

SELECTORS
KS-16201, KS-16202, KS-16203, AND
KS-16563 TYPES
REQUIREMENTS AND ADJUSTING PROCEDURES

1. GENERAL

1.01 This section covers the KS-16201, KS-16202, KS-16203, and KS-16563 type selectors.

1.02 The section is reissued to add requirements and procedures covering selector mounting and the alignment of index wheel, to add Fig. 4, 12, and 13, and to revise the list of tools. Detailed reasons for reissue will be found at the end of the section.

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

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

1.05 One dip of KS-6232 oil for the purpose of this section is the amount of oil retained on a strip of KS-7188 cleaning paper after being dipped in the oil to a depth of approximately 3/8 inch and wiped off lightly between a finger and the thumb.

1.06 One dip of KS-8559 lubricant for the purpose of this section is the amount of lubricant retained on the KS-14164 brush after being dipped into the lubricant to a depth of approx-

imately 3/8 inch and scraped once against the side of the container as the brush is removed.

1.07 A column of KS-7471 grease for the purpose of this section is a cylindrical-shaped quantity of grease of the length specified in the requirement, discharged from the No. 571A nozzle when used with the No. 353C grease gun.

1.08 A column of KS-13713 contact protectant for the purpose of this section is a cylindrical-shaped quantity of contact protectant of the length specified in the requirement, discharged from the No. 570A nozzle when used with the No. 353C grease gun.

1.09 Make-busy Information: Before making any of the inspections or readjustments specified herein, ascertain whether or not it is necessary to make any of the circuits busy. Circuits which are so affected should be made busy in the approved manner, and the necessary relays should be held operated or nonoperated to isolate the selector circuit.

Smooth and Uniform Operation: A selector operates smoothly and uniformly when it operates regularly under self stepping for not less than ten revolutions. A distinctive click indicating failure of the pawl to latch up over a tooth shall not be present.

1.11 Running and Stepping: In the circuit requirement table, test clip data is given to indicate the method of connecting the test set to the selector in checking and readjusting to meet the requirements specified herein. **Self Stepping** and **Pulse Stepping** appear in the **Remarks** column and are associated with the test or part is made accessible for other reasons or

necessary to rotate the selector under self stepping. **Pulse Stepping** is for use whenever it is necessary to operate the selector step by step.

1.12 Numbering of Rotor Brushes: The rotor brush pairs are numbered from left to right facing the front of the selector beginning with No. 1 pair, which is nearest to the indicator wheel.

1.13 Numbering of Contact Springs: The contact springs are numbered consecutively, starting at No. 1 spring which is nearest the mounting surface.

1.14 Moving Rotor Brushes by Hand: To move rotor brushes by hand, hold the armature operated by engaging the shoulder on the driving arm with the No. 207 offset screwdriver. Then move the rotor brushes by manually rotating the indicator wheel.

Caution: Failure to hold the armature operated may result in loosening the indicator wheel and rotor assembly.

1.15 To step the selector manually, engage the shoulder on the driving arm with the No. 207 offset screwdriver and move the armature until the retaining pawl drops over a tooth on the ratchet wheel; then release the armature.

1.16 Under some mounting conditions it will be necessary to remove the selector from its mounting in order to check and adjust for several requirements.

2. REQUIREMENTS

2.01 Cleaning

(a) The ratchet wheel teeth, armature and driving pawl bearings, and the surfaces of the magnet core and armature adjacent to each other shall be cleaned when necessary.

(b) The interrupter and off-normal contacts shall be cleaned when necessary in accordance with Section 022-100-811.

2.02 Lubrication

(a) Lubrication shall be applied semiannually as follows.

PART	LUBRICANT AND AMOUNT
Rotor Shaft	KS-7471 grease to completely fill the undercut portion of the shaft. The shaft shall be lubricated only if the rotor is removed for other reasons.
Driving Pawl and Pawl Spring — Fig. 1(A) and (B) Fig. 2(A) and (B)	One dip of KS-8559 lubricant distributed between both sides of the pawl bearing and to both ends of the pawl spring.
Ratchet Wheel Teeth — (except KS-16563 Selectors) Fig. 1(C)	3/4-inch column of KS-7471 grease distributed evenly over ratchet wheel teeth.
(KS-16563 selectors) Fig. 2(C)	1-1/8 inch column of KS-7471 grease distributed evenly over ratchet wheel teeth.
Indicator Wheel Lobes — (except KS-16563 selectors) Fig. 3(A)	One dip of KS-8559 lubricant distributed over the lobes on the surfaces contacted by the operating spring.
Driving Spring— Fig. 1(E) and Fig. 2(D)	One dip of KS-8559 lubricant divided between the two ends of the driving spring.
Rotor Brushes and Bank Contacts Fig. 1(D) (except KS-16563 selectors)	One dip of KS-6232 oil distributed over each six pairs of rotor brush tips of all selectors, except KS-16563 selectors.
Fig. 2(E) (KS-16563 selectors)	One dip of KS-6232 oil distributed over each four pairs of rotor brush tips on KS-16563 selectors.
Armature Bearing Fig. 3(B) and Fig. 5(A)	One dip of KS-8559 lubricant distributed to each side of each lug of the armature bearing.
Feeder Brush Tips Fig. 6(A) (except KS-16563 selectors)	1/4-inch column of KS-13713 contact protectant distributed over the hubs of each pair of rotor springs on the sides that contact the feeder brush tips.
2.03 Selector Mounting:	The selector shall be securely fastened to its mounting.
↳Gauge by feel.	

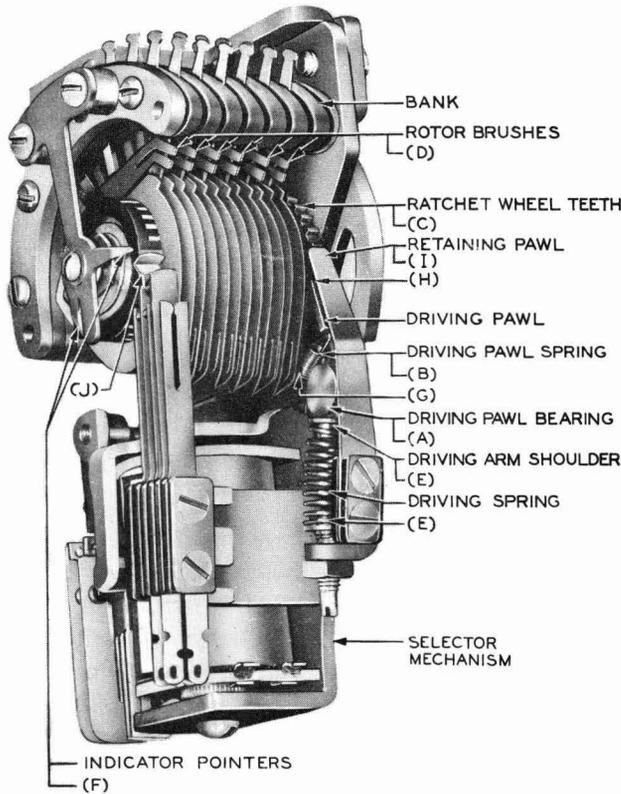


Fig. 1 — KS-16201, KS-16202, and KS-16203 Type Selectors — Front View — KS-16201 Selector Shown

2.04 Alignment of Index Wheel (KS-16203, List 2 Selector) Fig. 4(A): If the selector is mounted on an equipment control panel, each number on the index wheel shall be fully visible through the panel window when the selector is in the position in which the number is at the window. Gauge by eye.

Check this requirement at four points on the index wheel approximately 90 degrees apart with the eye directly in front of the window.

2.05 Feeder Brush Position and Tension

(a) Fig. 6(B)—With the feeder brushes engaging the associated rotor brushes, the two feeder brushes of each pair shall lie flat against each other at the section over which the associated rotor brushes pass.

Gauge by eye.

* (b) Fig. 7(A)—With the selector mechanism removed from the bank, the tips of each pair of feeder brushes shall be separated as

specified below when the pressure of adjacent feeder brushes is removed.

KS-16201, KS-16202, and KS-16203 selectors
5/32-inch separation

KS-16563 selectors 1/2-inch separation

Gauge by eye.

The insulators separating bank levels are approximately 5/32 inch thick.

2.06 Freedom of Movement of Rotor: The rotor shall turn freely on the shaft.

Gauge by feel.

Check this requirement by turning the rotor as described in 1.14.

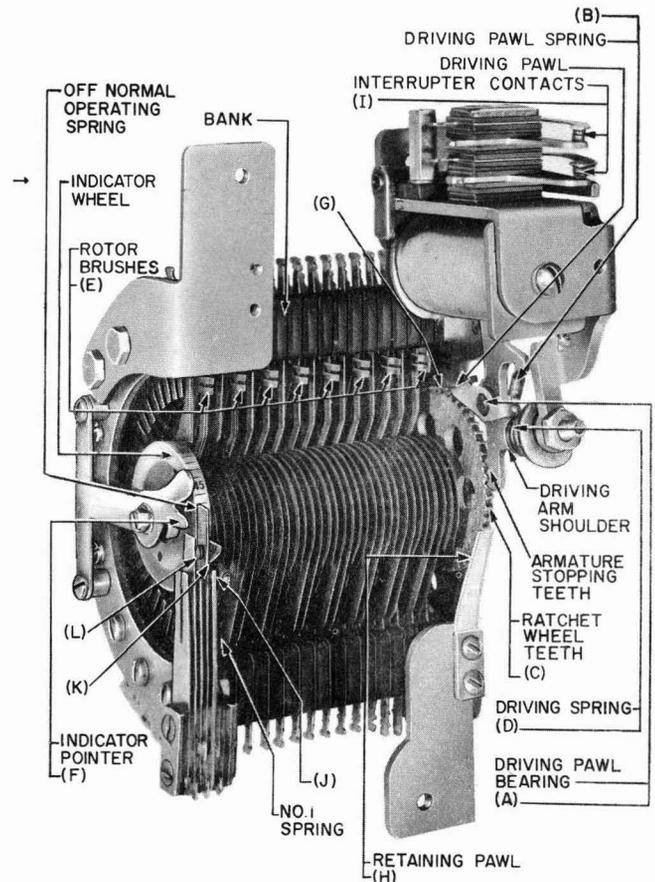


Fig. 2 — KS-16563, List 1 and 2 Selectors—Front View—KS-16563, List 1 Selector Shown

2.07 Rotor Brush Follow: When the mating brush is deflected, the follow at the tip of each rotor brush shall be:

(a) KS-16201, KS-16202, and KS-16203 Selectors

Bridging and nonbridging brushes 9/64 inch

Gauge by eye.

The slotted end of the driving spring adjusting screw is approximately 3/32 inch in diameter.

(b) KS-16563 Selectors

Bridging Brushes 1/8 inch

Nonbridging brushes 3/32 inch

Gauge by eye.

The space between two brush springs of a pair (separated by a metal spacer) is approximately 1/16 inch.

To check this requirement, step the selector to bring each set of rotor brushes successively in an accessible position away from the bank. Deflect each rotor brush with the KS-6320 orange stick and observe the follow of the mating brush.

2.08 Clearance Between Adjacent Pairs of Rotor Brushes: Fig. 6(C)—The clearance between adjacent pairs of rotor brushes when the tips of the rotor brushes are resting on the feeder brushes shall be

Min. 1/32 inch

Gauge by eye.

The combined thickness of a pair of feeder brushes is approximately 1/64 inch.

Checking this requirement will be facilitated by the use of the No. 510C portable lamp and W2BL cord.

2.09 Clearance Between Rotor Brush Springs and Feeder Brush Springs: There shall be a clearance between the rotor brush springs and their associated feeder brush springs and also between the rotor brush stubs (from which the spring tips have been removed—KS-16563 selectors) and their adjacent feeder brush springs of

Min. 1/64 inch

The combined thickness of a pair of feeder brushes is approximately 1/64 inch.

Check for this requirement on KS-16201, KS-16202; and KS-16203 selectors with each lobe of the indicator wheel successively in line with the pointer at the front of the selector; on KS-16563 selectors with the rotor at the 20th and 45th position as shown by the indicator wheel.

2.10 Rotor Brush Alignment: Fig. 1(D) and Fig. 2(E)—The tips of the rotor brushes shall be aligned so that they will enter onto the base of the feeder brushes with a movement to one side or the other no greater than

1/64 inch

Gauge by eye.

The combined thickness of a pair of feeder brushes is approximately 1/64 inch.

To check this requirement, successively set the rotor in a position where each set of rotor brushes is about to pass onto the feeder brushes and observe whether the tips of each pair of rotor brushes line up with the associated feeder brushes within the specified limit.

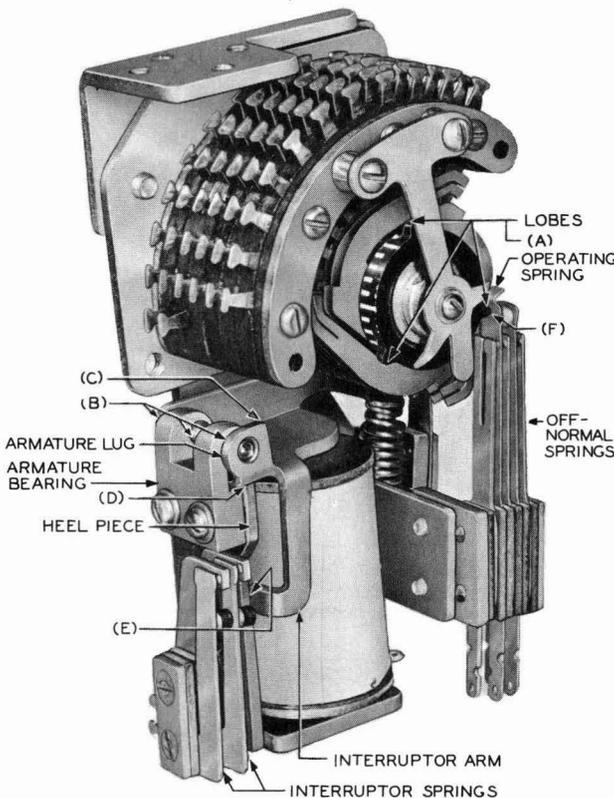
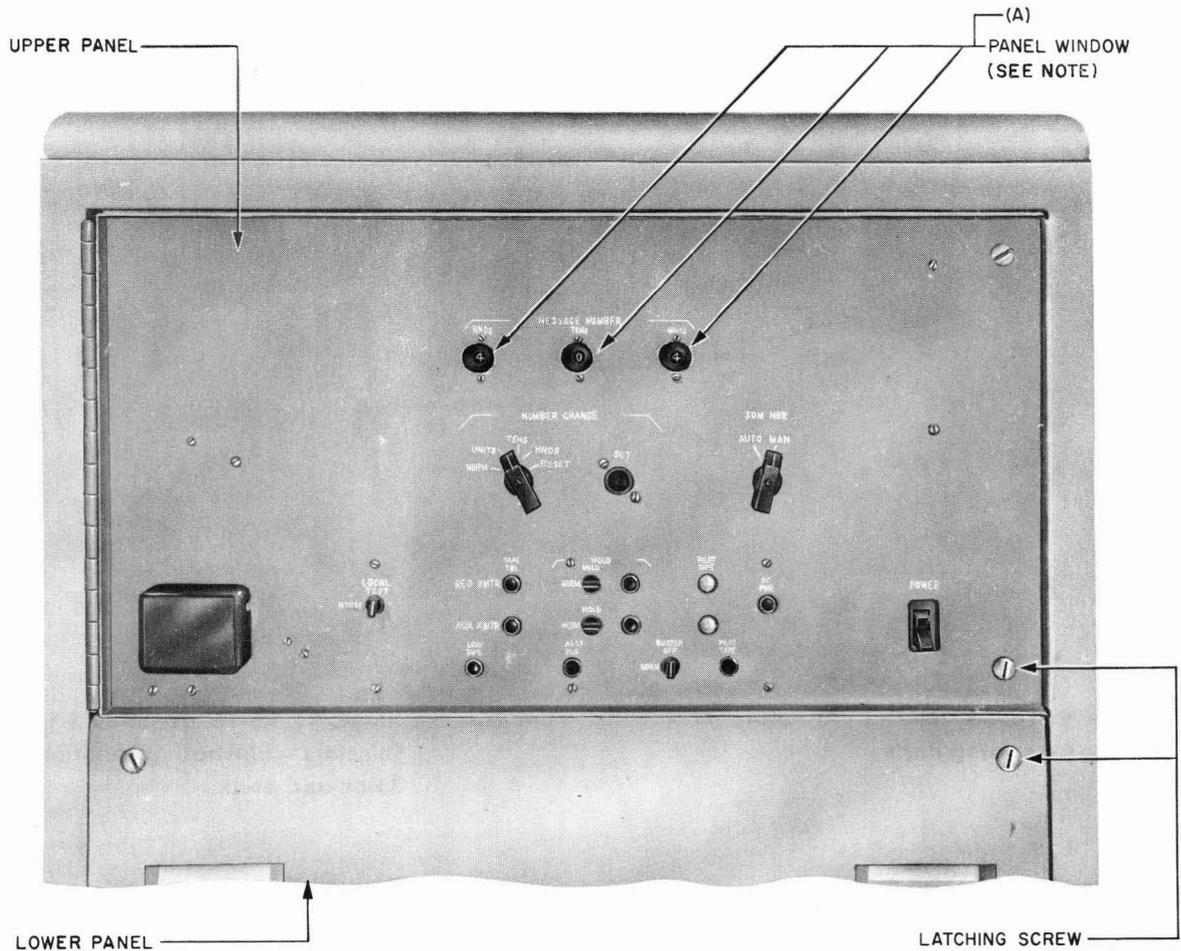


Fig. 3 — KS-16201, KS-16202, and KS-16203 Selectors — Rear View — KS-16201 Selector Shown



NOTE: NUMERALS ON INDEX WHEELS OF KS-16203 SELECTORS APPEAR IN PANEL WINDOWS.

Fig. 4 — Equipment Control Panel with KS-16203 Selectors

2.11 Indicator Pointer Position (KS-16201, KS-16202, and KS-16563 selectors only): Fig. 1(F) and 2(F)—The indicator pointer shall point to the line or number on the indicator wheel corresponding to the bank contacts on which the rotor brushes are resting.

Gauge by eye.

2.12 Freedom of Movement of Armature: Fig. 3(C) and 5(B)—The armature shall not bind in its bearings.

Gauge by feel.

To check, step the selector so that one set of rotor brushes rests on the third row of terminals. Attempt to move the armature from side to side by applying the KS-6320 orange stick to each side of the armature lug. Observe whether the armature moves freely.

2.13 Clearance Between Armature and Heelpiece: Fig. 3(D) and 5(C)—The clearance between the armature and the heelpiece with the armature electrically operated shall be

Min. 0.0015 inch

Max. 0.003 inch

Use the No. 92P and 92R gauges.

2.14 Position of Driving Pawl and Armature Stopping Teeth

(a) The sides of the driving pawl along its length shall be parallel with the sides of the ratchet wheel.

Gauge by eye.

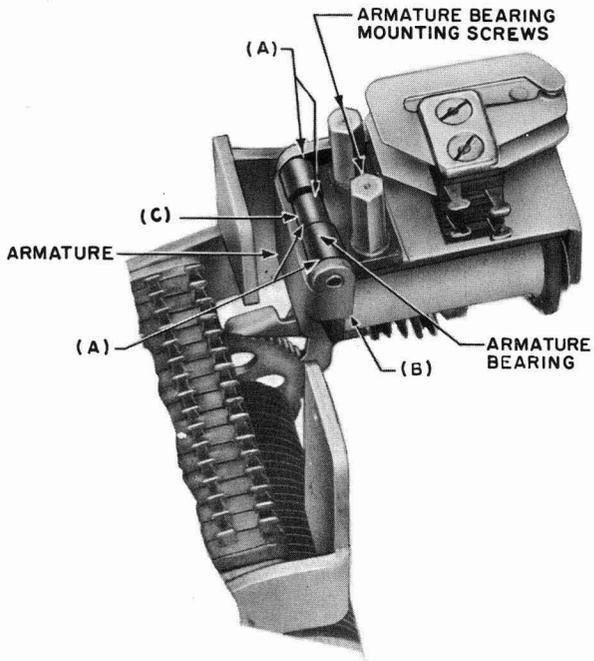


Fig. 5 – KS-16563 Selector—Armature and Associated Parts

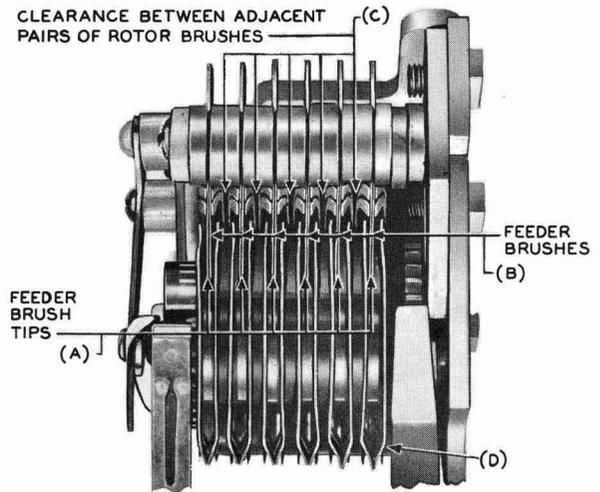


Fig. 6 – KS-16201, KS-16202, and KS-16203 Type Selectors – Illustrating Relation Between Rotor and Bank

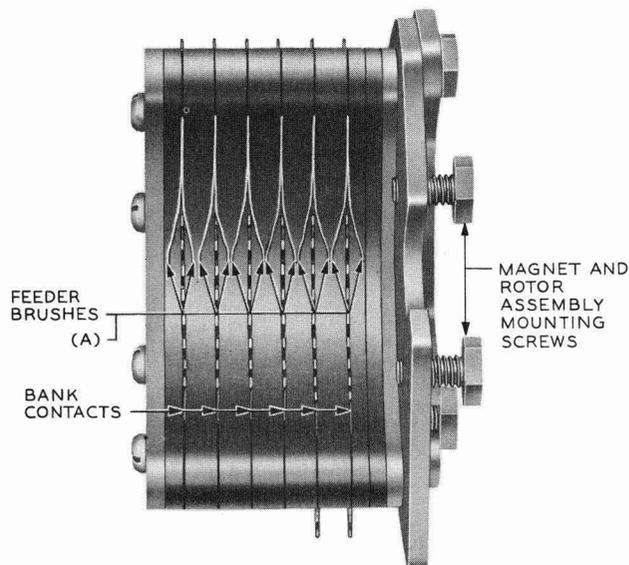


Fig. 7 – KS-16201, KS-16202, and KS-16203 Type Selectors – Bank Showing Feeder Brushes

(b) The tip of the driving pawl shall be parallel to the edge of the ratchet teeth.

Gauge by eye.

(c) The driving pawl shall engage the full width of the ratchet teeth.

Gauge by eye.

This requirement shall be met in any position of the pawl permitted by play in the armature and pawl bearings.

(d) The armature stopping teeth shall not extend more than

1/64 inch

beyond either edge of the ratchet teeth.

Gauge by eye.

This requirement shall be met in any position of the armature stopping teeth permitted by play in the armature bearings.

2.15 Driving Pawl and Driving Pawl Spring Clearance With Adjacent Rotor Brush:

Fig. 1(G)—(KS-16201, KS-16202, and KS-16203 Selectors)—The driving pawl and driving pawl spring shall clear the adjacent rotor brush in any position of the rotor by

1/32 inch

Gauge by eye.

The diameter of the driving spring wire is approximately 1/32 inch.

2.16 Interrupter Arm Position: Fig. 3(E)—(KS-16201, KS-16202, and KS-16203 Selectors)—With the selector electrically operated, the portion of the interrupter arm which actuates the interrupter springs shall clear the heelpiece by

Min. 0.010 inch

Gauge by eye.

The rotor brushes are 0.010 inch thick.

2.17 Freedom of Movement of Driving Pawl:

The driving pawl shall not bind in its bearings.

Gauge by eye.

To check, manually take up the play of the rotor in the direction of rotation, and then move the

pawl away from the ratchet wheel with the KS-6320 orange stick. Note whether the pawl returns to the ratchet wheel without binding when the orange stick is removed.

2.18 Driving Pawl Spring Tension: Fig. 1(H) and 2(G)—The tip of the driving pawl shall rest against the ratchet wheel with a pressure of

	KS-16201, KS-16202, KS-16203 SELECTORS		KS-16563 SELECTORS	
	GRAMS		GRAMS	
	MIN.	MAX.	MIN.	MAX.
Test	120	185	120	160
Readjust	130	175	130	150

Use the No. 79C or 62B gauge.

To check, manually move the rotor to take up the play in the direction of rotation away from the pawl tip and apply the gauge as close as possible to the tip of the pawl.

2.19 Clearance of Retaining Pawl With Driving Arm and Driving Pawl: (KS-16201, KS-16202, and KS-16203 Selectors)—With the armature in the unoperated position, the retaining pawl shall clear the armature and driving pawl by

1/32 inch

Gauge by eye.

The diameter of the driving spring wire is approximately 1/32 inch.

2.20 Retaining Pawl Tension: Fig. 1(I) and 2(H)—The tension of the retaining pawl against the ratchet wheel teeth measured at the tip of the pawl shall be

	GRAMS	
	MIN.	MAX.
Test	70	130
Readjust	75	125

Use the No. 70J or 79C gauge.

2.21 Retaining Pawl Position

(a) Fig. 1(I) and 2(H)—With the play in the rotor taken up in the direction opposite to rotor rotation and the armature in the unoperated position, there shall be a clearance between the tip of the retaining pawl and the radial face

of the ratchet tooth but this clearance shall not exceed

0.003 inch

Use the No. 92P gauge.

(b) Fig. 1(I) and 2(H)—The tip of the retaining pawl shall be parallel to the edge of the ratchet teeth and shall engage the full width of the ratchet wheel.

Gauge by eye.

(c) Fig. 6(D) — (KS-16201, KS-16202, and KS-16203 Selectors)—The retaining pawl shall clear the adjacent rotor brush during rotation by

1/32 inch

Gauge by eye.

The diameter of the driving spring wire is approximately 1/32 inch.

2.22 Position of Rotor Brushes on Bank Contacts:

(a) **Nonbridging Brushes** — Fig. 8(A) — With the armature in the unoperated position, the contacting edge of the tips of the brushes shall rest on the center third of the bank contacts.

Gauge by eye using the No. 510C portable lamp with W2BL cord, and the No. 376A dental mirror.

To check this requirement, step the selector so that one set of rotor brushes rests on the first row of bank contacts (adjacent to feeder brushes) and check the position of the No. 1 brush on the bank contact. Then step the selector until the rotor brushes rest on the last row of contacts and check the position of the No. 1 brush on the bank contact.

(b) **Bridging Brushes**—(KS-16563 Selectors) —With the armature in the unoperated position, the trailing edge of the bridging brushes shall be in alignment with the front edge of the bank contacts within

1/64 inch

Gauge by eye using the No. 510C portable lamp with W2BL cord.

The thickness of a pair of feeder brushes is 1/64 inch.

To check this requirement, step the selector so that successively each set of bridging brushes rests on the first row of bank contacts (adjacent to feeder brushes). Then step the selector so that the bridging brushes rest on the last row of contacts.

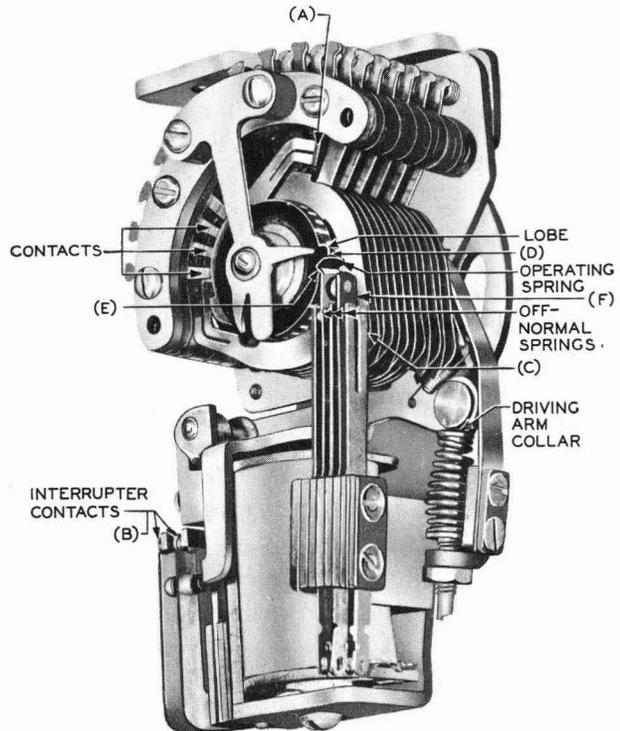


Fig. 8 — KS-16201, KS-16202, and KS-16203 Type Selectors — Side View (Left Side) — KS-16201 Selector Shown

(c) **Bridging Brushes** (KS-16201, KS-16202, and KS-16203 Selectors)—With the armature in the unoperated position, the flat tips of the bridging brushes shall be centered on the bank contacts within

1/64 inch

Gauge by eye.

The combined thickness of a pair of feeder brushes is 1/64 inch.

To check this requirement, step the selector so that successively each set of bridging brushes rests on the first row of bank contacts (adjacent to feeder brushes). Then step the selector

so that the bridging brushes rest on the last row of contacts.

2.23 Electrical Requirements: The selector shall meet the electrical requirements specified on the circuit requirement table.

2.24 Driving Spring Pressure: The driving spring pressure shall be such that when the armature is operated it shall return to its unoperated position when retarded manually.

Gauge by eye and feel.

To check this requirement, step the selector so that one set of rotor brushes is one step in front of the feeder brushes. This will give maximum rotor brush load for checking the requirement. Operate the armature by engaging the shoulder on the driving arm with the No. 207 offset screwdriver. Then slowly remove pressure against the driving arm shoulder and observe whether the armature returns to its unoperated position as the pressure is completely removed. Check this requirement for each set of rotor brush tips.

2.25 Interrupter Contact Alignment: Fig. 8(B) and 2(I)—The interrupter contacts shall not be out of alignment more than

40 per cent of base diameter (KS-16201, KS-16202, KS-16203)

20 per cent of face diameter (KS-16563)

Gauge by eye.

2.26 Interrupter Contact Make and Break: Fig. 2(I) and 8(B)

(a) **Interrupter Contacts Not Used for Self Stepping of Selector**—With the selector electrically energized against a gauge of the thickness specified below inserted between the armature and the core, the following conditions shall be met.

(1) All normally open contacts shall be open and all normally closed contacts shall be closed with the following gauges

Test 0.006 inch
Readjust 0.005 inch

Use the KS-6909 gauge inserted to the center of the core.

(2) All normally open contacts shall be closed and all normally closed contacts shall be open with the following gauges

Test 0.002 inch
Readjust 0.003 inch

Use the KS-6909 gauge inserted to the center of the core.

(b) **Interrupter Contacts Used for Self Stepping of Selector**—The interrupter contacts shall meet the contact make and break requirements covered by (a) except that deviations may be made from the limits specified for contact break, if necessary, to meet requirement 2.28.

Note: If the selector is equipped with two pairs of break contacts, the outer pair is used for self stepping when the selector is required to operate in that manner.

2.27 Interrupter Spring Contact Pressure: The pressure of normally closed (NC) interrupter spring contacts shall be:

(a) Selectors having one pair of NC contacts

	GRAMS	
	MIN.	MAX.
Test	250	425
Readjust	275	400

(b) Selectors having two pairs of NC contacts

	GRAMS (EACH PAIR)	
	MIN.	MAX.
Test	125	225
Readjust	150	200

Use the No. 62B or 79B gauge.

2.28 Interrupter Contact Test: The selector shall operate smoothly and uniformly on maximum 45 volts.

Use the No. 35D or 35F test set as covered in 3.004.

2.29 Mounting of Off-normal Springs
KS-16201, KS-16202, and KS-16203 Selectors

(a) The off-normal springs shall be mounted so that the longitudinal edges of the springs are parallel to the portion of the

selector frame in which the rotor shaft is mounted.

Gauge by eye.

(b) Fig. 8(C)—The off-normal springs shall clear the adjacent rotor brushes by

Min. 1/32 inch

Gauge by eye.

The wire of the driving spring is approximately 1/32 inch in diameter.

(c) Fig. 8(D)—The width of the operating spring shall be centered with respect to the width of the lobes of the indicator wheel within

1/32 inch

Gauge by eye.

The wire of the driving spring is approximately 1/32 inch in diameter.

(d) Fig. 9(A)—With one set of rotor brushes resting on the feeder brushes, the apex of the V section of the operating spring and the lobe of the indicator wheel shall be centered within

0.020 inch

Gauge by eye.

The thickness of the operating spring is 0.010 inch.

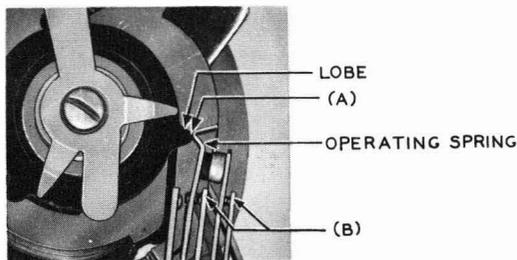


Fig. 9 — KS-16201, KS-16202, and KS-16203 Type Selectors — Showing Indicator Wheel and Operating Spring

(e) Fig. 3(F)—With the rotor brushes in a position immediately preceding and immediately following the position in which the indicator wheel lobes operate the off-normal springs, and with the rotor play taken up in either direction, the V section of the operating

spring shall clear the lobe by

0.010 inch

Gauge by eye.

The operating spring is 0.010 inch thick.

KS-16563 Selectors

(f) With the rotor in the position in which the off-normal springs are operated, the following requirements shall be met.

(1) The apex of the V section of the operating spring shall be aligned with the center line of the actuating bushing within

0.020 inch

Gauge by eye.

The thickness of the operating spring is 0.010 inch.

(2) The actuating bushing shall overlap both edges of the V section of the operating spring by

Min. 0.030 inch

Gauge by eye.

The thickness of the operating spring is 0.010 inch.

(g) With the rotor in the positions immediately preceding and immediately following the position in which the off-normal springs are operated and with the play in the rotor taken up in the direction toward the V section of the operating spring, the off-normal arm actuating bushing shall clear the V section of the operating spring by

Min. 0.010 inch

Gauge by eye.

The operating spring is 0.010 inch thick.

2.30 Clearance Between Off-normal Actuating Arm and No. 1 Spring of Off-normal Spring Assembly (KS-16563 Selector) Fig. 2(J)

(a) With the rotor in positions where the off-normal actuating arm is adjacent to the No. 1 off-normal contact spring and with the play in the rotor taken up toward the off-normal springs, the bushing shall clear the No. 1 spring by

Min. 0.015 inch

Gauge by eye.

The operating spring is 0.010 inch thick.

2.31 Clearance Between Off-normal Operating Spring and Indicator Wheel: (KS-16201, KS-16202, and KS-16203 Selectors) Fig. 8(E)—The V section of the off-normal spring shall clear the indicator wheel except in the positions of the rotor where the indicator wheel lobes operate the off-normal springs.

Gauge by eye.

2.32 Off-normal Spring Tension and Contact Pressure

(a) With the off-normal springs unoperated, the following requirements shall be met.

(1) Fig. 1(J) and 2(K)—The combined tension of the movable contact springs measured at the inner end of the V section of the operating spring shall be

	GRAMS	
	MIN.	MAX.
Test	30	55
Readjust	35	50

Use the No. 70J or 79C gauge.

(2) Fig. 2(L) and 8(F)—The tension of the outer movable contact spring against the operating spring measured at the inner side of the stud shall be

	GRAMS	
	MIN.	MAX.
Test	20	40
Readjust	25	35

Use the No. 70J or 79C gauge.

(b) Fig. 9(B)—With the off-normal springs operated, the pressure of the normally open contacts shall be

Min. 30 grams

Use the No. 70J or 79C gauge.

To check this requirement, loop a piece of linen thread around both bifurcations of the spring to be checked just behind the contacts and engage the loop with the pull finger of the gauge.

2.33 Contact Separation of Off-normal Springs:

The contact separation between each pair of normally open contacts and between each pair of contacts that are opened when the operating spring is operated shall be

Min. 0.008 inch

Use the KS-6909 gauge.

3. ADJUSTING PROCEDURES

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

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
206	Offset Screwdriver
207	Offset Screwdriver
245	Wrench
303	Spring Adjuster
353C	
(2 reqd)	Grease Gun
359	Cleaning Tool
363	Spring Adjuster
371	Spring Adjuster
376A	Dental Mirror
417A	Wrench
418A	Wrench
510C	Portable Lamp Equipped with W2BL Cord
570A	Nozzle
571A	Nozzle
KS-6320	Orange Stick
→KS-6367	Wrench
→R-5850	Wrench
KS-8511	Tweezers
KS-14164	Brush
—	3-inch Cabinet Screwdriver
→—	4-inch Regular Screwdriver
GAUGES	
62B	0-700 Gram Gauge
70J	0-150 Gram Gauge
79B	0-1000 Gram Push-pull Tension Gauge
79C	0-200 Gram Push-pull Tension Gauge
92P	0.003-inch Thickness Gauge
92R	0.0015-inch Thickness Gauge
92S	0.002-inch Thickness Gauge
KS-6909	Thickness Gauge Nest
MATERIALS	
KS-2423	Cloth
KS-6232	Oil
KS-6542	Dry Cell
(6 reqd)	
KS-7188	Cleaning Paper
KS-7471	Grease
KS-7860	Petroleum Spirits
KS-8559	Lubricant
KS-13713	Contact Protectant
—	Pipe Cleaner
—	No. 6 Cable Lacing Twine
—	No. 25 Gray Linen Thread

CODE OR SPEC NO.	DESCRIPTION
TEST APPARATUS	
35D or 35F	Test Set
2P10B	Cord
2W17A	Cord (Must be equipped with
(2 reqd)	No. 365 tools)
or two No.	
1W13B cords	
may replace	
one of the No.	
2W17A cords)	

3.002 *Removing Selector Mechanism from Bank:*

(1) *KS-16201, KS-16202, and KS-16203 Selectors*—Remove the selector mechanism from the bank as follows. To facilitate removing the selector mechanism from the bank without snagging the rotor brushes, step the selector so that the tips of one set of rotor brushes are in a position one step before passing the tip of the retaining pawl. Place a KS-2423 cloth directly below the selector to catch parts which may be dropped. Using the No. 206 and 207 offset screwdrivers, loosen the screws holding the off-normal spring assembly bracket on the frame. Remove the spring assembly from the frame and support it by the leads. Tag and disconnect the leads to the coil and interrupter springs. Except on the KS-16203 selector which has no shaft support bracket, remove the screws and bushings that mount the shaft support bracket to the bank, using the offset screwdrivers. Remove the screws mounting the selector mechanism on the bank frame using the No. 418A wrench. Carefully separate the selector mechanism from the bank and remove the assembly.

(2) *KS-16563 Selectors*—Remove the selector mechanism from the bank as follows. Step the selector so that one set of rotor brushes is one step in front of the feeder brushes. Loosen the off-normal spring assembly mounting screws with the No. 417A wrench and remove the spring assembly. Remove the shaft support bracket screws with the 3-inch cabinet screwdriver. Remove the shaft support and associated spacers. Using the No. 245 wrench, remove the shaft mounting nut at the right side of the selector. Using the No. 418A wrench, remove the two frame mounting nuts toward the front of the frame and loosen the third nut near the

rear of the frame. Remove the frame from the bank. Carefully disengage the upper portion of the rotor from the bank and remove the rotor.

3.003 *Mounting Selector Mechanism on the Bank:*

(1) *KS-16201, KS-16202, and KS-16203 Selectors*—Mount the selector mechanism on the bank as follows. To facilitate mounting the selector mechanism on the bank without snagging the rotor brushes, step the selector so that the tips of one set of rotor brushes are in a position four steps beyond the tip of the retaining pawl. With the selector mechanism frame against the outside of the bank frame and in approximately its correct position with respect to the bank, carefully engage the rotor brushes with the bank feeder brushes so that each pair of rotor brushes straddles its associated pair of feeder brushes. Position the selector mechanism with reference to the bank so that requirement 2.22 is met, and securely tighten the mounting screws using the No. 418A wrench. Mount the off-normal spring assembly and securely tighten the mounting screws using the No. 206 and 207 offset screwdrivers. Except on KS-16203 selectors, remount the screws and bushings that mount the shaft support bracket on the bank, using the offset screwdrivers. Reconnect the leads to the coil and interrupter springs.

(2) *KS-16563 Selectors*—Mount the selector mechanism on the bank as follows. Hold the rotor in front of the bank with the indicator wheel at the left and the off-normal actuating arm toward the bank. Align the brush at the right end of the rotor with the proper feeder brush from the right side of the bank and the other brushes in this group with their associated feeder brushes. Carefully engage these rotor brushes with the feeder brushes so that each pair of rotor brushes straddles its associated pair of feeder brushes. Move the rotor toward the bank so that the brushes engage the brush terminals and engage the remaining feeder brushes with the rotor as follows. Carefully move the rotor so that the remaining pairs of feeder brushes lie between the associated rotor brushes. Moving the rotor slightly from side to side will facilitate properly engaging the feeder brushes. Then rotate and move the

rotor to its proper radial position with respect to the bank. Insert the shaft in the rotor with the head of the shaft at the right. Position the frame against the right side of the bank with the rotor shaft in the frame notch and the driving pawl and armature stopping teeth engaging the rotor ratchet wheel teeth. Place the washers and nuts on the bank screws and the nut on the rotor shaft and tighten the nuts with the No. 418A and 245 wrenches. Mount the shaft support bracket on the spacers and secure the support to the shaft using the 3-inch cabinet screwdriver. Mount the off-normal spring assembly using the No. 417A wrench.

3.004 Using the No. 35D and 35F Test Sets

(1) **Connection to Battery and Ground:** Connect battery and ground to the test set shown in Fig. 10 by inserting the No. 310 plug on one end of the No. 2W17A cord into the

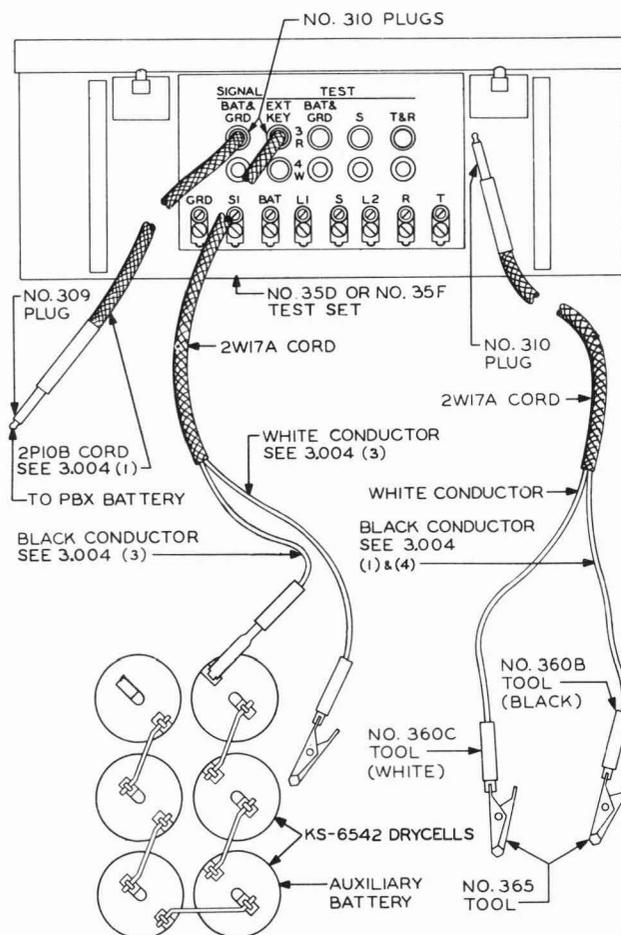


Fig. 10 — Method of Connecting No. 35D or 35F Test Set

SIGNAL BATT & GRD jack in the test set and connecting the No. 360B tool (black shell) and No. 360C tool (white shell) on the other end of the cord to ground and battery supplies, respectively, on a test connecting block or fuse panel. If a jack having a battery and ground supply is available, use a No. 2P10B cord and insert the No. 309 plug into this jack and the No. 310 plug into the SIGNAL BATT & GRD jacks in the test set. Two No. 1W13B cords with the No. 364 tools at one end and No. 365 tools at the other end may be used instead of the No. 2W17A or 2P10B cords, in which case, connect battery and ground to the BATT and GRD terminals, respectively, of the test set.

Note: To avoid possible grounding of the battery supply lead, connect the cord to the test set first and when disconnecting, remove the cord from the test set last.

(2) **Preparation of Keys, Switches, and Sliders:** Operate the G knife switch to GRD and operate the BATT and GRDCO key. Move the sliders of the No. 3 rheostat to the extreme left to remove all resistance.

(3) **Connection of Auxiliary Battery to Test Set:** Connect the black (ring) conductor of the No. 2W17A cord to the negative (—) terminal of the auxiliary battery and insert the cord into the TEST EXT KEY 3R jack. Connect the white (tip) conductor to the positive (+) terminal of the auxiliary battery. It may be necessary to shift this conductor from cell to cell, as described in (4), to obtain the proper voltage.

(4) **Voltage and Self-stepping Test:** With the test set connected as described in (1), (2), and (3), proceed as follows. Plug a No. 2W17A cord into the TEST T & R jack of the test set and connect the white (tip) conductor to terminal 2 of the selector magnet and the black (ring) conductor to terminal 1. Operate the VM, 75 VOLTS and No. 3 key and read the voltage. Release the No. 3 key and shift the white conductor on the dry cell terminals as required until the voltage is not more than 46.5 volts. Reoperate the No. 3 key and adjust the sliders of the No. 3 rheostat to obtain 45 volts. With the No. 3 key released, shift the black (ring) conductor to the point in the circuit where the test note on the circuit requirement table for

selector self stepping states that the ground should be connected. Operate and hold the No. 3 key or close the locking switch. The selector should then self step (rotate) under control of its interrupter contacts.

(5) **Checking Condition of Individual Dry Cells Used in Auxiliary Battery:** To check the condition of the individual dry cells used in the auxiliary battery, operate the BAT & GRDCO key and the VM key. Place the REV key in normal position and the G switch in open position. Move all sliders to the extreme right. Plug the No. 2W17A cord into the T & R jack. Connect the black conductor of the No. 2W17A cord to the positive (+) terminal and the white conductor of the cord to the negative (-) terminal of the individual dry cell. Operate the telegraph key and read the voltage. If the voltage is less than 0.55 volt, the dry cell is unfit for further use.

3.01 *Cleaning* (Reqt 2.01)

(1) **Ratchet Wheel Teeth and Armature and Driving Pawl Bearings:** If upon inspection there is found to be an accumulation of gummy oil or foreign matter on the ratchet wheel teeth or armature and pawl bearings, apply KS-7860 petroleum spirits very sparingly with the KS-14164 No. 4 artist's show card brush to soften this matter so that it may be removed. Allow the wearing parts of the selector, such as the ratchet wheel and armature bearings to dry and then lubricate them as covered in 3.02.

(2) **Magnet Core and Armature:** Insert the No. 359 cleaning tool between the armature and core and apply sufficient pressure with the No. 207 offset screwdriver against the shoulder on the armature arm to hold the armature against the cleaning tool. Then forcibly withdraw the cleaning tool. Repeat this operation several times, using first one flat surface of the tool and then the other, to remove dust or other foreign matter that may have accumulated on the armature or core.

Note: If a new No. 359 cleaning tool is to be used, check whether the tool is covered with a protective film of oil. If this condition exists, remove the film with KS-7860 petroleum spirits applied on a KS-2423 cloth. Then wipe the tool with a dry KS-2423 cloth.

(3) **Interrupter and Off-normal Contacts:**
Clean the contacts as covered in Section 022-100-811.

Rotor Bearing and Shaft

(4) Remove the selector mechanism from the bank as described in 3.002. Remove the rotor from the shaft. Clean the rotor shaft by wiping it with a clean KS-2423 cloth moistened with KS-7860 petroleum spirits. Then wipe the shaft with a dry, clean KS-2423 cloth.

(5) Remove the lubricant from the bearing hole in the rotor as follows, using a pipe cleaner. Dip one end of the pipe cleaner in KS-7860 petroleum spirits and, after allowing the excess to drain off, insert the saturated end of the cleaner into the hole. Work the cleaner back and forth a few times to loosen the old lubricant; then draw the entire cleaner slowly through the hole so that the dry portion of the cleaner will remove the excess petroleum spirits. Remove any lint in the hole by blowing through it.

(6) Lubricate the rotor shaft as covered in 3.02.

(7) Lift the retaining and driving pawls with the KS-6320 orange stick and slide the rotor on the shaft. Release the pawls so they engage the ratchet teeth. Then move the armature toward the core by pressing against the driving arm shoulder with the No. 207 offset screwdriver and slide the rotor further on the shaft until the stop teeth on the driving arm engage the ratchet teeth. Refer to Fig. 11. Mount the magnet and rotor assembly as described in 3.003.

3.02 *Lubrication* (Reqt 2.02)

(1) To lubricate the rotor bearing and shaft, remove the rotor following the procedure in 3.01(4) and (5). Apply the specified quantity of lubricant to the shaft. Remount the parts as covered in 3.01(7).

(2) Apply the specified quantity of lubricant to the armature bearings.

(3) Apply the specified quantity of lubricant to the pawl bearing and to both ends of the pawl spring.

(4) Before lubricating the ratchet teeth clean them, if necessary, as covered in 3.01(1).

Apply about one-quarter of the specified quantity of grease over two or three teeth. (The ratchet wheel is 3/32 inch wide.) Step the selector about 1/4 revolution and apply a similar quantity of grease. Continue in this manner until the specified quantity of grease is applied. This will insure that the grease is evenly distributed over the ratchet wheel teeth.

- (5) Apply the specified quantity of lubricant to the indicating wheel lobes.
- (6) Apply the specified quantity of lubricant to the rotor brushes.
- (7) To apply contact protectant to the feeder brush tips, place the specified quantity of protectant on the rotor hub between each pair of rotor brushes in one position of the rotor. Step the selector one revolution as described in 1.15. Since the feeder brushes contact the inner surface of the rotor brushes close to the hub, this will distribute the contact protectant over the feeder brush tips.
- (8) Distribute the specified quantity of lubricant between the two end turns of the driving spring at each end of the spring.

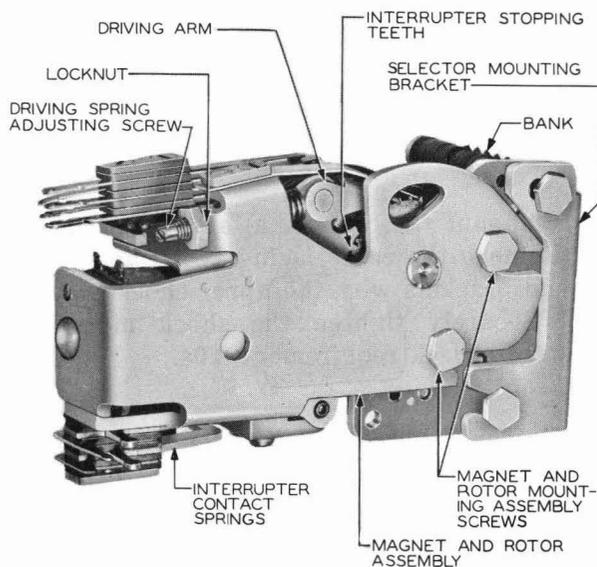


Fig. 11 - KS-16201, KS-16202, and KS-16203 Type Selectors - Side View - (Right Side)

3.03 Selector Mounting (Reqt 2.03) ↗

- (1) Tighten loose mounting screws with the 4-inch regular screwdriver. ↘

3.04 Alignment of Index Wheel (Reqt 2.04) ↗

(1) If the requirement is not met, swing the upper panel of the equipment cabinet outward to gain access to the selector. To do this, first remove the lower panel by turning the latching screws counterclockwise with the 4-inch regular screwdriver and lifting the panel out of the cabinet. Then turn the latching screws of the upper panel counterclockwise and swing the panel outward.

(2) If distortion of the index wheel is the cause of failure to meet the requirement, carefully straighten the wheel with the fingers. Do not exert any force on the wheel which would tend to rotate it.

(3) If the alignment of all index wheels on selectors on the panel is off in the same direction, slightly loosen the screws at each end of the selector mounting bar (Fig. 12) using the 4-inch regular screwdriver. Shift the bar as required and securely tighten the screws.

(4) If the requirement cannot be met by repositioning the mounting bar as covered in (3), slightly loosen the screws of the selector mounting bracket (Fig. 12) using the 4-inch regular screwdriver. Shift the bracket on the mounting bar as required and securely tighten the screws.

(5) If the requirement still is not met, slightly loosen the selector mounting screws (Fig. 12) using the No. 418A wrench. Shift the selector on the mounting bracket as required and securely tighten the screws.

(6) In most cases satisfactory alignment of the index wheel can be obtained by the above procedures. In a few cases, however, it may be necessary to reposition the index wheel on the rotor assembly as covered in (7) through (10). If this is necessary, take care not to loosen the rotor assembly; see procedure (9).

(7) Using the 4-inch regular screwdriver, slightly loosen the screw of the lower shock mounting at each end of the panel and remove the screws from the upper shock mountings. Swing the selectors downward and support them by tying one of the end brackets with No. 6 cable lacing twine as shown in Fig. 13. Make sure that the mounting bar does not touch the terminal strip at the end of the panel. ↘

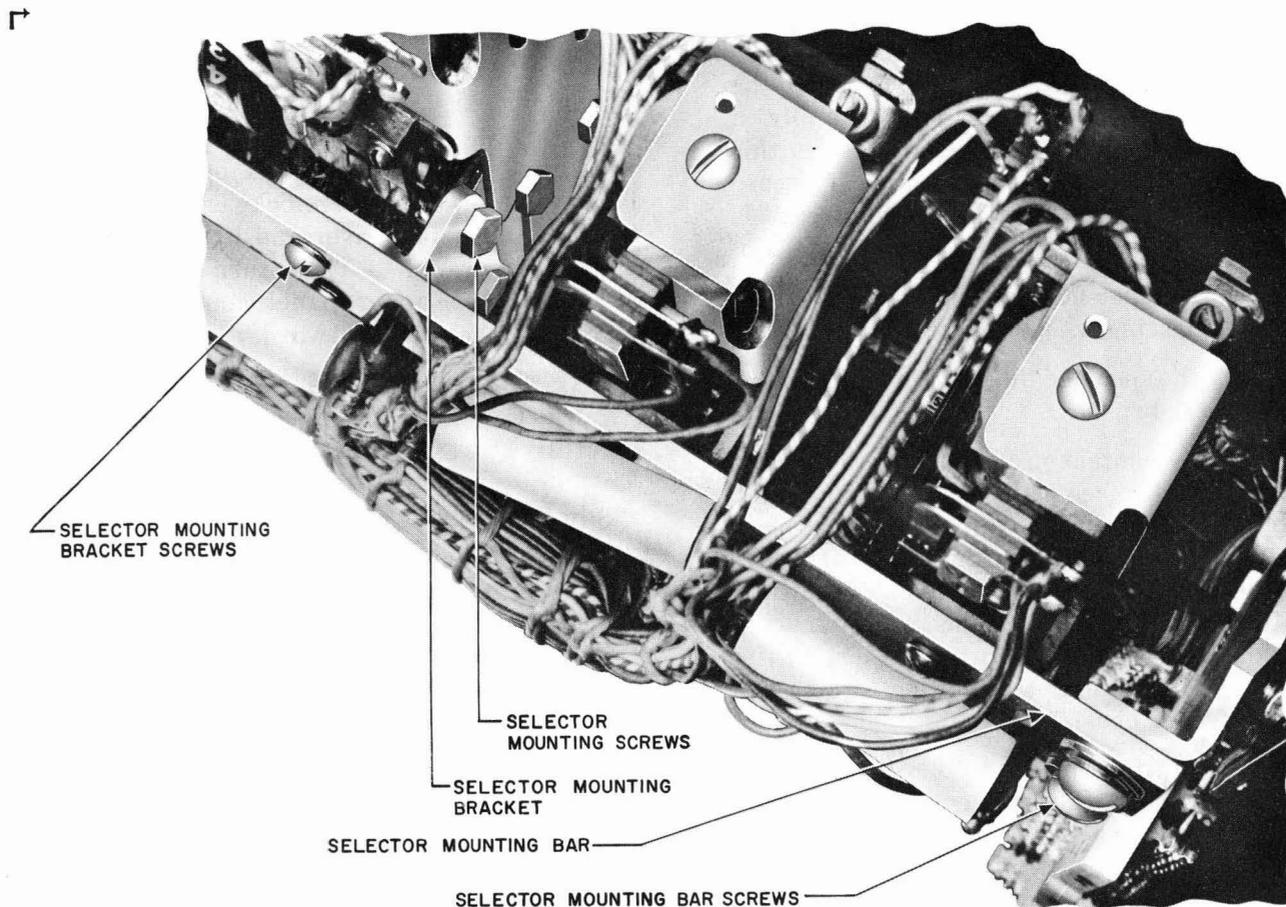


Fig. 12 — Mounting of KS-16203, List 2 Selector on Control Cabinet

(8) Loosen the off-normal spring assembly mounting screws with the 3-inch cabinet screwdriver and remove the spring assembly, carefully supporting it by its leads.

(9) Engage the rotor assembly clamping bushing with the R-5850 wrench, and the index wheel clamping bushing with the KS-6367 wrench as shown in Fig. 13. Exert slight upward pressure on the R-5850 wrench to prevent loosening of the rotor assembly, press a finger against the rim of the index wheel to prevent its turning, and slightly loosen the index wheel bushing by moving the KS-6367 wrench downward. Reposition the index wheel to meet the requirement. Then, exert slight downward pressure on the R-5850 wrench, press a finger against the rim of the index wheel, and securely tighten the index wheel bushing by moving the KS-6367 wrench upward.

(10) Remount the off-normal spring assembly. Remove the cable lacing twine and align the end brackets with the upper shock mountings. Securely tighten the shock mounting screws. Recheck requirement 2.04.

3.05 Feeder Brush Position and Tension (Req 2.05)

- (1) If the requirement is not met, remove the selector mechanism as covered in 3.002.
- (2) If the two springs of a pair of feeder brushes do not lie flat against each other along the required length, proceed as follows. Straighten this length of the individual springs, if necessary, using the No. 363 spring adjuster. Then apply the adjuster over the two springs and work the adjuster along the springs to bring them into contact.

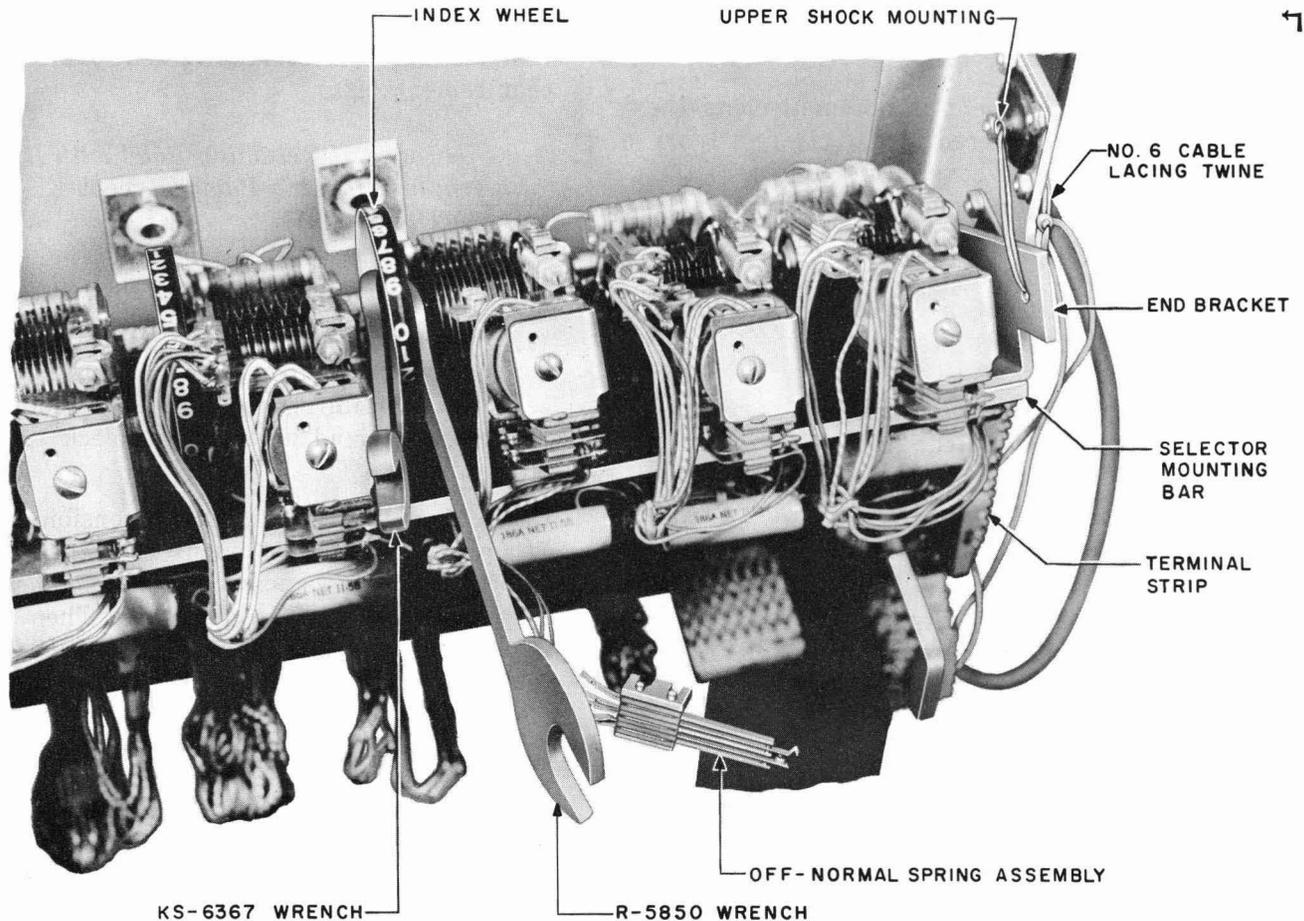


Fig. 13 — Repositioning of Index Wheel

(3) If the spring tension requirement is not met, place the No. 363 adjuster on the individual spring to be adjusted at the point where the two springs of the pair separate. Adjust the spring as required.

(4) Remount the selector mechanism as described in 3.003.

3.06 Freedom of Movement of Rotor (Reqt 2.06)

(1) If the rotor does not turn freely on the shaft, clean and lubricate the rotor and the shaft as covered in 3.01(4) through (7). If this does not correct the condition, refer the matter to the supervisor.

3.07 Rotor Brush Follow (Reqt 2.07)

3.08 Clearance Between Adjacent Pairs of Rotor Brushes (Reqt 2.08)

3.09 Clearance Between Rotor Brush Springs and Feeder Brush Springs (Reqt 2.09)

3.10 Rotor Brush Alignment (Reqt 2.10)

(1) If any of the requirements are not met, adjust the rotor brush spring as required using the No. 363 adjuster. After adjusting for any one requirement, check the other related requirements.

3.11 Indicator Pointer Position (KS-16201, KS-16202, and KS-16563 selectors only) (Reqt 2.11)

(1) If the requirement is not met, refer the matter to the supervisor.

3.12 Freedom of Movement of Armature
(Reqt 2.12)

(1) If the requirement is not met, clean the bearings as covered in 3.01(1) and lubricate the bearings as covered in 3.02(2). If this does not correct the condition, refer the matter to the supervisor.

3.13 Clearance Between Armature and Heel-piece (Reqt 2.13)

3.14 Position of Driving Pawl and Armature Stopping Teeth (Reqt 2.14)

3.15 Driving Pawl and Driving Pawl Spring Clearance With Adjacent Rotor Brush
(Reqt 2.15)

3.16 Interrupter Arm Position (Reqt 2.16)

(1) If the requirements are not met, slightly loosen the armature bearing mounting screws with the 3-inch cabinet screwdriver (KS-16201, KS-16202, KS-16203 selectors) or the No. 417A wrench (KS-16563 selectors). Position the armature bearing so that the requirements are met. Insert the No. 92S (.002 inch) gauge between the armature and heel-piece, hold the armature against the gauge, and securely tighten the armature bearing mounting screws.

3.17 Freedom of Movement of Driving Pawl
(Reqt 2.17)

(1) If the requirement is not met, clean the pawl bearing as covered in 3.01(1). Lubricate the bearing as covered in 3.02(3). If this does not correct the condition, refer the matter to the supervisor.

3.18 Driving Pawl Spring Tension (Reqt 2.18)

(1) If the requirement is not met, unhook the spring at the pawl end using the KS-8511 tweezers. On the KS-16201, KS-16202, and KS-16203 selectors it will be necessary to first remove the retaining pawl using the 3-inch cabinet screwdriver. If the spring tension is above maximum, stretch the spring slightly. Hook the spring in the pawl and check the requirement. If this does not correct the condition or if the spring tension is below minimum, replace the spring. After the requirement is

met, if the retaining pawl has been removed, remount it to meet requirement 2.21. Check requirement 2.20.

3.19 Clearance of Retaining Pawl with Driving Arm and Driving Pawl (Except KS-16563 Selectors) (Reqt 2.19)

3.20 Retaining Pawl Tension (Reqt 2.20)

(1) To adjust the clearance of the retaining pawl with the armature and driving pawl, bend the retaining pawl as required using the No. 303 spring adjuster. Then check requirement 2.20.

(2) Adjust the retaining pawl tension by applying the No. 303 adjuster to the base of the pawl as near as possible to the point where the pawl is fastened to the frame. Then check requirement 2.19 except in the case of KS-16563 selectors.

3.21 Retaining Pawl Position (Reqt 2.21)

(1) If the requirements are not met, loosen the retaining pawl mounting screws with the 3-inch cabinet screwdriver. Position the pawl as required and securely tighten the screws. Check requirement 2.19 except on KS-16563 selectors, and check requirement 2.20.

3.22 Position of Rotor Brushes on Bank Contacts (Reqt 2.22)

(1) (KS-16201, KS-16202, and KS-16203 Selectors). If the requirement is not met, loosen the magnet and rotor assembly mounting screws with the No. 418A wrench, and shift the position of the magnet and rotor assembly with relation to the bank as required. Securely tighten the mounting screws.

(2) (KS-16563 Selectors)—If the requirement is not met, loosen the frame mounting nuts with the No. 418A wrench and shift the position of the bank with relation to the frame, as required. Securely tighten the mounting screws.

3.23 Electrical Requirements (Reqt 2.23)

3.24 Driving Spring Pressure (Reqt 2.24)

(1) If the requirements are not met, slightly increase or decrease the driving spring pressure as required. Loosen the adjusting

screw locknut with the No. 417A (KS-16563 selector) or No. 418A wrench (KS-16201, KS-16202, and KS-16203 selectors). To increase the spring pressure, turn the adjusting screw clockwise and to decrease the spring pressure, turn the adjusting screw counterclockwise using the 3-inch cabinet screwdriver or No. 206 or 207 offset screwdrivers. Tighten the locknut and check for requirements 2.23 and 2.24.

3.25 Interrupter Contact Alignment (Reqt 2.25)

(1) If the requirement is not met, slightly loosen the interrupter spring mounting screws with the 3-inch cabinet screwdriver and position the springs as required. Securely tighten the mounting screws. Check requirements 2.26, 2.27, and 2.28.

3.26 Interrupter Contact Make and Break (Reqt 2.26)

3.27 Interrupter Spring Contact Pressure (Reqt 2.27)

(1) To adjust for contact make or break, apply the No. 371 spring adjuster at the base of the stationary spring and adjust the spring as required. To adjust the contact pressure, apply the No. 303 adjuster near the base of the movable spring and adjust the spring as required.

3.28 Interrupter Contact Test (Reqt 2.28)

(1) If after requirement 2.24 is met, the selector does not step smoothly and uniformly on minimum voltage, proceed as follows. Using the No. 371 spring adjuster, adjust the stationary spring of the break spring combination to obtain smooth and uniform operation within the limits specified in 2.26. If there are two sets of break contact springs, adjust the outer set to obtain smooth and uniform operation of the selector.

3.29 Mounting of Off-normal Springs (Reqt 2.29)

(1) Slightly loosen the off-normal spring mounting bracket screws using the 3-inch cabinet screwdriver for the KS-16201, KS-16202, and KS-16203 selectors or the No. 417A wrench for the KS-16563 selectors and adjust the position of the spring assembly as required. Securely tighten the screws.

3.30 Clearance Between Off-normal Actuating Arm and No. 1 Spring of Off-normal Spring Assembly (KS-16563 Selectors) (Reqt 2.30)

3.31 Clearance Between Off-normal Operating Spring and Indicator Wheel (KS-16201, KS-16202, and KS-16203 Selectors) (Reqt 2.31)

3.32 Off-normal Spring Tension and Contact Pressure (Reqt 2.32)

3.33 Contact Separation of Off-normal Springs (Reqt 2.33)

(1) Adjust the springs as required using the No. 303 spring adjuster on No. 1 spring and the No. 363 spring adjuster on the other springs. Apply the adjuster at the base of the springs.

Reasons for Reissue

1. To add a requirement covering selector mounting (2.03).
2. To revise Fig. 2.
3. To add a requirement covering alignment of index wheel (2.04).
4. To add Fig. 4.
5. To revise the list of tools (3.001).
6. To add a procedure covering selector mounting (3.03).
7. To add procedures covering alignment of index wheel (3.04).
8. To add Fig. 12 and 13.