SELECTORS

60BA, 60BC, 60BP, 60BR, 66A, D-151294, AND D-175279

REQUIREMENTS AND ADJUSTING PROCEDURES

1. GENERAL

1.01 This section covers No. 60BA, 60BC, 60BP, 60BR, 66A, D-151294, and D-175279 selectors.

1.02 This section is reissued to revise the requirement for the engagement of holding pawl and ratchet wheel, to amplify and revise the requirement for contact spring position, and to revise the adjusting procedure for armature lever clearance. Detailed reasons for reissue will be found at the end of the section.

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

1.04 One drop of oil, for the purpose of this section, is the amount of oil released from a piece of No. 22 bare tinned copper wire after it has been dipped 1/16 inch into KS-6232 oil and quickly removed.

1.05 Before checking or readjusting to meet the requirements the equipment should be taken out of service in accordance with established procedures.
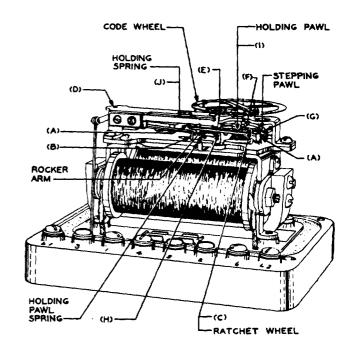
2. REQUIREMENTS

2.01 Cleaning: Parts shall be cleaned when necessary in accordance with the procedures covered in Part 3 of this section.

2.02 Lubrication

(a) The following parts shall be adequately lubricated with KS-6232 oil. When lubrication is necessary, one drop shall be applied to each of the following points.

   (1) Fig. 1(A) - The surfaces of the rocker arm which come in contact with the phosphor-bronze pins.

   (2) Fig. 1(B) - The side of the rounded end of the holding pawl which makes contact with the stud.

   (3) Fig. 1(C) - The teeth of the ratchet wheel.

   (4) Fig. 1(D) - The armature bearings.

NOTE— THE NOS. 66A AND D-175279 SELECTORS ARE THE SAME AS THE SELECTORS SHOWN ABOVE EXCEPT THEY HAVE TWO RINGING POSITION TERMINALS AND ARE DESIGNED FOR PLUG-IN CONNECTION BY MEANS OF A JACK ON THE UNDERSIDE OF THE BASE.

Fig. 1 - No. 60BA, 60BC, 60BP, 60BR, and D-151294 Selectors (See note)

(5) Fig. 1(E) - The rocker arm bearings.

(6) Fig. 1(F) - The ratchet wheel shaft bearings.

(7) Fig. 1(G) - The stepping pawl bearing pin.

(8) Fig. 1(H) - The holding pawl bearing.

(b) Recommended Lubrication Intervals:
After turnover, it is recommended
that the parts listed in (a) be lubrica-
ted at intervals of three months. This
interval may be extended if periodic in-
spections have indicated that local con-
ditions are such as to insure that
requirement (a) is met during the extended
interval.

2.03 Clearance Between Stepping Pawl and
Ratchet Wheel: Fig. 2(A) - With the
stepping pawl in the normal position, there
shall be a clearance between the stepping
pawl and the ratchet wheel of

Min 0.005 inch

Gauge by eye.

Rotate the ratchet wheel manually and check
that the requirement is met in all posi-
tions.

2.04 Stepping Pawl Position

(a) Fig. 2(B) - With the armature in the
normal position, the stepping pawl
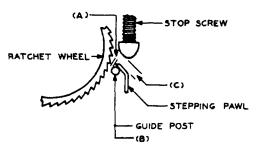shall rest against the guide post.

Gauge by eye.

(b) With the armature operated, the step-
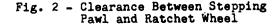ping pawl shall fully engage with the
teeth on the ratchet wheel.

2.05 Stepping Pawl Travel: Fig. 2(C) - The
total travel of the stepping pawl
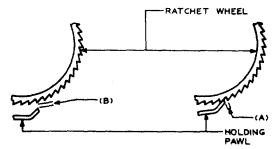(travel from the guide post to the stop
screw) shall be

Min 1-3/4 teeth of the ratchet wheel
Max 2 teeth of the ratchet wheel

Gauge by eye.

(a) To check, operate the armature man-
ually. With the stepping pawl rest-
ing against the stop screw hold the code
wheel and release the armature. The
stepping pawl will drop back against the
guide post. Gauge the distance between

Fig. 2 - Clearance Between Stepping
Pawl and Ratchet Wheel

Fig. 3 - Engagement of Holding Pawl
and Ratchet Wheel

the end of the stepping pawl and the
position of the tooth on the code wheel
which was advanced by the pawl. Release
the code wheel. Check the requirement
with the armature operated against each
pole piece in turn.

2.06 Engagement of Holding Pawl and Ratchet
Wheel

(a) Fig. 3(A) and 5 - With the ratchet
wheel normal, the holding pawl shall
fall reliably in the first tooth of the
ratchet wheel with a clearance of maxi-
mum 0.005 inch as the armature is oper-
ated toward the front magnet core. When
the armature is operated toward the rear
magnet core, this clearance shall be maxi-
mum 0.008 inch. Partially operate the
armature slowly by hand and check that the
pawl falls in behind the tooth before
the ratchet wheel starts to move.

(b) The holding pawl shall engage each
succeeding tooth of the ratchet wheel
reliably after the wheel is advanced by
the operation of the stepping pawl.

Gauge by eye.

2.07 Clearance Between the Holding Pawl
and Ratchet Wheel: Fig. 3(B) - With
the holding pawl in the normal position,
there shall be a clearance between the
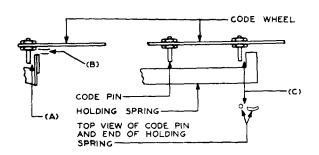holding pawl and the ratchet wheel of

Min 0.005 inch
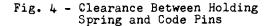
Gauge by eye.

Rotate the ratchet wheel manually and check
that the requirement is met in all posi-
tions.

2.08 Holding Pawl Spring Tension: Fig.1(I)-
The tension of the holding pawl
spring shall be sufficient to insure that
with the armature operated the holding pawl
will rest against the face of each tooth of
the ratchet wheel with a very light pres-
sure (approximately 1-1/2 grams).

CODE WHEEL

(B)

CODE PIN
HOLDING SPRING
TOP VIEW OF CODE PIN
AND END OF HOLDING
SPRING

(A)

(C)

Fig. 4 - Clearance Between Holding
Spring and Code Pins

Gauge by eye and feel.

Use the No. 70F gauge as a reference.

2.09 Clearance Between Holding Spring and Code Pins

(a) Fig. 4(A) - When the code wheel is revolved by hand there shall be a clearance between the curved end of the holding spring and the inside of the code pins of

Min 0.005 inch

Gauge by eye.

(b) Fig. 4(B) - When the code wheel is revolved by hand there shall be clearance between the shoulder portion of the code pins and the holding spring of

Min 0.015 inch

Gauge by eye.

(c) Fig. 4(C) - As the code wheel is advanced by the armature, the holding spring in its outward movement shall clear the code pins by

Min 0.005 inch

Gauge by eye.

To check, step the selector manually one step less than the first digit of the code for the selector. Hold the code wheel in position manually. Release the armature. Again operate the armature until the stepping pawl just engages with the ratchet wheel. Release the code wheel and continue slowly operating the armature, observing the clearance as the holding spring passes the code pin in its outward movement.

2.10 Engagement of Holding Spring With Code Pins: The code wheel and code pins shall be so located that after the specified group or groups of pulses have

been applied the holding spring will, on the release of the armature, engage with the code pin and retain the code wheel in that position until it is advanced by the next group of pulses or released by a releasing pulse.

Gauge by eye.

2.11 Holding Spring Position: Fig. 1(J) - In its normal position, the holding spring shall rest lightly (with approximately 1-1/2 grams pressure measured just back of the stud) against the rubber stud on the rocker arm.

Use the No. 70F gauge.

2.12 Code Wheel Position

(a) Fig. 5(A) - The code wheel shall be mounted on the shaft so that the heads of the setscrews clear the spring washer located under the ratchet cam screw.

Gauge by eye.

(b) The code wheel shall be set so that after the wheel has been advanced by the operation of the armature the number of steps indicated on the circuit requirement table, the contact spring on the code wheel will make contact with the specified contact terminal.

Gauge by eye.

2.13 Contact Spring Position

(a) Fig. 5(B) - With the selector in the normal position, the flat portion of the contact spring shall rest against the code wheel with a very light pressure (approximately 1/2 gram).
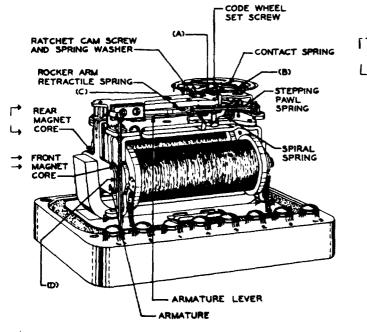
Use the No. 70F gauge.

(b) Fig. 5(B) - With the selector in a horizontal position and with the contact spring resting on the top of the first contact terminal, and the code wheel held in position by the holding spring engaging the code pin, the contact spring shall be lifted from the point on the code wheel on which it rests in its normal position by

Min 0.020 inch

Gauge by eye.

The thickness of the contact spring is 0.010 inch.

(c) Fig. 5(B) - With the selector in a vertical position (armature end down) and with the contact spring resting on the top of the first contact terminal, and the code wheel held in position by the holding

CODE WHEEL
SET SCREW

(A)

RATCHET CAM SCREW
AND SPRING WASHER

CONTACT SPRING

ROCKER ARM
RETRACTILE SPRING
(C)

(B)

STEPPING
PAWL
SPRING

REAR
MAGNET
CORE

FRONT
MAGNET
CORE

SPIRAL
SPRING

(D)

ARMATURE LEVER

ARMATURE

NOTE – THE NOS. 66A AND D-175279 SELECTORS ARE
THE SAME AS THE SELECTORS SHOWN ABOVE
EXCEPT THEY HAVE TWO RINGING POSITION
TERMINALS AND ARE DESIGNED FOR PLUG-IN
CONNECTION BY MEANS OF A JACK ON THE
UNDERSIDE OF THE BASE.

Fig. 5 - No. 60BA, 60BC, 60BP, 60BR, and
D-151294 Selectors - Armature
End View (See Note)

spring engaging the code pin, the contact
spring shall be lifted from the point on
the code wheel on which it rests in its
normal position by

Min 0.010 inch

Gauge by eye.

(d) The contact spring shall not make
contact with the contact terminals
when advanced to one step before or one
step beyond each contact terminal.

Gauge by eye.

(e) The offset section on the contact
spring into which the contact is
fitted shall be approximately parallel
to the code wheel.

Gauge by eye.

2.14 Spiral Spring Tension: The tension of
the spiral spring shall be sufficient
to restore the code wheel to normal whenever
the rocker arm is in its normal position and
the code wheel is not in such a position
that it is held by the holding spring en-
gaging the code pins.

Gauge by eye.

(a) To check that this requirement is met,
place the selector in the same rela-
tive position it will assume when mounted
in the associated equipment. Advance the
code wheel by operating the armature man-
ually and check that the code wheel re-
stores properly from each of the following
positions as the armature is slowly re-
leased.

(1) One step beyond the normal position.

(2) One step beyond each contact ter-
minal.

2.15 Rocker Arm Retractile Spring Tension:
Fig. 5(C) - The tension of the rocker
arm retractile spring (including the tension
of the holding spring) shall be sufficient
to restore the rocker arm to normal, when
no current is flowing through the selector
winding.

Gauge by eye.

2.16 Armature Position

(a) Fig. 5(D) - With the armature in the
normal position, the faces of magnet
cores shall lie in as near a parallel
plane as possible with the armature. The
air gaps between the armatures and the
cores shall be approximately equal.

Gauge by eye.

2.17 Armature Lever Clearance: The arma-
ture lever shall clear all parts ex-
cept the rocker arm throughout its stroke.
The vertical or horizontal play in the arma-
ture bearings shall not be sufficient to
permit the lever to touch adjacent parts.

Gauge by eye and feel.

2.18 End Play: Fig. 1(D), 1(F), 1(E), and
1(H) - The armature shaft, ratchet
wheel shaft, rocker arm shaft, and the hold-
ing pawl shall have end play but the end
play shall be

Max 0.010 inch

Gauge by eye and feel.

2.19 Over-all Operating Requirements

(a) Before checking that the operating
requirements are met, a check shall
be made to insure that the selector key

or dial and the associated equipment are in proper adjustment and that the circuit is in condition to transmit the series of impulses which will advance the selector to the specified terminal.

(b) When the proper series of impulses is transmitted to the selector under normal operating conditions the selector shall step to the proper terminal as determined by the code setting of the selector. On key operated impulse circuits, the ← selector shall remain on this terminal for approximately 2 seconds and then restore to normal.

3. ADJUSTING PROCEDURES

3.001 List of Tools, Gauges, and Materials

Code or Spec. No.	Description
Tools	
144	Combination Screwdriver and Wrench
145	Adjusting Hook
417A	1/4- and 3/8-inch Hex. Open Double-end Flat Wrench
485A (2 prs)	Smooth Jaw Pliers ←
KS-6320	Orange Stick
KS-6854	3-1/2-inch Screwdriver
KS-14164	Brush ←
-	3-inch H Cabinet Screwdriver
Gauges	
70F	10-0-10 Gram Gauge
Materials	
KS-2423	Cloth ←
KS-6232	Oil
KS-7860	Petroleum Spirits
-	No. 22 Bare Tinned Copper Wire ←

3.002 **Setting Code Pins:** To set the code pins for any particular code, which steps the selector to the first contact terminal begin at the fixed code pin adjacent to the end of the contact spring and count in a counterclockwise direction the number of holes in the code wheel corresponding to the last digit of the code. Place a code pin in the last hole counted with the No. 145 tool. Screw a code pin nut on the code pin with the No. 144 tool

and tighten it securely. Count in a counterclockwise direction from the pin just mounted the number of holes corresponding to the next to last digit of the code and mount another code pin in the last hole counted. Count from the code pin last mounted the number of holes corresponding to the second from last digit of the code and the last hole counted should be adjacent to the end of the holding spring. If it is not adjacent reset the code wheel position as outlined in 3.12.

> Note: For codes which are intended to step the selector to other than the first terminal, subtract 2, 4, or 6 from the last digit, depending on whether the selector is to step to the second, third, or fourth terminals respectively. Use this digit as the last digit, in counting from the fixed pin adjacent to the end of the contact spring. For codes in which the first digit is one, this digit shall be disregarded as it is simply a clearing pulse and in no way affects the setting of the code pins.

3.01 Cleaning (Rq 2.01)
3.02 Lubrication (Rq 2.02)

(1) Clean the parts of the selector when necessary by applying KS-7860 petroleum spirits to the parts with the KS-14164 brush and allow to dry thoroughly. Take care in this operation to avoid injury to the delicate mechanism and springs associated with the armature arm, the rocker arm, and code wheel. After cleaning relubricate as covered in (2).

(2) Lubricate the various points listed by applying KS-6232 oil very sparingly with the No. 22 bare tinned copper wire (one drop applied to each of the ← points). To lubricate the ratchet wheel shaft bearing apply the oil with the wire ← under the code wheel bearing and lubricate the shaft. After applying the oil ← operate the selector manually a few times to work the oil into the bearings. Take care to keep the oil away from the contacts and the selector windings. Wipe off any excess oil from the parts using a clean, dry KS-2423 cloth. Wrapping the cloth around one end of the KS-6320 orange stick will facilitate removal of excess oil from points which may not otherwise be accessible.

3.03 **Clearance Between Stepping Pawl and Ratchet Wheel (Rq 2.03)**

(1) To adjust the clearance between the stepping pawl and the ratchet wheel, place the KS-6854 screwdriver through the hole in the frame against the stepping pawl guide post and adjust the guide post

slightly in the direction necessary to increase or reduce the clearance as required. Take care not to bend the guide post more than is absolutely necessary to provide the proper clearance.

3.04 Stepping Pawl Position (Rq 2.04)

(1) If the stepping pawl does not rest against the guide post, lubricate the stepping pawl bearing pin as outlined in 2.02. If the stepping pawl still does not rest against the guide post, it is an indication that the tension of the stepping pawl spring is insufficient. In this case it will be necessary to replace the retractile spring as covered in Section 026-700-801.

3.05 Stepping Pawl Travel (Rq 2.05)
3.06 Engagement of Holding Pawl and Ratchet Wheel (Rq 2.06)

(1) If, with the ratchet wheel in the normal position, the holding pawl does not drop reliably into the tooth of the ratchet wheel, adjust the position of the ratchet wheel cam screw with the KS-6854 screwdriver. Step the selector manually the number of steps corresponding to the sum of all digits in the code but disregarding the first digit when this digit is one. Check that the selector stops on the proper contact terminal for the code used. If it does not, reset the cam screw so that the holding pawl will fall properly into the next adjacent tooth.

(2) If the stepping pawl travel requirement is not met or if the holding pawl does not engage the ratchet wheel properly on steps after the first step, there is an indication that the armature travel is incorrect or that the conical head stop screw is not set properly. To correct this condition loosen the locknut on the stop screw using the No. 417A wrench and then turn the stop screw in or out as required with the KS-6854 screwdriver. Tighten the locknut securely. If the armature travel is not correct, increase or decrease the armature travel as covered in 3.16.

3.07 Clearance Between Holding Pawl and Ratchet Wheel (Rq 2.07)

(1) If the requirement is not met adjust the post on the rocker arm against which the tail of the pawl rests using the No. 485A pliers. Exercise care not to adjust the post more than is necessary and to avoid damaging the holding pawl retractile spring.

3.08 Holding Pawl Spring Tension (Rq 2.08)

(1) Adjust the tension of the holding pawl retractile spring by applying the No. 485A pliers to the holding pawl

spring bracket and adjusting the offset portion of the bracket so as to provide sufficient tension to insure that the holding pawl rests against the face of each tooth as the ratchet wheel is advanced by the armature. In adjusting, take care to keep the tension of the spring as small as practicable consistent with meeting the tension requirement.

3.09 Clearance Between Holding Spring and Code Pins (Rq 2.09)
3.10 Engagement of Holding Spring With Code Pins (Rq 2.10)
3.11 Holding Spring Position (Rq 2.11)

(1) Adjust the holding spring so that it will clear the code pins by applying the No. 485A pliers to the spring just in front of the roller on the rocker arm. If the cup shaped portion of the holding spring does not clear the shoulder of the code pins, loosen the spring clamping screws with the 3-inch H cabinet screwdriver and move the holding spring down. Take care that the holding spring is not set so low as to cause it to fail to engage the code pins properly and that it rests against the stop spring. Tighten the clamping screws securely.

(2) If the holding spring does not clear the code pins in its outward movement, or if it does not engage the code pins properly, check requirement 2.12 code wheel position. If necessary reposition the code wheel as outlined in 3.12. If the code wheel is properly adjusted, loosen the holding spring clamping screws with the 3-inch H cabinet screwdriver and move the spring longitudinally. Check that the spring is properly positioned to clear the shoulder of the code pins and to engage the code pins properly and tighten the clamping screws securely.

(3) If the holding spring does not rest against the rubber stud on the rocker arm adjust the spring near the point where it leaves the clamping plate and insulators using the No. 485A pliers. In making this adjustment, adjust the holding spring and the stop spring as a unit and take care after the adjustment is completed to see that the holding spring rests against the stop spring especially at the free end of the stop spring. The holding spring should rest on the rubber stud on the rocker arm with a very light pressure.

3.12 Code Wheel Position (Rq 2.12)

(1) To adjust the position of the code wheel on the shaft, loosen the two setscrews holding the code wheel on the shaft using the KS-6854 screwdriver. Lift the code wheel from the shaft. Advance

the ratchet wheel by stepping the selector manually the number of steps corresponding to the sum of all digits in the code for the selector but disregarding the first digit when this digit is one. Lock the selector operated in this position by inserting a KS-6320 orange stick between the armature and the pole piece on the side opposite to which the armature is operated. Place the code wheel on the shaft so that the contact spring is adjacent to the particular contact terminal to which the code is intended to step the selector. Adjust the wheel until the contact spring position requirement is met. Tighten the setscrews in the hub of the code wheel securely. Remove the orange stick from the armature gap and check that the code wheel restores to normal. Check that the code wheel position and contact spring position requirements are met.

3.13 Contact Spring Position (Rq 2.13)

(1) If the flat portion of the contact spring does not rest properly against the code wheel, adjust the contact spring at the point adjacent to the rivets, using the slotted end of the No. 145 spring adjuster.

(2) If the contact spring is not lifted from its position on the code wheel as the spring passes over the contact terminal, adjust the contact end of the spring slightly using the slotted end of the No. 145 spring adjuster. Take care to see that after this adjustment is made, the portion of the contact spring which carries the contact is approximately parallel to the surface of the code wheel. If necessary to adjust the contact spring so that it is not parallel with the code wheel in order to obtain the proper lift as the spring passes over the terminals, it is an indication that the code wheel is set too high or too low on the shaft. In this case loosen the setscrews in the code wheel hub and reset the code wheel position as covered in 3.12.

(3) If the contact spring makes contact with the contact terminals when the code wheel is advanced to one step before or one step beyond the terminal, adjust the contact terminals using the No. 485A pliers. Take care in making this adjustment not to loosen the terminal rivets.

3.14 Spiral Spring Tension (Rq 2.14)

(1) If the spiral spring tension is not sufficient to restore the code wheel to normal when it is one step beyond the normal position, adjust the tension of the spiral spring by moving the supporting arm of the outer end of the spring in a clockwise direction using the hooked end of the No. 145 spring adjuster. Moving

the supporting arm in a counterclockwise direction decreases the tension. Do not increase the tension of the spring sufficiently to cause the spiral spring to be distorted when the code wheel is advanced to the last contact terminal.

(2) If the code wheel does not restore properly from one step beyond the contact terminals, it indicates that the tension of the contact spring is too great or that the code wheel is set so that the spring is lifted too high as it passes over the contact terminals. In this case reduce the tension of the contact spring using the No. 145 spring adjuster as covered in 3.13 or reposition the code wheel on the shaft as covered in 3.12.

3.15 Rocker Arm Retractile Spring Tension (Rq 2.15)

(1) If the rocker arm does not restore to normal when no current is flowing through the selector, lubricate the rocker arm bearings as outlined in 2.02. If the rocker arm still does not restore to normal, adjust the tension of the rocker arm retractile spring. Use the No. 485A pliers and adjust the bracket of the rocker arm retractile spring as required. The tension of the spring shall not be greatly in excess of the amount required to restore the rocker arm to its normal position since a higher voltage will be required to operate the selector if the tension of the rocker arm spring is excessive.

3.16 Armature Position (Rq 2.16)

(1) To adjust to meet this requirement loosen the core locknuts using the No. 417A wrench and turn the core using the 3-inch H cabinet screwdriver. Turn the core in a clockwise direction to decrease the armature gap and in a counterclockwise direction to increase the gap. Tighten the locknut securely and check that the selector meets the over-all operating requirements.

3.17 Armature Lever Clearance (Rq 2.17)

(1) Adjust the armature lever slightly using two pairs of the No. 485A pliers. Grasp the armature lever from the rear magnet core side of the selector with one pair of pliers, close to where the lever is joined to the armature. With the second pair of pliers, grasp the armature lever from the front magnet core side of the selector adjacent to the other pair of pliers. Hold the pliers inserted from the rear magnet core side rigid to eliminate excessive strain on the armature bearings. Adjust the armature lever

clearance with the pliers inserted on the front magnet core side. Avoid adjusting the armature lever more than is necessary.

3.18 Under_Play (Rq 2.18)

(1) If this requirement is not met, disassemble the selector in accordance with Section 026-700-801 and install spacing washers on the appropriate shafts.

(a) On the armature shaft, ratchet wheel shaft, and the portions of the rocker arm shaft that fit into the bearings in the middle and upper plates install a P-216676 washer or washers, as required.

(b) On the rocker arm shaft between the rocker arm and the holding pawl install a P-216677 washer or washers, as required.

3.19 Over-all Operating Requirements (Rq 2.19)

(1) If the selector fails to operate properly, it may be due to excessive tension of the rocker arm spring, excessive tension of the spiral spring, excessive tension of the contact spring as it passes over the terminals, or incorrect armature gaps. Adjust for these conditions as covered above reducing the tensions of the springs toward the specified minimums as covered in the preceding paragraphs. After making these adjustments if the electrical requirements are still not met, check that the armature air gaps are not excessive. Failure to operate indicates too great an air gap and failure to release indicates either too small or unequal air gaps. Adjust the armature air gaps until the selector operates properly in the circuit. If proper operation of the selector still cannot be

obtained by adjusting the armature gaps refer the matter to the supervisor.

REASONS FOR REISSUE

1. To reword the title of the section and refer to the .60-type selectors and the D-151294 selector by specific code numbers and add information for the No. 66A and D-175279 selectors.

2. To revise the information defining measurement of oil for lubrication (1.04).

3. To revise the requirement and procedure for lubrication[2.02(a) and 3.01 and 3.02(2)].

4. To revise the requirement for engagement of holding pawl and ratchet wheel [2.06(a)].

5. To amplify and add information in the requirement for contact spring position [2.13(b) and 2.13(c)].

6. To amplify information in the requirement for spiral spring tension [2.14(a)].

7. To amplify figure information (Fig. 5).

8. To amplify information in the requirement for over-all operating requirements [2.19(b)].

9. To revise the list of tools, gauges, and materials (3.001).

10. To revise the procedure for armature lever clearance [3.17(1)].

11. To add a procedure covering end play (3.18).