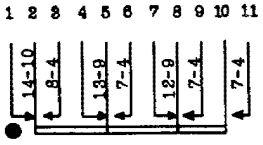


FIG. 303

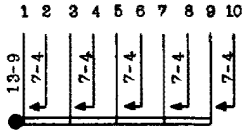


FIG. 304

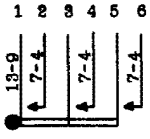
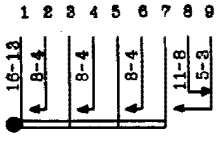


FIG. 305



On 224-type relays, double spring assemblies are arranged as shown in the spring combination figures. On 223 types, the top and bottom assemblies shown in the figures are interchanged.

Spring Combination Figures Are for Readjust Only

FIG. 306

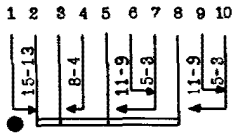


FIG. 307

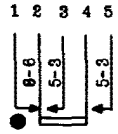


FIG. 308

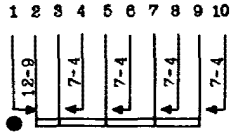


FIG. 309

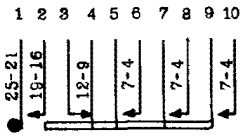


FIG. 310

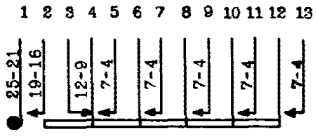


FIG. 311

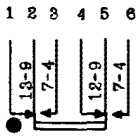


FIG. 312

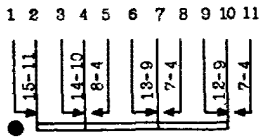


FIG. 313

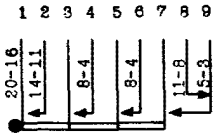


FIG. 314

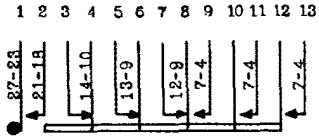


FIG. 315

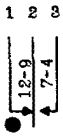


FIG. 316

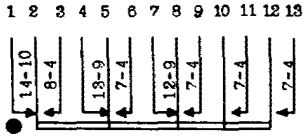


FIG. 317

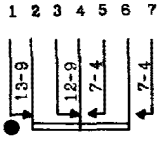


FIG. 318

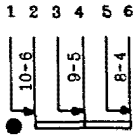


FIG. 319

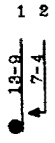


FIG. 320

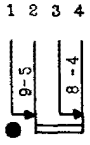


FIG. 321

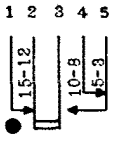


FIG. 322

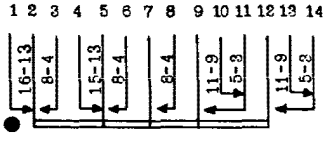


FIG. 323

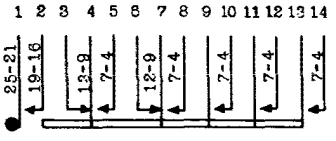


FIG. 324

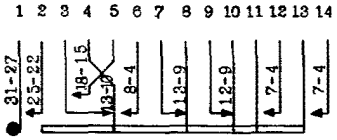


FIG. 325

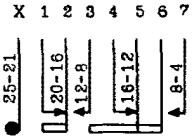


FIG. 326

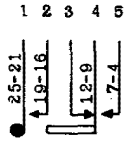


FIG. 327

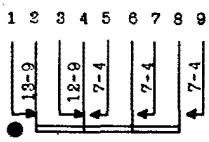


FIG. 328

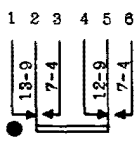
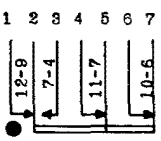


FIG. 329



Spring Combination Figures Are for Readjust Only

FIG. 330

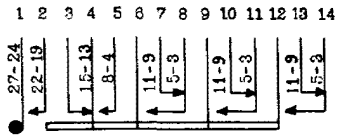


FIG. 331

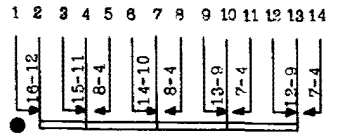


FIG. 332

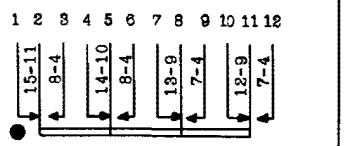


FIG. 333

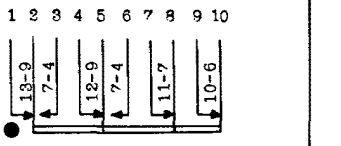


FIG. 334

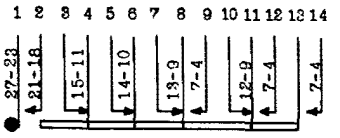


FIG. 335

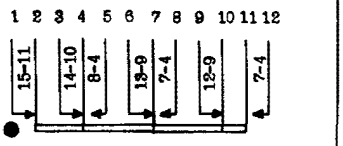


FIG. 336

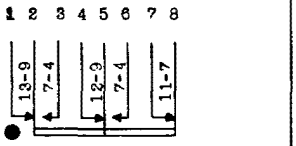


FIG. 337

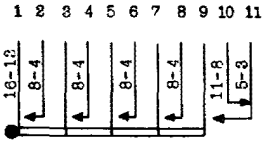


FIG. 338

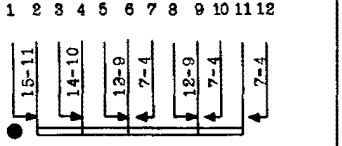


FIG. 339

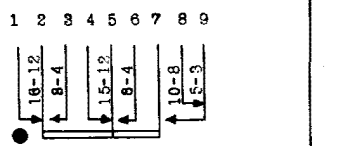


FIG. 340

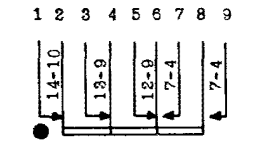


FIG. 341

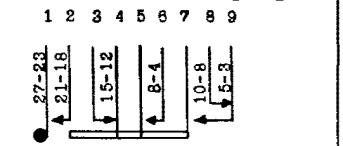


FIG. 342

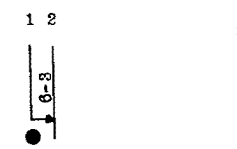


FIG. 343

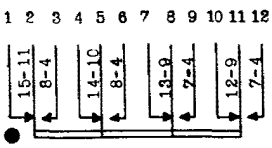


FIG. 344

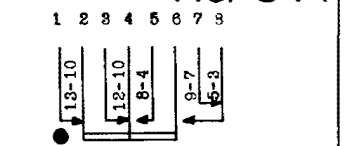


FIG. 345

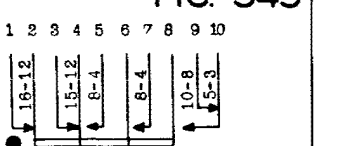


FIG. 346

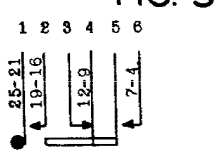


FIG. 347

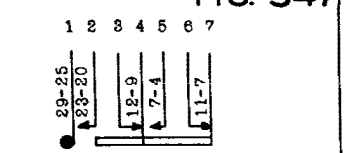


FIG. 348

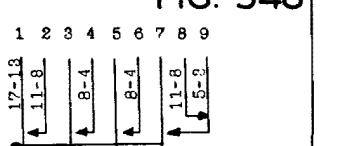


FIG. 349

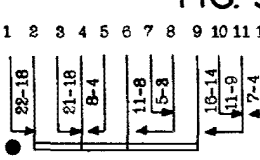


FIG. 350

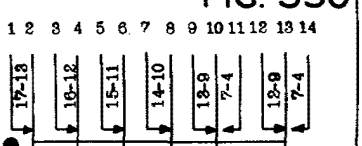


FIG. 351

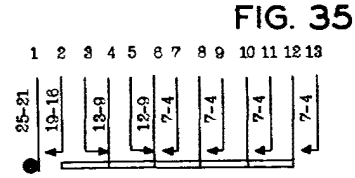


FIG. 352

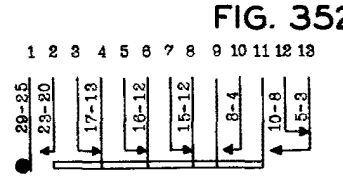
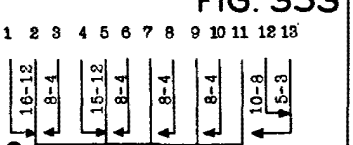


FIG. 353



Spring Combination Figures Are for Readjust Only

FIG. 354

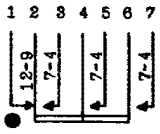


FIG. 355

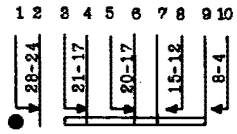


FIG. 356

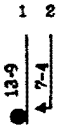


FIG. 357

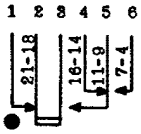


FIG. 358

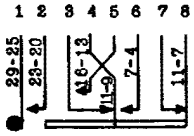


FIG. 359

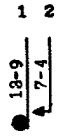


FIG. 360

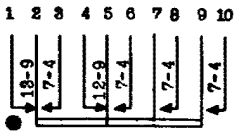


FIG. 361

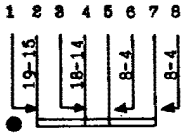


FIG. 362

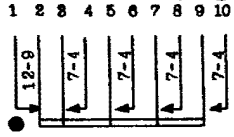


FIG. 363

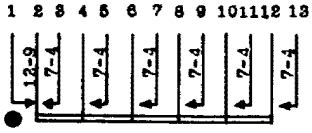


FIG. 364

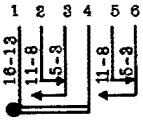


FIG. 365

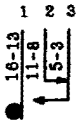


FIG. 366

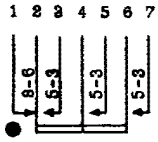


FIG. 367

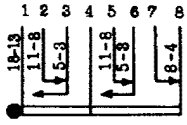


FIG. 368

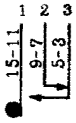


FIG. 369

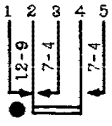


FIG. 370

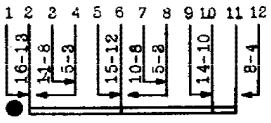


FIG. 371

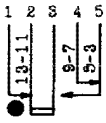


FIG. 372

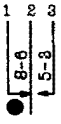


FIG. 373

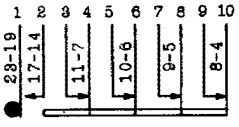


FIG. 374

FIG. 375

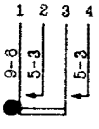


FIG. 376

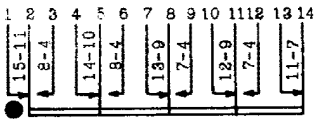
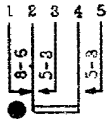


FIG. 377



Spring Combination Figures Are for Readjust Only

FIG. 378

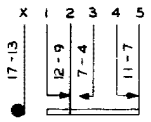


FIG. 379

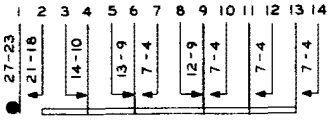


FIG. 380

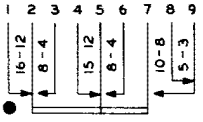


FIG. 381

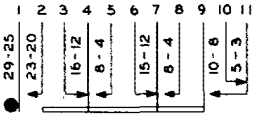


FIG. 382

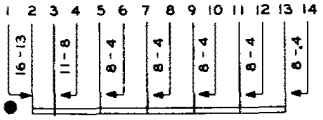


FIG. 383

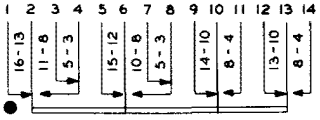


FIG. 384

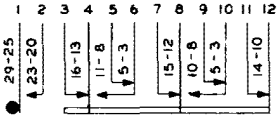


FIG. 385

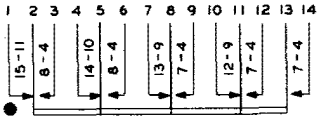


FIG. 386

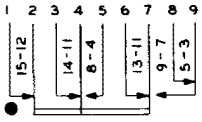


FIG. 387

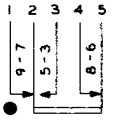


FIG. 388

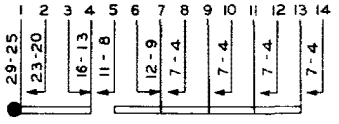


FIG. 389

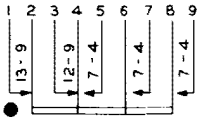


FIG. 390

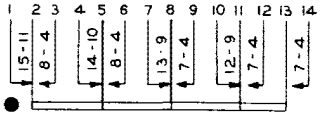


FIG. 391

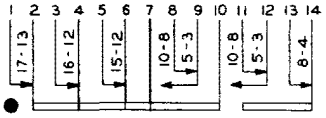


FIG. 392

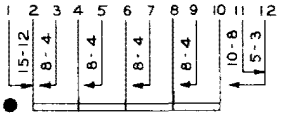


FIG. 393

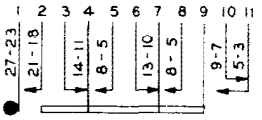


FIG. 394

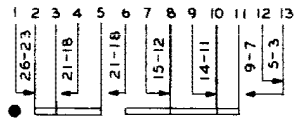


FIG. 395

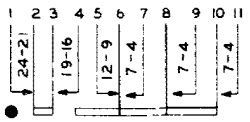


FIG. 396

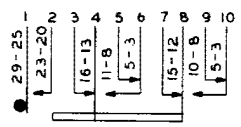


FIG. 397

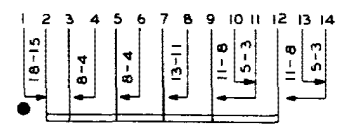


FIG. 398

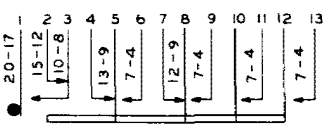
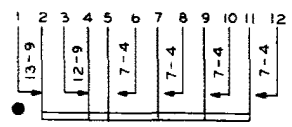
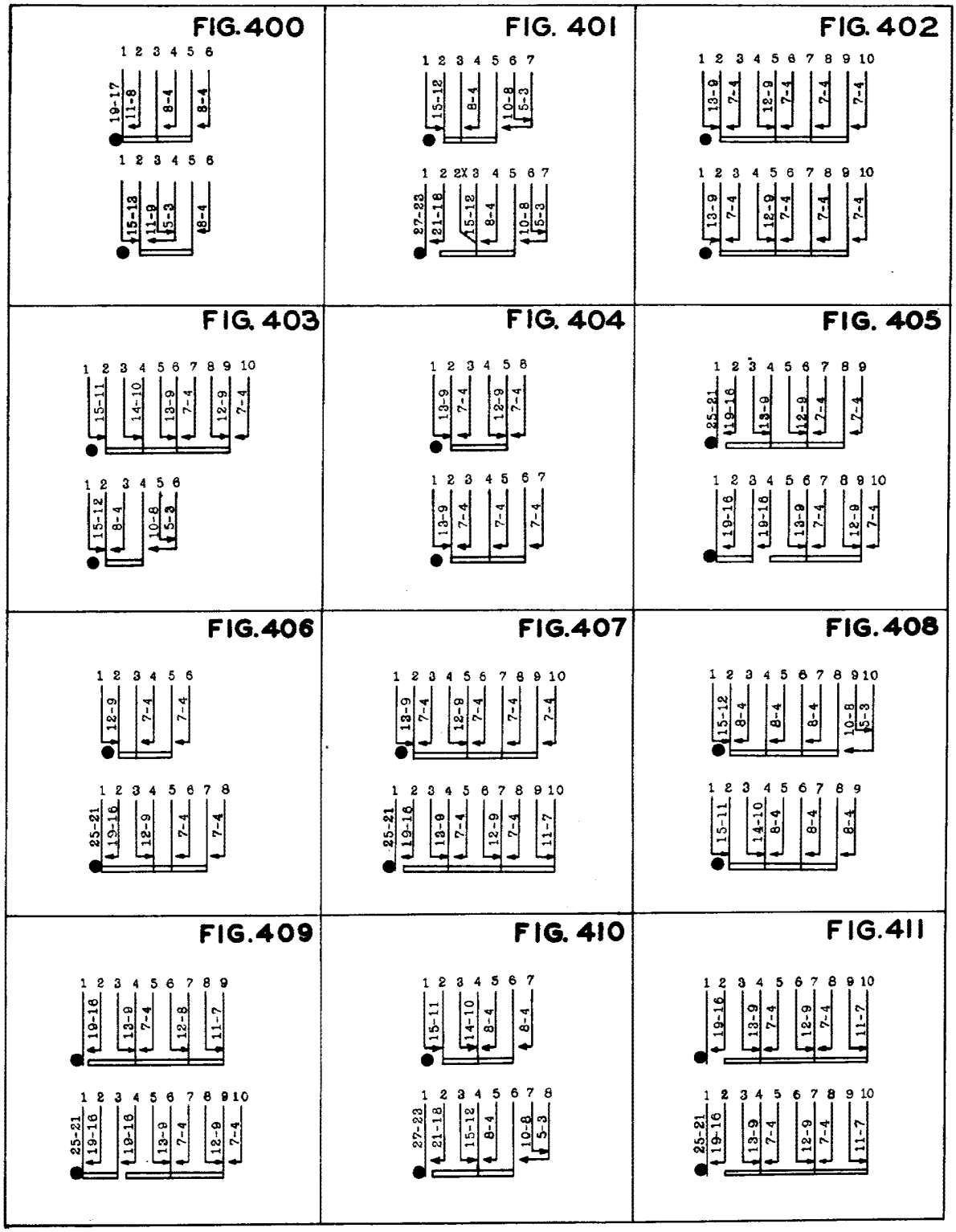


FIG. 399

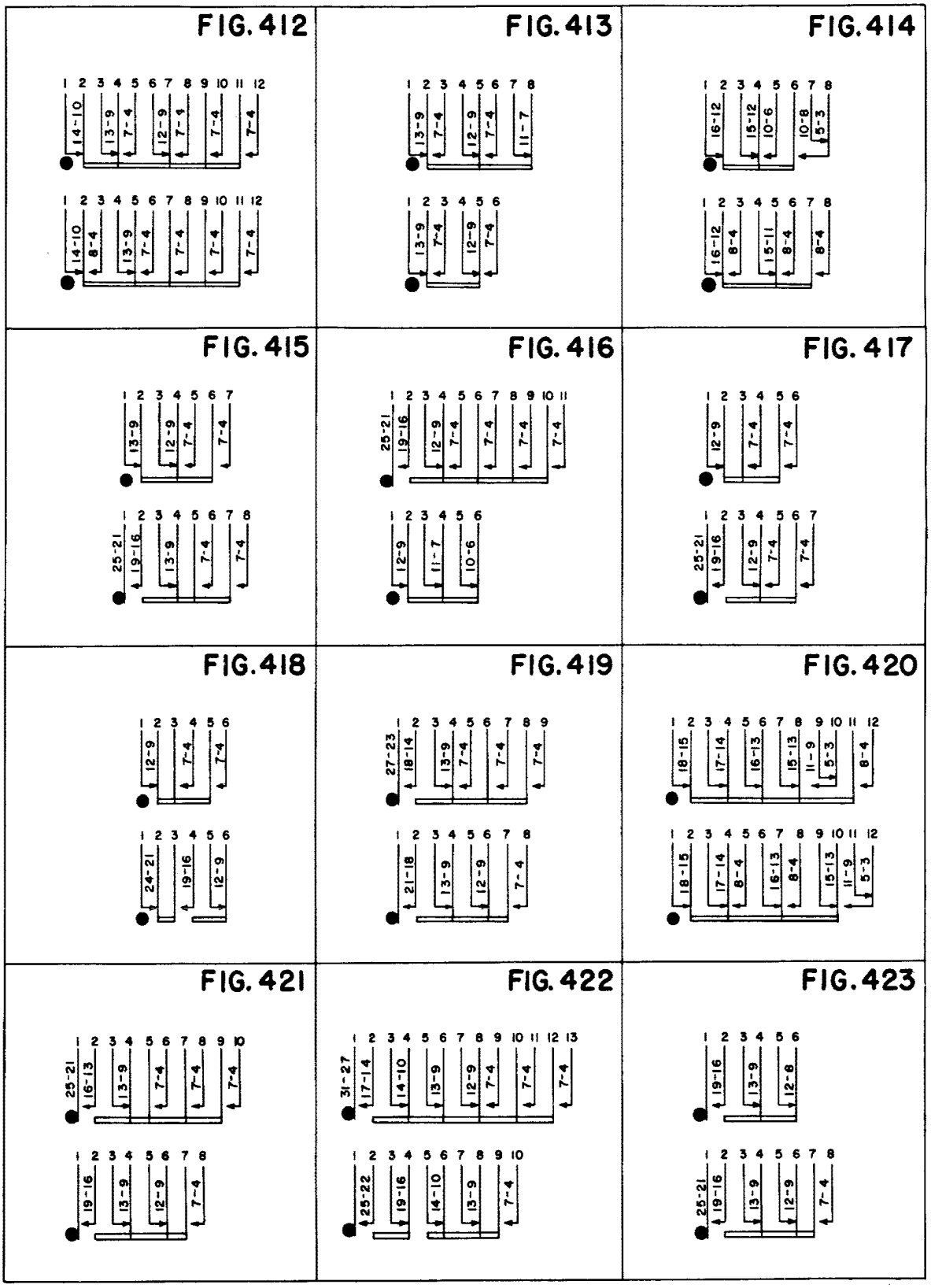


Spring Combination Figures Are for Readjust Only



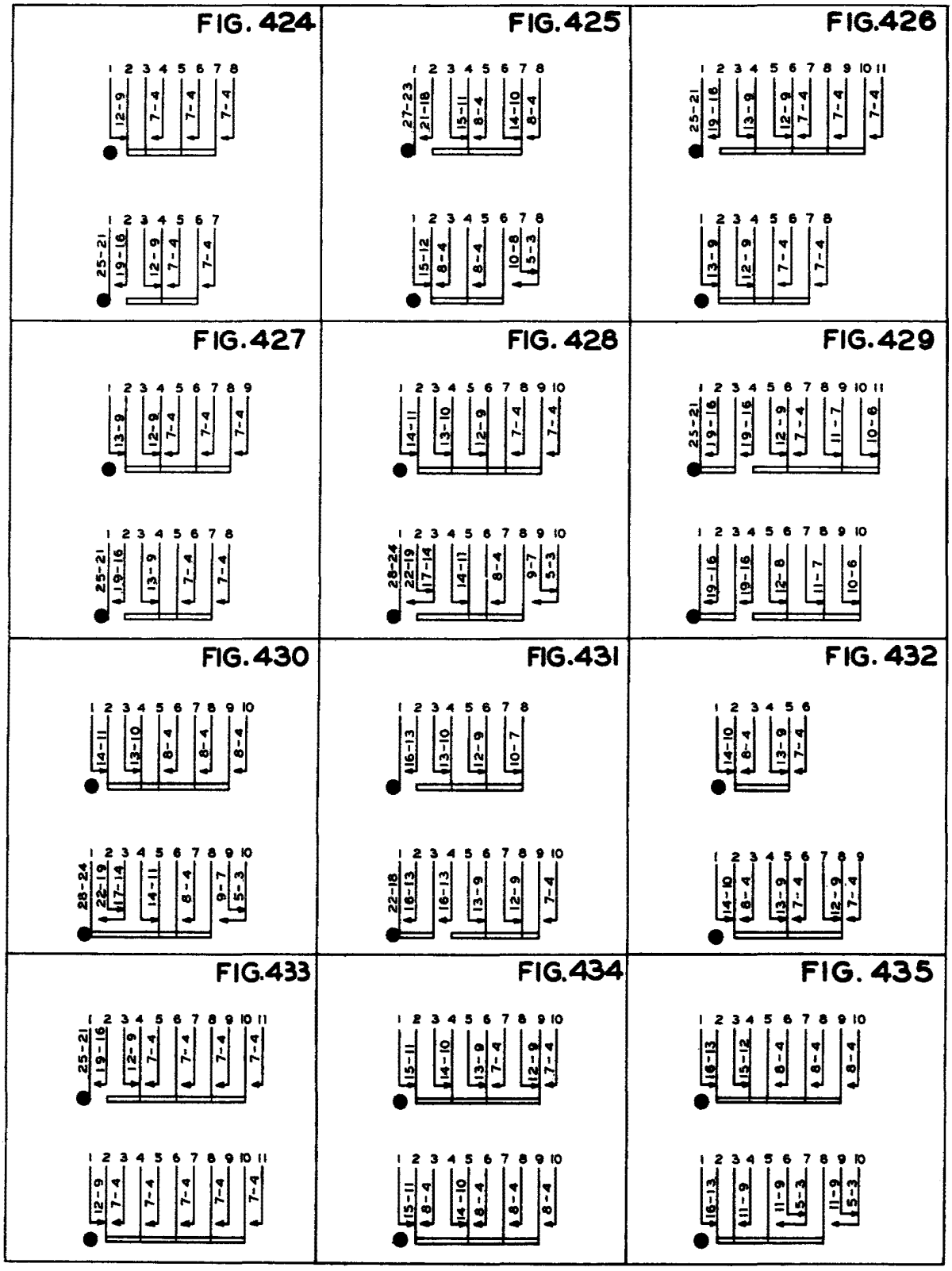
On 224-type relays, double spring assemblies are arranged as shown in the spring combination figures. On 223 types, the top and bottom assemblies shown in the figures are interchanged.

Spring Combination Figures Are for Readjust Only



On 224-type relays, double spring assemblies are arranged as shown in the spring combination figures. On 223 types, the top and bottom assemblies shown in the figures are interchanged.

Spring Combination Figures Are for Readjust Only



On 224-type relays, double spring assemblies are arranged as shown in the spring combination figures. On 223 types, the top and bottom assemblies shown in the figures are interchanged.

Spring Combination Figures Are for Readjust Only

FIG. 436

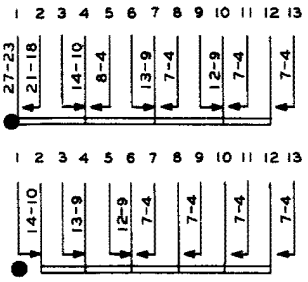


FIG. 437

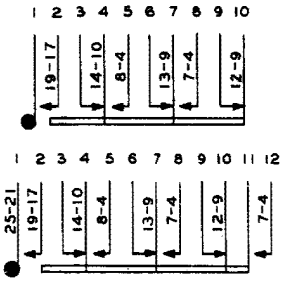


FIG 438

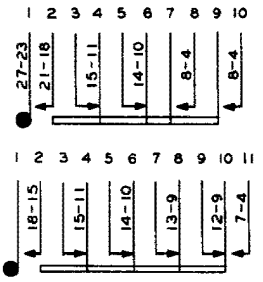


FIG. 439

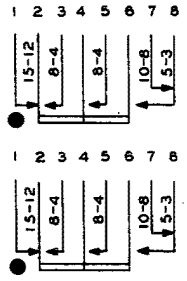


FIG. 440

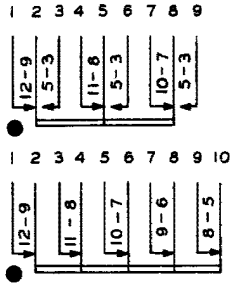


FIG. 441

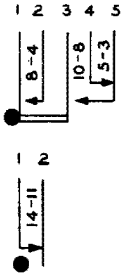


FIG. 442

FIG. 443

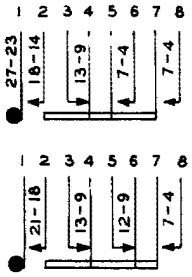


FIG. 444

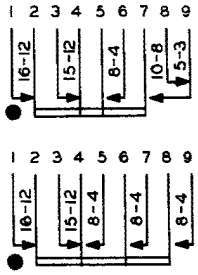


FIG. 445

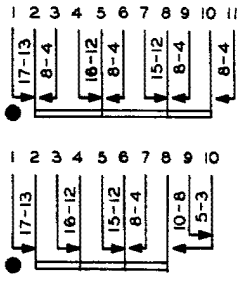
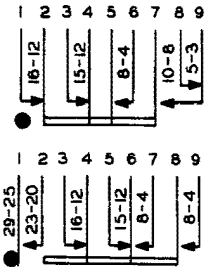


FIG. 446



On 224-type relays, double spring assemblies are arranged as shown in the spring combination figures. On 223 types, the top and bottom assemblies shown in the figures are interchanged.

Spring Combination Figures Are for Readjust Only

FIG. 500

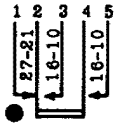


FIG. 501

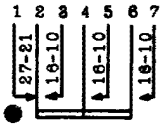


FIG. 502

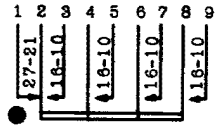


FIG. 503

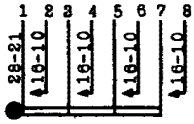


FIG. 504

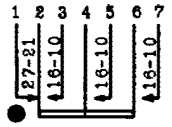


FIG. 505

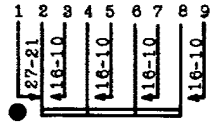


FIG. 506

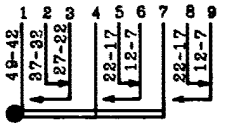


FIG. 507

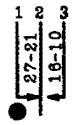


FIG. 508

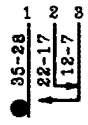


FIG. 509

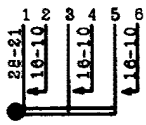


FIG. 510

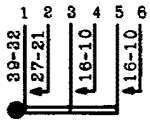


FIG. 511

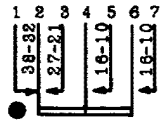


FIG. 512

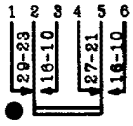


FIG. 513

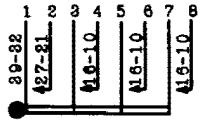


FIG. 514

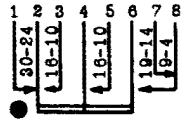


FIG. 515

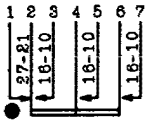


FIG. 516

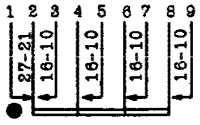


FIG. 517

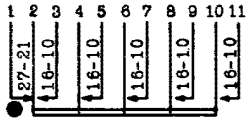


FIG. 518

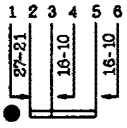


FIG. 519

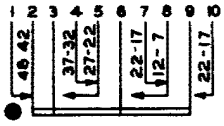


FIG. 520

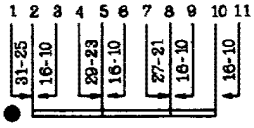


FIG. 521

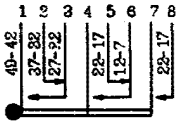


FIG. 522

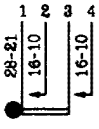


FIG. 523

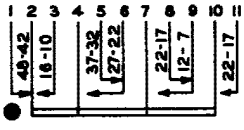


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FIG. 524

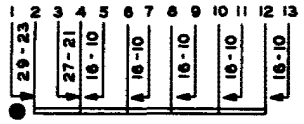


FIG. 525

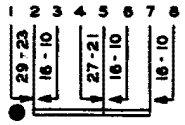


FIG. 526

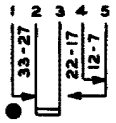


FIG. 527

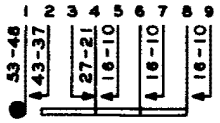


FIG. 528

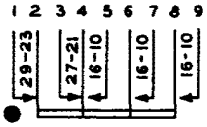


FIG. 529

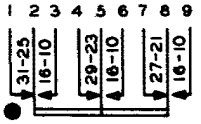
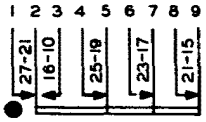


FIG. 530



Spring Combination Figures Are for Readjust Only

FIG. 700

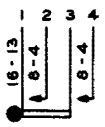


FIG. 701

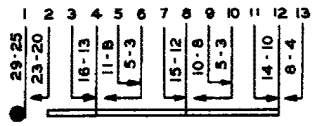


FIG. 702

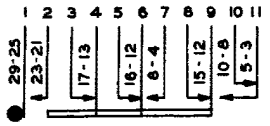


FIG. 703

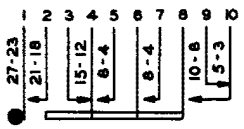


FIG. 704

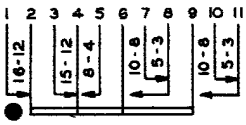


FIG. 705

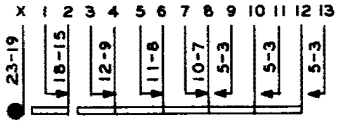


FIG. 706

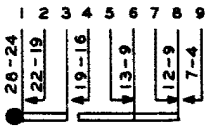


FIG. 707

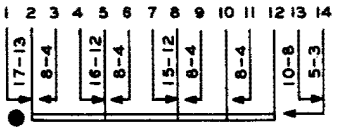


FIG. 708

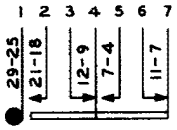
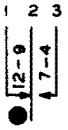


FIG. 709



† FIG. 710

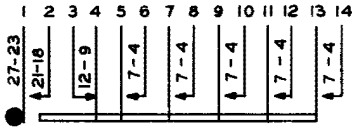


FIG. 711

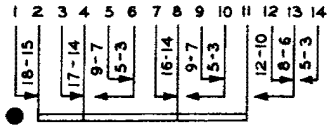


FIG. 712

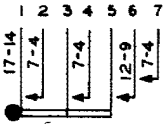


FIG. 713

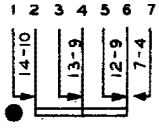


FIG. 714

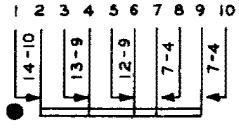


FIG. 715

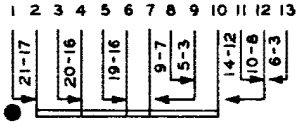


FIG. 716

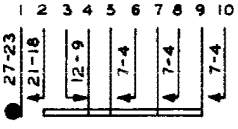


FIG. 717

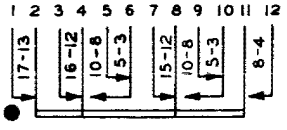


FIG. 718

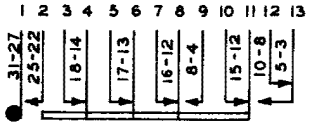
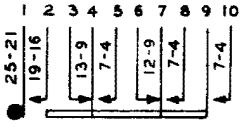


FIG. 719



† FIG. 720

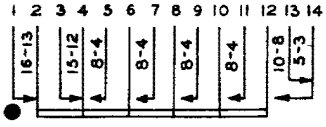


FIG. 721

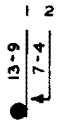


FIG. 722

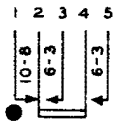
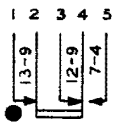


FIG. 723



† Indicates change in this issue.

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FIG.724

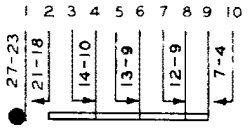


FIG.725

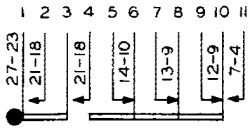


FIG.726

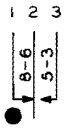


FIG.727

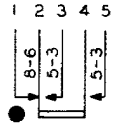


FIG.728

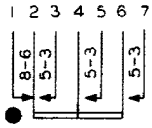


FIG.729

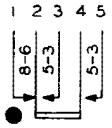


FIG.730

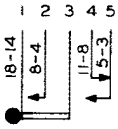


FIG.731

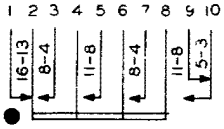


FIG.732

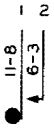


FIG.733

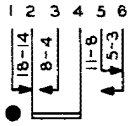
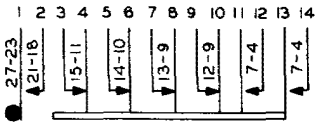


FIG.734



†FIG.735

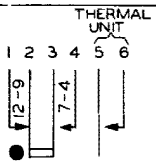


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FIG.901

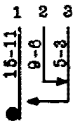


FIG.902

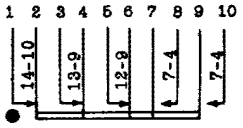


FIG.903

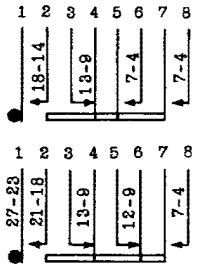


FIG.904

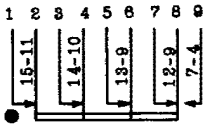


FIG.905

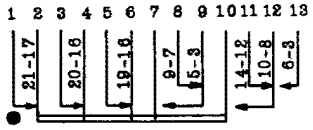


FIG.906

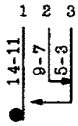


FIG.907

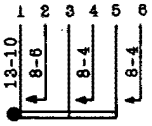


FIG.908

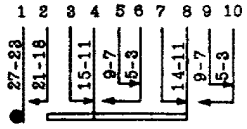


FIG.909

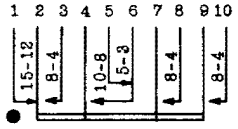


FIG.910

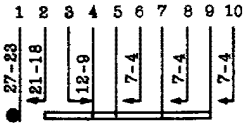


FIG.911

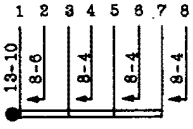


FIG.912

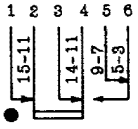


FIG.913

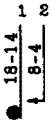


FIG.914

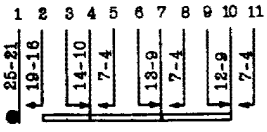


FIG.915

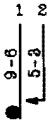


FIG.916

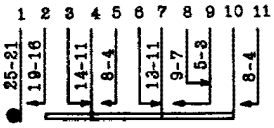


FIG.917

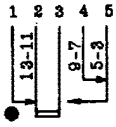


FIG.918

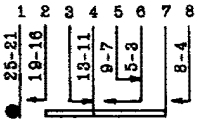


FIG.919

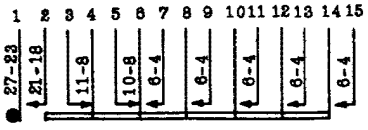


FIG.920

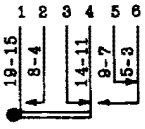
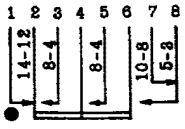


FIG.921



On 224-type relays, double spring assemblies are arranged as shown in the spring combination figures. On 223 types, the top and bottom assemblies shown in the figures are interchanged.

Spring Combination Figures Are for Readjust Only

FIG. 922

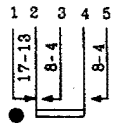


FIG. 923

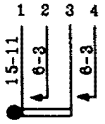


FIG. 924

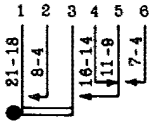


FIG. 925

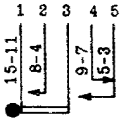


FIG. 926

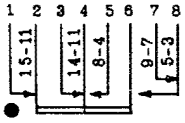


FIG. 927

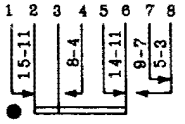


FIG. 928

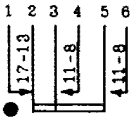


FIG. 929

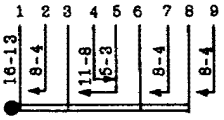


FIG. 930

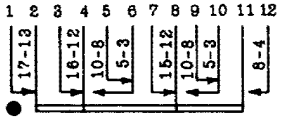


FIG. 931

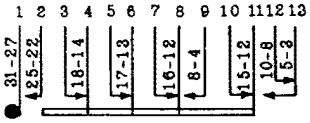


FIG. 932

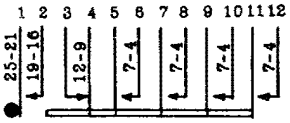


FIG. 933

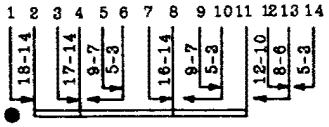


FIG. 934

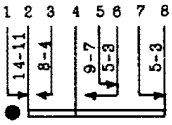


FIG. 935

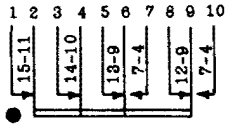


FIG. 936

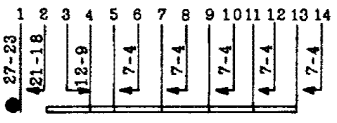


FIG. 937

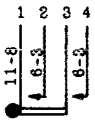


FIG. 938

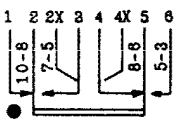


FIG. 939

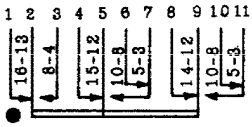


FIG. 940

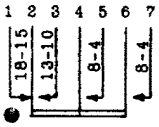


FIG. 941

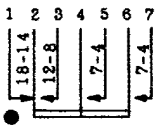


FIG. 942

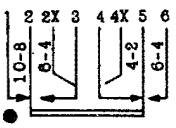


FIG. 943

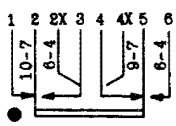


FIG. 944

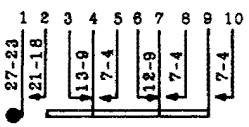
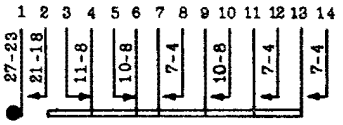


FIG. 945



Spring Combination Figures Are for Readjust Only

FIG. 946

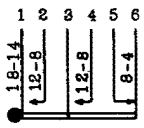


FIG. 947

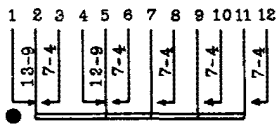


FIG. 948

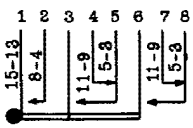


FIG. 949

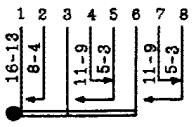


FIG. 950

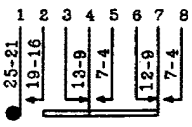


FIG. 951

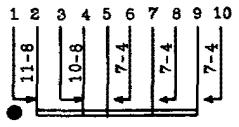


FIG. 952

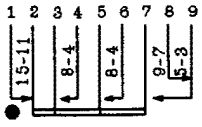


FIG. 953

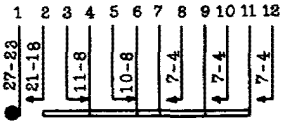


FIG. 954

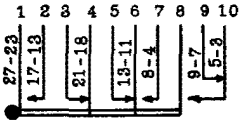


FIG. 955

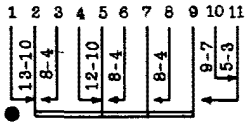


FIG. 956

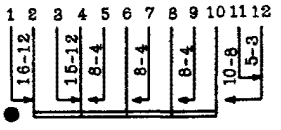


FIG. 957

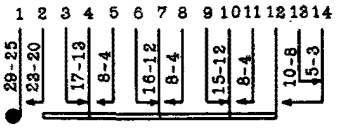


FIG. 958

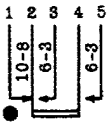


FIG. 959

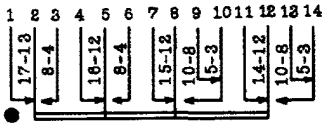


FIG. 960

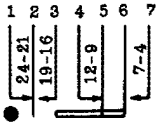


FIG. 961

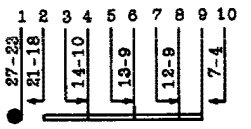


FIG. 962

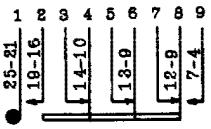


FIG. 963

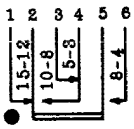


FIG. 964

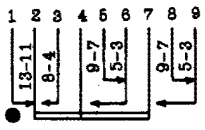


FIG. 965

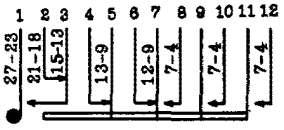


FIG. 966

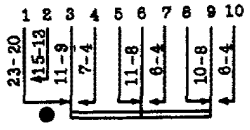


FIG. 967

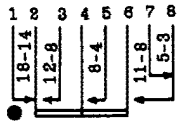


FIG. 968

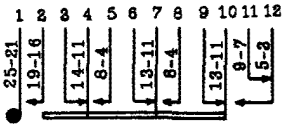
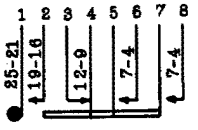


FIG. 969



Spring Combination Figures Are for Readjust Only

FIG. 970

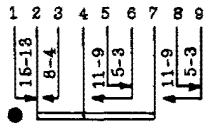


FIG. 971

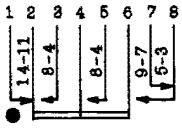


FIG. 972

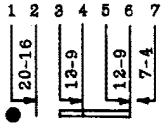


FIG. 973

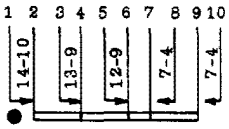


FIG. 974

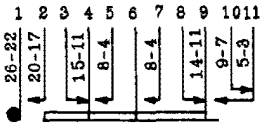


FIG. 975

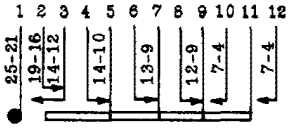


FIG. 976

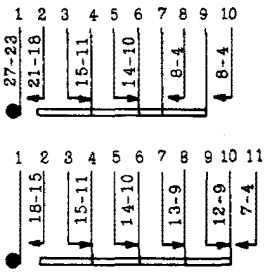


FIG. 977

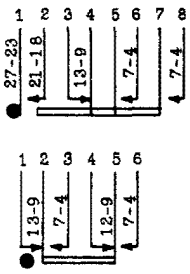


FIG. 978

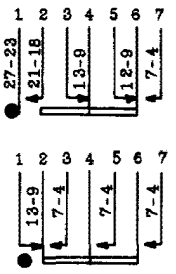


FIG. 979

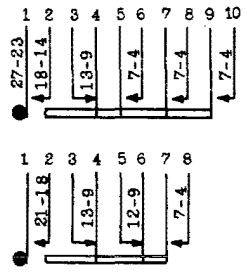


FIG. 980

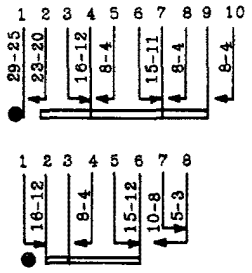


FIG. 981

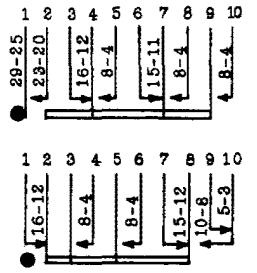


FIG. 982

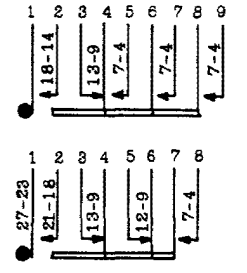


FIG. 983

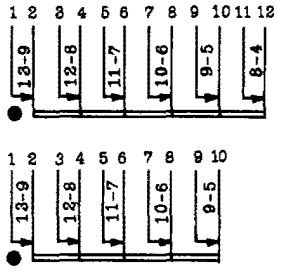
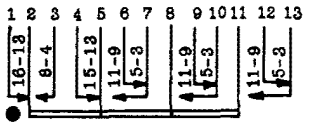
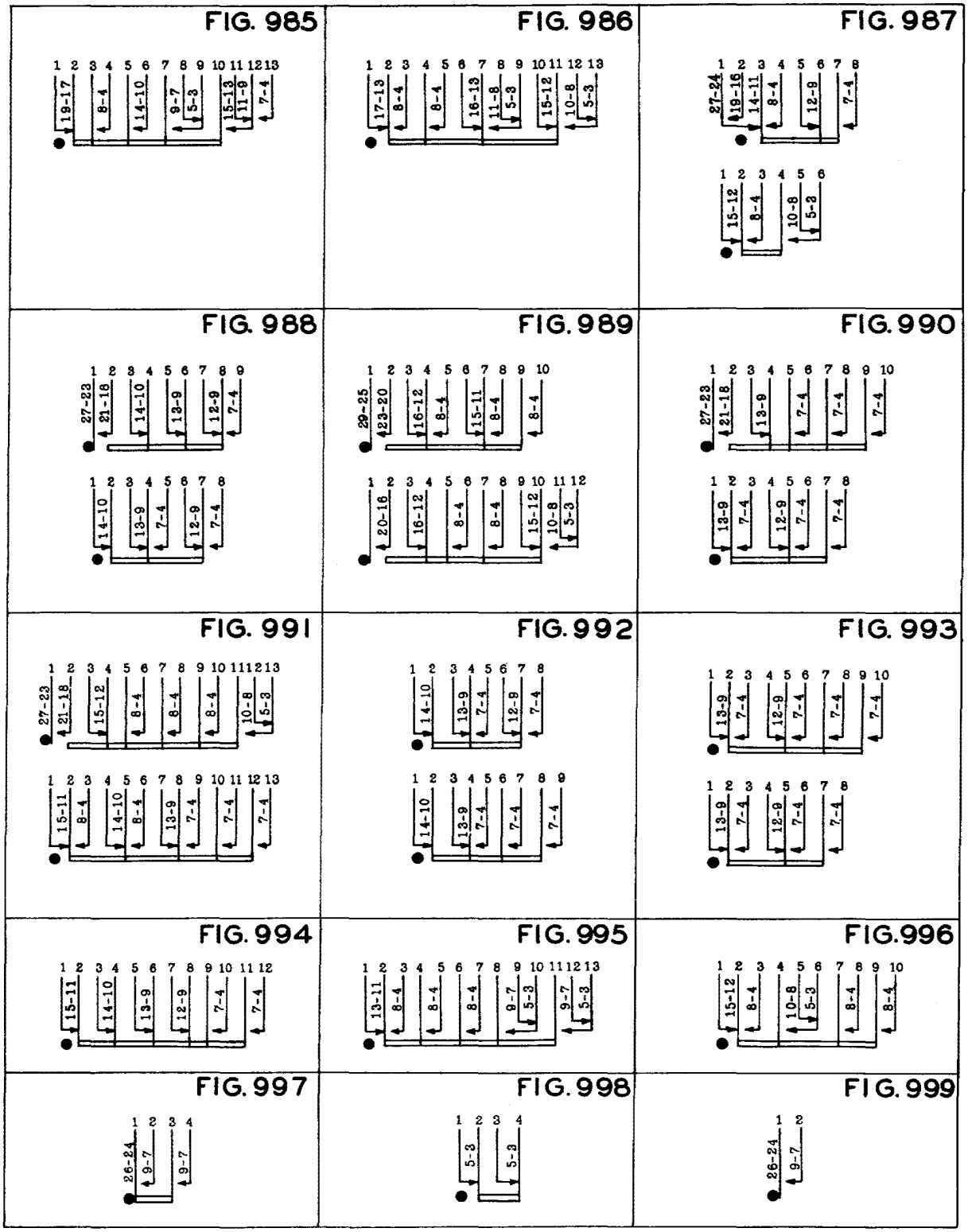


FIG. 984



On 224-type relays, double spring assemblies are arranged as shown in the spring combination figures. On 223 types, the top and bottom assemblies shown in the figures are interchanged.

Spring Combination Figures Are for Readjust Only



On 224-type relays, double spring assemblies are arranged as shown in the spring combination figures. On 223 types, the top and bottom assemblies shown in the figures are interchanged.

Spring Combination Figures Are for Readjust Only

FIG.1000

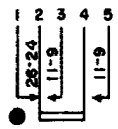


FIG.1001

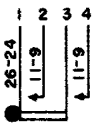


FIG.1002

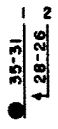


FIG.1003

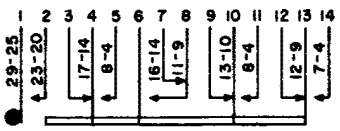


FIG.1004

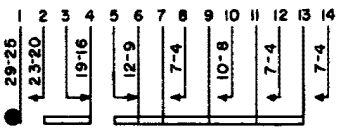


FIG.1005

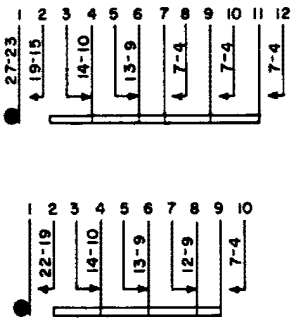


FIG.1006

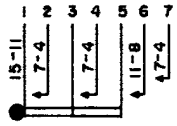


FIG.1007

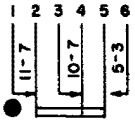


FIG.1008

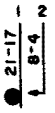


FIG.1009

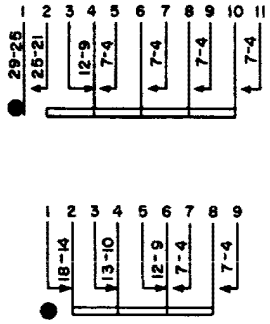


FIG.1010

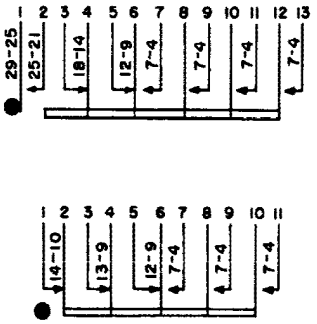


FIG.1011

FIG.1012

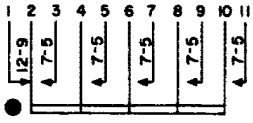


FIG.1013

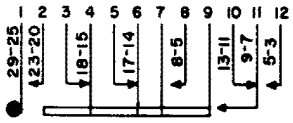


FIG.1014

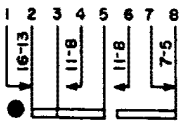
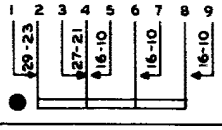


FIG.1015



On 224-type relays, double spring assemblies are arranged as shown in the spring combination figures. On 223 types, the top and bottom assemblies shown in the figures are interchanged.

3. ADJUSTING PROCEDURES

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

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
43	3/16- and 1/4-Inch Hex Open Double-End Flat Wrench
48	Combination 7/32- and 1/4-Inch Hex Double-End Socket Wrench and Screwdriver
129B	1/4-Inch Hex Open Double-End Offset Wrench
207	90-Degree Offset Screwdriver, Modified (See 3.002)
209	5/16-Inch Hex Open Single-End Offset Wrench
256	Spring Adjuster
259	Spring Adjuster
326B	Adjuster
415B	Spring Adjuster
416B	Spring Adjuster
417A	1/4- and 3/8-Inch Hex Open Double-End Flat Wrench
418A	5/16- and 7/32-Inch Hex Open Double-End Flat Wrench
436A	Heelpiece Adjusting Tool
474A	3/16- and 1/4-Inch Hex Closed Double-End Offset Wrench
476A	3/16-Inch Hex Offset Socket Wrench
510C	Test Lamp [must be equipped with a 561A straight tip or 562B curved tip, and W2CB (24 volt) or W2BL (48 volt) cord]
563A	90-Degree Offset Screwdriver
564A	45-Degree Offset Screwdriver
597A	Armature Adjuster
764A	Spring Adjuster ←
765A	Spring Adjuster ←
766A	Spring Adjuster ←
KS-6320	Orange Stick
KS-7782	Parallel-Jaw Pliers
R-1051	File
AECo H14769	Armature Backstop Adjuster
P-220366	Dental Mirror
—	4-Inch E Screwdriver (or the replaced 4-inch regular screwdriver)
GAUGES	
68C	70-0-70 Gram Gauge
74D	Thickness Gauge Nest
92R	0.0015-Inch Nonmagnetic Offset Thickness Gauge
129A	0.007-Inch Thickness Gauge
187A	Thickness Gauge Nest
KS-6909	Thickness Gauge Nest
KS-6938	Thickness Gauge Nest
MATERIALS	
KS-7187	1/2- by 1-1/2 Inch Bell Seal Bond Paper, Substance No. 20
KS-7860	Petroleum Spirits
—	Hardwood Toothpicks, Flat at One End and Pointed at the Other
TEST APPARATUS	
35 Type	Current Flow Test Set
J34717A	Pulsing Test Set or Equivalent
J34720A	Pulse Repeating Test Set or Equivalent
J64722A	Pulse Repeating Test Set or Equivalent
J94713A	Relay Timing Test Set

3.002 Modify the 207 offset screwdriver by cutting it in two parts with a hacksaw at a line midway between the two ends and remove burrs from the cut edges with the R-1051 file. If difficulty is experienced in inserting the modified screwdriver between the relay and adjacent springs [3.06(3)], both halves of the screwdriver may be further modified by reducing the height of the offset portion and the thickness of the shank adjacent to this portion as covered in (1) and (2).

(1) Reduce the height of the offset blade by about 1/32 inch using the R-1051 file. Then file down the fillets on both sides of the blade to provide a blade height of approximately 1/16 inch. Leave a slight fillet at the inner corner of the offset.

(2) Reduce the thickness of the shank by approximately 1/32 inch for a length of approximately 3/4 inch from the blade end by filing down the surface at the back of the shank.

3.01 ***Cleaning*** (Reqt 2.01)

(1) Clean the contacts and other parts of the relay in accordance with Section 069-306-801.

3.02 ***Relay Mounting*** (Reqt 2.02)

3.03 ***Vertical Clearance Between Relays*** (Reqt 2.03)

(1) Shift the position of the relay when necessary to obtain the required clearance by loosening the mounting screws with the 4-inch E screwdriver. Securely tighten the screws.

3.04 ***Contact Alignment*** (Reqt 2.04)

(1) If the contacts are misaligned, proceed as follows.

(a) If the assembly is loose, align the springs as required and tighten the spring assembly clamping screws with the 4-inch E screwdriver or with the 563A or 564A offset screwdrivers as shown in Fig. X.

(b) If the contact alignment requirement is not met and the spring assembly screws are tight, refer the matter to the supervisor.

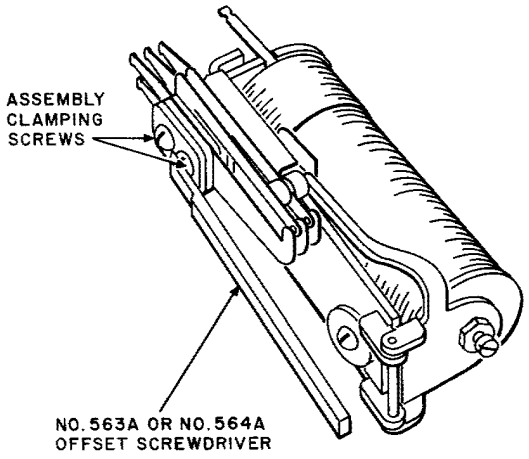


Fig. X—Aligning Contact Springs

3.05 ***Armature Movement*** (Reqt 2.05)

Relays With Pin-Type Armatures

(1) If the requirement is not met, replace the armature as covered in Section 040-236-801.

Relays With Pivot-Type Armatures

(2) If the armature binds and there is some endplay, loosen the pivot screw locknut with the 43, 417A, or 418A wrench depending on the nut provided on the relay. Turn the pivot bearing screw sufficiently in a counterclockwise direction with the 563A or 564A offset screwdriver as shown in Fig. Y to permit moving the armature. Then remove the armature and check for burrs on the heelpiece, armature bearings, pivots, or armature. Replace the parts at fault in accordance with Section 040-236-801.

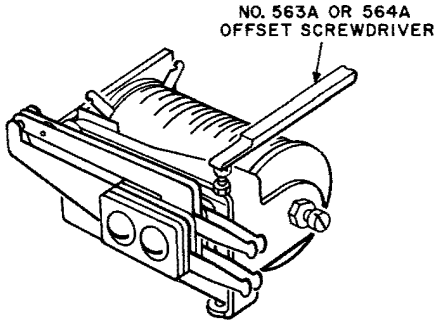


Fig. Y—Adjusting for Armature Movement

(3) If the trouble is not due to burrs, clean the bearing surface with a clean toothpick which has been dipped in petroleum spirits. Do not use the same toothpick for more than one operation. Exercise care that the petroleum spirits do not come in contact with insulators, studs, or spoolheads. Remount the armature, position the pivot screw to obtain the required endplay, and securely tighten the locknut.

(4) If there is no armature endplay, loosen the locknut with the No. 43, 417A, or 418A wrench and reposition the pivot screw with the No. 563A or 564A offset screwdriver. If the endplay is excessive, turn the screw in a clockwise direction. Then tighten the locknut securely.

3.06 ***Residual Airgap*** (Reqt 2.06)
3.07 ***Heelpiece Airgap*** (Reqt 2.07)

All Relays Except 247- and 248-Type Relays

(1) First adjust the residual airgap as covered in (2) if the residual screw is readily accessible, or as covered in (3) if the residual screw is behind a normal post spring assembly or rotary off-normal spring assembly on a switch. Then, if necessary, adjust the heelpiece airgap as described in (4) through (7).

(2) If the residual screw is readily accessible, adjust the residual airgap as follows. Loosen the residual screw locknut with the socket wrench of the No. 48 combination wrench and screwdriver. Using the screwdriver, turn the residual screw clockwise to increase and counterclockwise to decrease the gap. After the residual airgap has been adjusted, tighten the residual screw locknut. Then recheck the requirement.

(3) If the residual screw is behind a normal post spring or rotary off-normal spring assembly on a switch, first remove the cover from the switch adjacent to the relay being adjusted. Then adjust the residual airgap as follows. Loosen the residual screw locknut with the No. 129B or 474A wrench, taking care to avoid grounding the adjacent springs. Using the modified No. 207 screwdriver, turn the residual screw clockwise to increase or counterclockwise to decrease the gap. After the residual airgap has been properly adjusted, tighten the residual screw locknut while holding the screw in the adjusted position with the screwdriver. Then, recheck the requirement.

(4) To adjust the heelpiece airgap, proceed as follows. Loosen the armature yoke mounting screw with the No. 563A or 564A offset screwdriver. Position the armature yoke so that there is a gap of approximately 0.025 inch as gauged by eye between the armature and heelpiece and tighten the armature yoke screw to hold the armature temporarily in this position.

(5) Insert the No. 436A heelpiece adjusting tool between the armature and heelpiece as shown in Fig. Z, AA, and AB for the various types of relays. Operate the relay. Loosen the armature yoke screw about 1/8 turn and tap the armature lightly toward the heelpiece with the handle of the screwdriver until the No. 436A tool binds. Exercise care not to tap the yoke. The purpose of tapping the armature is to take up all the play in the yoke bearing in the direction of the heelpiece. If the yoke is tapped rather than the armature, the play will be taken up in the opposite direction. Hold the armature in this position with the fingers and tighten the armature yoke mounting screw securely. When using the No. 436A tool from the heelpiece side, exercise care not to mutilate the tool when tightening the armature yoke screw. Remove the tool and recheck the heelpiece airgap.

(6) If B- and C-position relays do not meet the timing or pulsing tests after the heelpiece has been adjusted as described in (3) and (4) with the No. 436A tool, it may be necessary to readjust the heelpiece airgap closer to the minimum limit.

(7) In certain cases changing the residual airgap or heelpiece airgap may cause the relay to fail to meet the spring gauging requirement. If the relay was known to meet this requirement prior to the gap adjustments and no longer meets the requirement, the condition may readily be corrected by adjusting the armature lever slightly with the No. 597A armature adjuster. With the armature held against the core, apply the adjuster to the straight portion of the lever arm at the point shown in Fig. AC, taking care not to burr

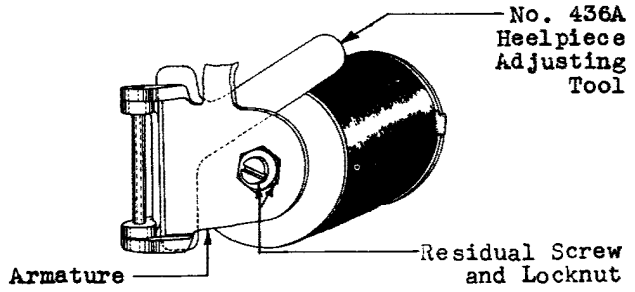


Fig. Z – Adjusting the Heelpiece Airgap With the No. 436A Heelpiece Adjusting Tool Inserted From the Armature Side (all except 251- and 252-type relays)

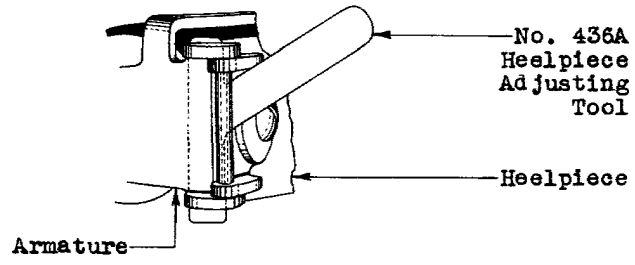


Fig. AA – Adjusting the Heelpiece Airgap With the No. 436A Heelpiece Adjusting Tool Inserted From the Heelpiece Side (all except the No. 223BN relay and 225-, 247-, and 248-type relays)

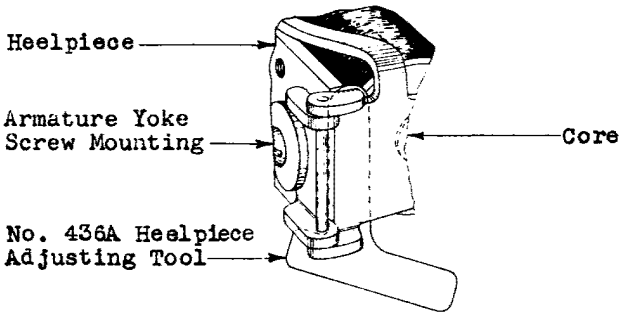


Fig. AB – Adjusting the Heelpiece Airgap on 251- and 252-Type Relays With the No. 436A Heelpiece Adjusting Tool Inserted From the Bottom

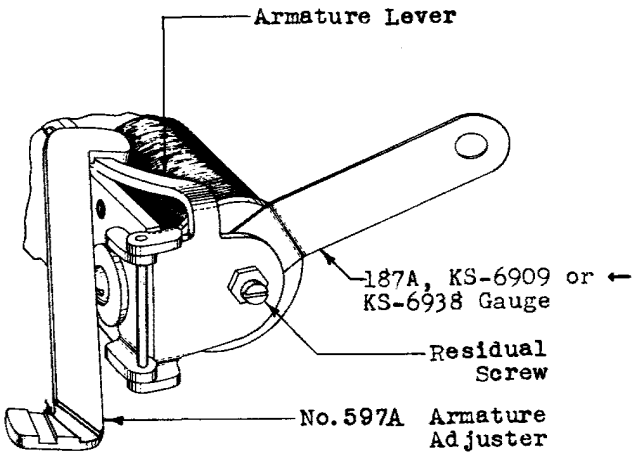


Fig. AC – Method of Adjusting the Armature Lever

the lever arm. If the lever arm is adjusted in this way, make sure that the first lever spring is parallel to the heelpiece when the armature is in the released position.

247- and 248-Type Relays

(8) First adjust the heelpiece airgap as covered in (9) if the residual screw is readily accessible or as covered in (10) if the residual screw is behind a normal post spring assembly or behind a rotary off-normal spring assembly on a switch. Then, if necessary, adjust the residual airgap as described in (11) and (12).

(9) If the residual screw is readily accessible, adjust the heelpiece airgap as follows. Using the No. 48 combination wrench and screwdriver, back out the residual screw all the way before readjusting the heelpiece airgap. Loosen the armature yoke screw with the No. 476A wrench and set the heelpiece airgap as described in (4) through (7).

(10) If the residual screw is behind a normal post spring or rotary off-normal spring assembly on a switch, first remove the cover from the switch adjacent to the relay being adjusted. Then adjust the heelpiece airgap as follows. Loosen the residual screw locknut, using the No. 474A wrench. With the modified No. 207 screwdriver, back out the residual screw all the way before adjusting the heelpiece airgap. Loosen the armature yoke screw with the No. 476A wrench and set the heelpiece airgap as described in (4) through (7).

(11) After the heelpiece airgap has been properly adjusted, adjust the residual airgap as described in (2) or (3). Then tighten the armature yoke screw, taking care to avoid applying excess force that may cause the screw to break.

(12) In the case of 247C, H, J, and N relays having Stellite* or sapphire inserts in the core (relays manufactured after January 1, 1948), note that the armature centers vertically with respect to the spoolhead before tightening the armature yoke screw. To check this, note the relation of the armature with respect to the winding terminal staking holes.

* Trademark

3.08 ***Armature Travel*** (Reqt 2.08)

Note: In 3.08 through 3.16 the spring bending and backstop adjustment tools listed are those designed for adjusting relays mounted in switches. When relays are mounted on strip mounting plates, it may be necessary, due to small clearances, to substitute the following tools:

(a) 764A Tool—for adjusting upper springs

(b) 765A Tool—for adjusting lower springs

(c) 766A Tool—For adjusting heavy springs and the armature backstop

3.09 ***Armature Stud Gap*** (position of first lever spring with respect to armature stud) (Reqt 2.09)

3.10 ***Armature Backstop Screw Position*** (251- and 252-type relays only) (Reqt 2.10)

All Relays Except 251- and 252-Type Relays

First Lever Spring Is a Normally Open Contact Spring or a Balancing Spring

(1) If the relay fails to meet the armature travel requirement, insert between the armature and core a gauge of the larger value specified for armature travel in the proper spring combination figure on pages 15 through 50. Energize the relay.

(2) If under this condition all first lever springs are not parallel to the heelpiece, make the following adjustment. With the 597A armature adjuster applied to the armature lever as shown in Fig. AC, adjust the lever until the associated first lever spring is approximately parallel to the heelpiece.

(3) Note whether the armature backstop is touching the armature lever. If it is not touching, adjust the backstop so that it just touches the armature lever, using the 326B or 416B adjuster or the H14769 armature backstop adjuster if the relay has a pin-type armature (see Fig. AD). If the relay has pivot-type armature, use the KS-7782 pliers as shown in Fig. AE. After making this adjustment de-energize the relay, remove the gauge, and insert the smaller gauge specified for armature travel in the proper spring combination figures on pages 15 through 50. Re-energize the relay and note that the armature leaves the backstop.

(4) If the first lever spring does not hold the armature against the backstop, tension this spring as required using the 415B, 416B, or 259 spring adjuster or the KS-7782 pliers.

(5) Check that springs other than the first lever spring meet the spring gauging limits specified in the spring combination figure, and if necessary readjust the springs as covered in 3.16.

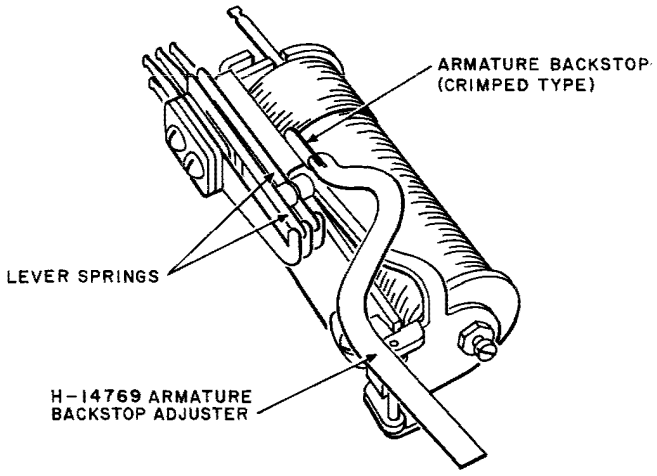


Fig. AD—Adjusting the Clearance Between the Armature Stud and the First Lever Spring On Relays Equipped With Pin-Type Armatures

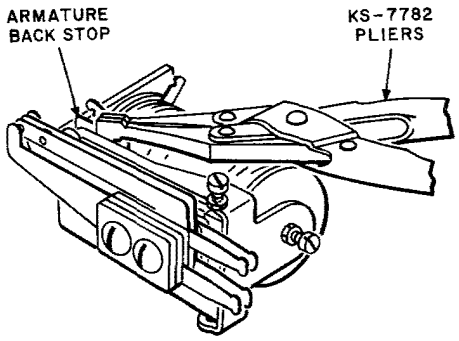


Fig. AE—Adjusting the Armature Stud Gap on Relays Equipped With Pivot-Type Armature

First Lever Spring Is a Normally Closed Contact Spring

(6) Before adjusting the relay to meet the armature travel or stud-gap requirements, adjust all lever springs if necessary, so that they are positioned to be as nearly parallel to the heelpiece as practicable. To position the first lever spring parallel to the heelpiece, adjust the associated break contact spring as required, using the 415B or 416B spring adjuster.

(7) To adjust the relays to meet the armature travel requirement, insert between the armature and core a gauge of the minimum value specified for the first contact in the proper spring combination figure on pages 15 through 50. Energize the relay. Adjust the armature lever or levers, using the 597A armature adjuster as shown in Fig. AC, so that the first contact breaks as near the minimum value as is consistent with meeting the sequence of the associated normally closed contacts and normally open contacts. After making this adjustment, remove the gauge and insert the maximum gauge specified for the first contact or contacts of the spring assembly. Again energize the relay. Observe that the first contact does not break.

(8) After making the adjustments described in (7), adjust the armature backstop to provide the proper stud gap as described in (9). Check that the other springs meet the spring gauging limits specified in the spring combination figures and, if necessary, readjust as described in 3.16.

(9) To change the clearance between the armature stud and the first lever spring, adjust the armature backstop with the 326B, 416B, or H14769 adjuster where the relay has a pin-type armature (see Fig. AD). If the relay has a pivot-type armature, use the KS-7782 pliers as shown in Fig. AE. Adjust the backstop away from the armature stud to increase the gap, and toward the stud to decrease the gap.

251- and 252-Type Relays

(10) If the relay fails to meet the armature travel requirement, proceed as follows. Loosen the backstop screw locknut with the 209 wrench. Insert between the armature and core a gauge of the larger value specified for armature travel in the proper spring combination figure on pages 15 through 50. Energize the relay. Hold the locknut with the wrench, and adjust the screw so that it just touches the armature. Securely tighten the locknut. Check that the armature backstop screw position requirement is met.

(11) If the armature stud gap requirement is not met, tension the first lever spring or balancing spring so that it holds the armature against the backstop screw.

(12) If the armature backstop screw position requirement is not met, proceed as follows. Loosen the backstop screw locknut with the 209 wrench and turn the backstop screw forward until the gauge can be inserted between the armature and the front pole piece without the armature leaving the backstop screw. Before tightening the locknut, check that the armature travel requirement is still met. If the armature travel is satisfactory, securely tighten the locknut.

(13) If the armature backstop screw cannot be located properly and still meet the armature travel requirement, it will be necessary to relocate the front pole piece. Loosen the screws clamping the front pole piece to the center pole piece, using the 563A and 564A offset screwdrivers and move the front pole piece backward or forward as required. The proper position for the front pole piece will be obtained with the ends of the front pole-piece arms approximately flush with the rear surface of the center pole piece as gauged by eye. Securely tighten the clamping screws and check the armature travel as measured in (10) through (12). Readjust if necessary.

(14) If it is necessary to adjust the armature lever after requirement 2.16 has been met, recheck the armature travel.

3.11 ***Straightness of Springs*** (Reqt 2.11)

(1) Do not straighten kinked lever springs unless the kinks interfere with proper adjustment of the springs, since removing kinks tends to weaken the springs and to shorten their life. Normally, straight springs that have been adjusted should have no sharp bends. A gradual bow, however, if permissible.

(2) If a spring is excessively bowed or bent, straighten it with the 415B or 416B spring adjuster. In some cases, such as the ◀

thermal units of 305-, 307-, and 309-type relays, it will be necessary to use the No. 259 spring adjuster or the KS-7782 pliers.

(3) To remove an excessive bow in a lever spring, place the adjuster or pliers on the spring just behind the stud and slide the tool along the spring to a point near the inner end as shown in Fig. AF and AG. Draw the adjuster or pliers forward the length of the bow carefully, exerting pressure in a direction opposite to the bow. Adjust the spring in line with its movement to avoid tilting the spring.

(4) To remove a kink in the spring, apply the adjuster or pliers just in front of the kink and carefully bend the spring to remove the kink. Where mounting conditions permit, it is desirable to hold the spring with one tool behind the kink and bend the spring with a second tool.

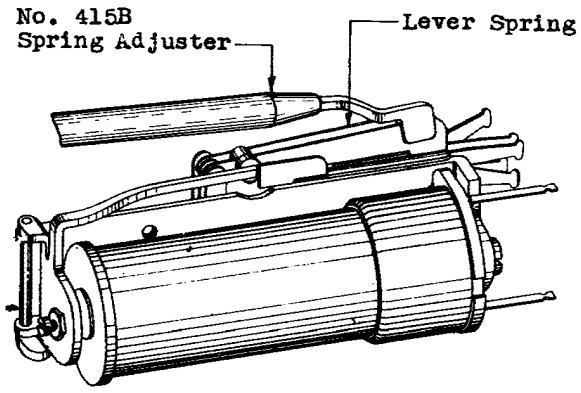


Fig. AF – Adjusting Lever Spring for Tension

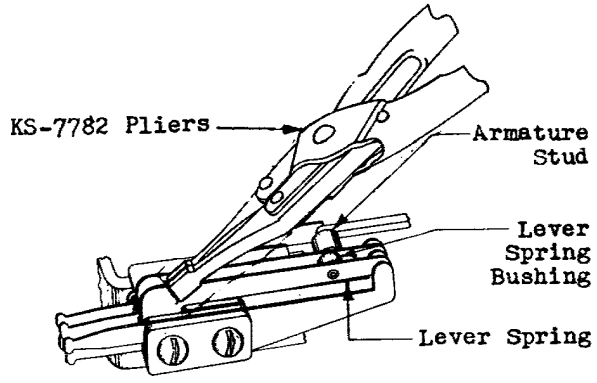


Fig. AG – Removing Excessive Bow From Spring

Except Thermal Units of 305-, 307-, and 309-Type Relays

(5) After straightening the springs, check requirements 2.12 through 2.16 and readjust if necessary.

3.12 ***Contact Separation*** (Reqt 2.12)
3.13 ***Contact Sequence*** (Reqt 2.13)
3.14 ***Contact Pressure*** (Reqt 2.14)
3.15 ***Contact Follow*** (Reqt 2.15)
3.16 ***Spring Gauging*** (Reqt 2.16)

(1) If the above requirements are not met, adjust the lever springs as described in (2) and the stationary springs as described in (3). Adjust the springs toward the preferred limit of the spring gauging requirement described in (4). Distribute the spring tension as described in (5).

(2) ***Adjustment of Lever Springs***: To adjust the lever springs proceed as follows.

(a) Place the No. 415B or 416B adjuster on the spring just behind the stud and slide it along to a point near the inner end as shown in Fig. AF. In some cases it may be necessary to use the No. 259 adjuster or the KS-7782 parallel-jaw pliers. When using the pliers, apply them to the spring at the point at which the spring adjuster is applied as shown in Fig. AF.

(b) To increase the tension of a spring toward the armature stud, bend the spring toward the stud; to decrease the tension, bend the spring away from the stud. Adjust the spring in line with its movement to avoid tilting. Take care not to disturb adjacent springs. Do not adjust springs any more than necessary, since repeated adjustment may injure a spring.

(c) If sufficient tension (toward the armature stud) cannot be obtained by adjusting the spring as described in (b) without bowing the spring beyond the permissible limit, or reducing the clearance between springs to a point where they may touch, proceed as follows.

(d) Apply the spring adjuster or pliers to the spring just behind the stud and slide the tool along the spring to a point near the inner end as shown in Fig. AF and AG. Then carefully draw the tool forward

the length of the spring, meanwhile applying pressure so that the spring is formed into a slight gradual bow with the concave surface facing the heelpiece. Then move the tool to the inner end of the spring and adjust the spring as described in (b). The magnitude of the bow to be formed in the spring must be learned by experience and should be such that when the final adjustment is made at the inner end of the spring, the spring will be approximately straight.

(3) ***Adjustment of Stationary Springs***: To adjust the stationary springs (back or front contact springs) proceed as follows.

(a) Apply the No. 415B or 416B spring adjuster to the slanting edge of the spring near the point where the spring leaves the insulators, as shown in Fig. AH. In some cases it may be necessary to use the KS-7782 pliers or the No. 259 spring adjuster.

(b) Adjust the spring carefully to the left or right as required to properly position the spring, taking care not to disturb adjacent springs. Take care not to tilt the springs. Do not adjust springs more than necessary, since repeated adjustment may injure a spring.

(c) In the case of Z-position (225 type) relays, adjust the stationary springs where mounting conditions permit with the No. 256 spring adjuster applied from the right, near the point where the spring leaves the insulators. In some cases it may be necessary to remove the switch from the mounting plate to properly adjust these relays.

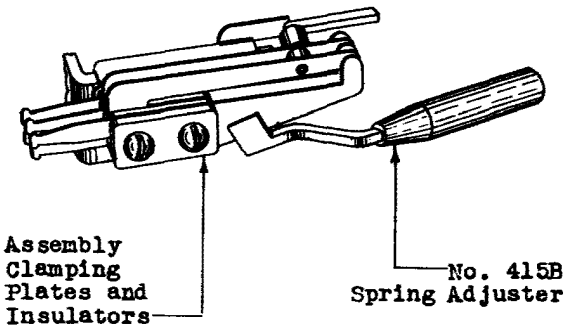


Fig. AH – Adjusting Spring to Meet the Spring Gauging Requirements

(4) ***Preferred Adjustments for Spring Gauging Requirements:*** Adjust the springs toward the preferred limit for spring gauging as follows.

(a) Adjust normally closed contacts (except normally closed contacts of make-before-break spring assemblies) so that the contacts ***just*** break with a gauge inserted of a value as near the minimum specified as will insure meeting the sequence of normally closed contacts and normally open contacts.

(b) Adjust the normally closed contacts of make-before-break assemblies so that the contacts break as near the specified maximum gauging value as possible.

(c) Adjust normally open contacts so that the contacts ***just fail*** to make with gauge of the maximum value inserted.

(5) ***Distribution of Spring Tension***: Distribute the tension on springs as follows.

(a) On spring assemblies having more than one normally closed contact, it is advisable to tension the lever springs against the associated normally closed contact springs so that the contact pressure at each normally closed contact is approximately equal, consistent with meeting the electrical requirements. Check for approximate equal distribution of tension, using the KS-6320 orange stick applied to the spring, first removing the tension of the springs which press against the spring being checked. On D-position relays of selectors and on similar functioning relays, it may not be possible to evenly distribute the tension and still meet the electrical requirements.

(b) In the case of lever springs associated with normally open contacts only, distribute the tension between the lever springs as equally as possible, consistent with meeting electrical requirements.

(c) In order to meet electrical requirements applying to the preliminary contacts of 2-step operation relays, it may be necessary to tension the lever spring associated with the preliminary contacts to a different value from that of the other lever springs in the spring assembly.

3.17 ***Electrical Requirements*** (Reqt 2.17)

DC Requirements

(1) If a relay fails to meet the dc electrical operate or hold requirement, reduce the tension of the lever springs as covered in 3.12 through 3.16.

(2) If a relay fails to meet the dc electrical nonoperate or release requirement, increase the tension of the lever springs as covered in 3.12 through 3.16.

(3) If ring trip relays on connectors arranged for 1400- or 1500-ohm maximum external subscriber loop fail to meet the pretrip or trip tests (using the test set test resistance values as applied by the connector test set or test line for making tests on connectors), proceed as follows. Readjust the relay mechanically as covered in this section and electrically in accordance with the dc readjust requirements specified in the circuit requirements table. Repeat the test set or test line set (using test resistance values). If the relay still fails to meet these tests, adjust the tension of the No. 1 spring so that the relay meets the readjust resistance values as provided for pretrip and trip tests in the test set or test line.

AC Requirements

(4) If ring trip relays for which ac requirements are specified on connectors arranged for 900- or 1000-ohm maximum external subscriber loop, having a 60- to 75-volt silent interval tripping battery, fail to meet the pretrip or trip test (test set test resistance values) as applied by the connector test set or test line for making these tests proceed as follows. Readjust the relays mechanically as covered in this section and electrically in accordance with the readjust resistance values specified in the circuit requirement table and applied by the connector test set or test line. Recheck the ac requirements.

3.18 ***Timing Requirements*** (Reqt 2.18)

(1) If the relay meets all the preceding requirements but fails to meet its hold timing requirement, slightly decrease the spring tension and follow. If a satisfactory adjustment cannot be obtained in this manner, reduce the residual airgap as covered in 3.06. In some cases it may be necessary to reduce the heelpiece airgap. If these adjustments are made, recheck that the spring gauging requirement is met.

(2) If the relay fails to meet its release requirement, increase the spring tension slightly as described in 3.12 through 3.16. If a satisfactory adjustment cannot be obtained in this manner, increase the residual airgap. If either of these adjustments are made, recheck the spring gauging requirement.

(3) Also refer to the section covering the analysis and correction of pulsing failures.

3.19 ***Pulse Repeating Requirement*** (Reqt 2.19)

(1) If the relays do not meet the pulse repeating requirement, proceed as outlined in Section 040-012-711 or 040-011-711.

REASONS FOR REISSUE

1. To revise the title and add information to cover the 305-, 307-, and 309-type relays (1.03).
2. To add a definition of operate for thermal unit of 305-, 307-, and 309-type relays (1.07 and 1.23).
3. To amplify the requirement covering contact alignment (2.04).
4. To amplify information covering exception to residual airgap requirement (2.06).
5. To revise the requirement covering heelpiece airgap (2.07).
6. To revise Fig. L and N.
7. To add reference to No. 187A gauge in armature travel requirement 2.08(a) and (b) and in Fig. S.
8. To omit the note covering stacking of gauges [2.08(c)].
9. To amplify the requirement and procedure covering straightness of springs (2.11 and 3.11).
10. To revise the requirement covering spring gauging [2.16(b) and (c)].

REASONS FOR REISSUE (Cont)

11. To amplify the requirement covering timing requirements (2.18).
12. To revise Fig. 710 and 720 and to add Fig. 735.
13. To revise the list of tools, gauges, materials, and test apparatus (3.001).
14. To revise the information for modifying the No. 207 offset screwdriver (3.002).
15. To amplify the procedure covering residual airgap (3.06).
16. To add designation for No. 187A gauge in Fig. AC.