KEYS
214, 217, 227, 228, 229, 230, 231, 273, 352, 362, 408, AND 416 TYPES
REQUIREMENTS AND ADJUSTING PROCEDURES

1. GENERAL

1.01 This section covers the 214-, 217-, 227-, 228-, 229-, 230-, 231-, 273-, 352-, 362-, 408-, and 416-type keys.

1.02 This section is reissued to revise the list of tools, gauges, and materials, to cover the use of Nos. 1A and 2A cushions for removing key buttons, to add information for cleaning and repainting the red marking on indicators, to specify a different tool for adjusting indicator lugs, and to add a procedure for lubricating the plunger rod buffer of lever units. 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 Asterisk: Requirements are marked with an asterisk (*), when to check for them would necessitate the dismantling or dismounting of apparatus, or would affect the adjustment involved or other adjustments. No check need be made for these requirements unless the apparatus or part is made accessible for other reasons or its performance indicates that such a check is advisable.

1.05 The normal (unoperated) position of a plunger is that position in which the top of the metallic shoulder portion of the plunger rod assembly rests flat against the indicator base or key frame with the normally open contacts open and the normally closed contacts closed.

1.06 The operated position of a plunger is that position in which the plunger rod is depressed to the extreme position of its stroke with the normally open contacts closed and the normally closed contacts open.

1.07 The normal (unoperated) position of a lever is that position in which the lever is in its extreme forward position, and the metallic shoulder portion of the plunger rod assembly rests flat against the key frame with the normally open contacts open and the normally closed contacts closed.

1.08 The operated position of a lever is that position in which the lever is in its extreme rear position with all normally open contacts closed and all normally closed contacts open.

*2. REQUIREMENTS

*2.01 Cleaning

(a) Contacts shall be cleaned, when necessary, in accordance with approved procedures.

(b) Other parts shall be cleaned in accordance with approved procedures.

2.02 Plunger Movement: Fig. 1 (A) and (B) - The plungers shall work freely in their bearings and, when released, unrestrained shall return to their normal position with a snap.

Gauge by eye and feel.

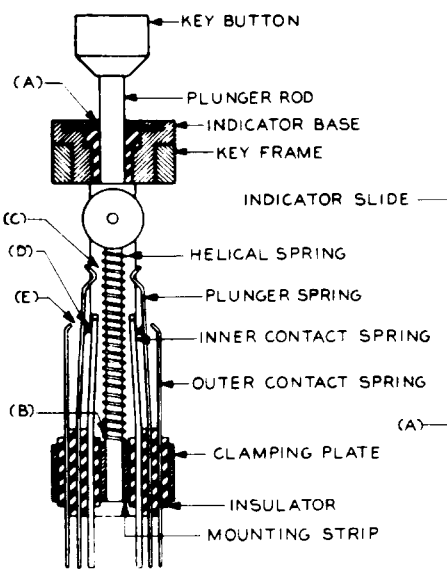

Fig. 1

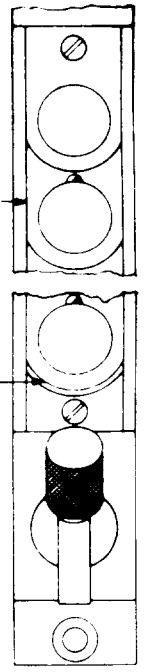

Fig. 2

2.03 Visibility of Indicator: Fig. 2(A) - The indicator shall be plainly visible when any plunger is depressed to the operated position.

Gauge by eye.

2.04 Indicator Slide Movement - Fig. 2(A)

(a) The indicator slides shall not bind.

Gauge by feel.

(b) The indicator slides shall not move due to their own weight when the key is in a vertical position with the long axis of the mounting up.

Gauge by eye.

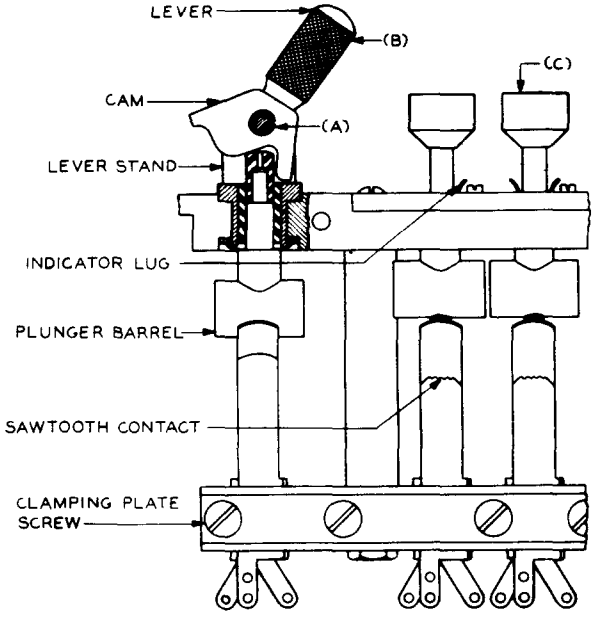

Fig. 3

2.05 Lever Movement: Fig. 3(A) - The cams on keys equipped with a lever unit shall move freely in their bearings.

Gauge by feel.

*2.06 Contact Separation: Fig. 1 (D) and (E) - The separation between any pair of contacts normally open or between any pair of contacts that are opened when the key is operated shall be

Test - Min 0.014 inch
Readjust - Min 0.016 inch

Gauge by eye.

*2.07 Spring Clearance: Fig. 1(C) - There shall be a clearance between any contact spring and the associated helical spring of

Test - Min 0.020 inch
Readjust - Min 0.025 inch

Gauge by eye.

*2.08 Contact Pressure

(a) Fig. 1(D) - With the key in the normal position, there shall be a pressure between all normally closed contacts of

Test - Min 200 grams
Readjust - Min 225 grams

Use the No. 62B gauge.

(b) Fig. 1(E) - With the key in the operated position, there shall be a pressure between all normally open contacts of

Test - Min 50 grams
Readjust - Min 55 grams

Use the No. 68B gauge.

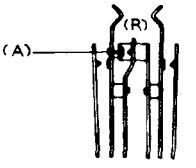

Fig. 4

Exception: Fig. 4(A) - On spring combinations having contact arrangements as shown at R, the pressure of the contact R, when closed, shall be

Test - Min 200 grams
Readjust - Min 225 grams

Use the No. 62B gauge.

*2.09 Contact Follow: Fig. 1(E) - There shall be a follow on all normally open contacts of

Test - Min 0.008 inch
Readjust - Min 0.010 inch

Gauge by eye.

Exception: This requirement does not apply to the inside contact of the spring combination shown in Fig. 4 and designated R.

*2.10 Contact Sequence - Fig. 1 (D) and (E)

(a) Normal Contact Sequence - Break-Make Combinations: Unless otherwise specified, the normally closed contacts, operated directly by a plunger spring of an individual spring assembly shall break before the normally open contacts of the same assembly directly associated with the plunger spring make, by

Test - Min 0.005 inch
Readjust - Min 0.006 inch

Gauge by eye.

(b) Cross Sequence - Break-Make Spring Combinations on Ringing and Coin Control Spring Assemblies: Unless otherwise specified, all normally closed contacts operated by the depression of a plunger shall break before any of the normally open contacts make by

Test - Min 0.005 inch
Readjust - Min 0.006 inch

Gauge by eye.

(c) Special Sequence for Coin Control Spring Assemblies: Unless otherwise specified, the break contact on the ring side (rear or right) of the key shall break before the break contact on the tip side (front or left) breaks.

Gauge by eye.

Exception: When the key is equipped with a single break contact on the front or left side, and a transfer (break before make) on the rear or right side the break contact on the front or left side shall break before the break contact on the rear or right side breaks.

Gauge by eye.

(d) Other contact sequence requirements shall be met when specified on the circuit drawing.

2.11 Plunger Operate Pressure: Fig. 3(C) - The pressure required to depress a plunger to the end of its stroke shall be

Test - Max 2500 grams
Readjust - Max 2300 grams

Use the No. 79F gauge.

2.12 Lever Operate Pressure: Fig. 3(B) - The pressure required to operate a lever to its operated position shall be

Test - Max 1500 grams
Readjust - Max 1400 grams

Use the No. 79F gauge.

In checking this requirement the pressure shall be applied to the top portion of the handle and perpendicular to it.

2.13 Lever Release Pressure: Fig. 3(B) - The pressure required to restore the lever from the locked position shall be

Test - Min 50 grams
Readjust - Min 55 grams

Use the No. 68B gauge.

In checking this requirement the pressure shall be applied to the top portion of the handle and perpendicular to it.

3. ADJUSTING PROCEDURES

3.001 List of Tools, Gauges, and Materials

Code or Spec No.	Description
Tools	
45B	Hex., Single-end Socket Wrench
210	Key-button Pliers
259	Spring Adjuster
303	Spring Adjuster
371	Spring Adjuster
465A	Stirring Rod
KS-6854	Screwdriver
KS-14162	Brush
-	3-inch Cabinet Screwdriver
-	4-inch Regular Screwdriver
Gauges	
62B	0-700 Gram Gauge
68B	70-0-70 Gram Gauge
79F	0-6000 Gram Push-Pull Tension Gauge
Materials	
KS-2423	Cloth
KS-7435	Thinner
KS-7860	Petroleum Spirits
KS-8286	Red Multiple Marking Paint
KS-8496	Lubricating Compound
1A or 2A	Cushion (or equivalent tubing)
-	Shellac
-	Hardwood Toothpicks (flat on one end and pointed on the other)

3.002 Due to the design and method of mounting these keys, it will not be possible to perform certain of the readjustments specified herein unless the key is removed from the keyshelf. Whenever this is necessary, inspect the entire key for possible faults and make all adjustments that may appear necessary at this time. This will insure that the entire key is in proper working order before it is remounted.

3.003 To remove the key from the keyshelf proceed as follows. If the keyshelf is equipped with retaining strips, remove the retaining strip screws with the 3-inch cabinet screwdriver and then remove both retaining strips; remove the mounting screws with the 4-inch regular screwdriver, after which the key may be lifted out of the keyshelf as limited by the skinners. When the key is mounted in a universal-type mounting, raise the keyshelf and loosen the mounting screws with the 3-inch cabinet screwdriver. Raise the key out of the keyshelf far enough to give access to the spring assembly mounting nuts and remove the nuts with the No. 45B wrench, after which the mounting strip can be removed from the key frame. In separating the mounting strip from the key frame exercise care not to lose the helical springs on the plunger units.

*3.01 Cleaning (Rq 2.01)

(1) Clean the contacts in accordance with approved procedures. Clean other parts as outlined in 3.02(1), (2), and (3), 3.03(2) and (3), 3.05(1), 3.08(5), and 3.11(3).

3.02 Plunger Movement (Rq 2.02)

(1) If a plunger rod binds in the key frame, it is probably due to dirt. Place a few drops of KS-7860 petroleum spirits in the slot between the plunger rod and the key frame. Operate the plunger a few times and then wipe the plunger rod with a clean dry KS-2423 cloth. Repeat this operation until all dirt has been removed.

(2) Indicator-type Keys: If the bind is not due to the above condition, see whether it is caused by a roughened or bent plunger rod. In either case replace the plunger rod. When performing this operation, first remove the buttons with the fingers or, if necessary, with the No. 210 key-button pliers placing three or four thicknesses of KS-2423 cloth over the button as shown in Fig. 5. Where available, a No. 1A or 2A cushion, or equivalent, may be slid over each jaw of the No. 210 pliers and the pliers used without the cloth. After the buttons have been removed, loosen the two indicator base mounting screws from the key frame. The indicator base will be forced up due to the tension in the helical springs. Grip the slightly raised indicator base with the fingers and lift it out very carefully, leaving all the plungers in their respective positions. Remove the individual plunger assemblies from the frame being careful not to lose the helical springs. At this time clean all the plunger rods, helical springs, and plunger slots thoroughly with KS-7860 petroleum spirits. Wipe the plunger barrels with a clean dry KS-2423 cloth. Do not use the petroleum spirits on the plunger barrels. After the petroleum spirits has been thoroughly dried replace each plunger assembly separately taking care that the helical springs are in their proper positions. When replacing the plunger rods be sure that no two grooved ends of plunger barrels are adjacent except where a wide space or a mounting stud separates the two plunger barrels. This is necessary to prevent bind between the plunger barrels.

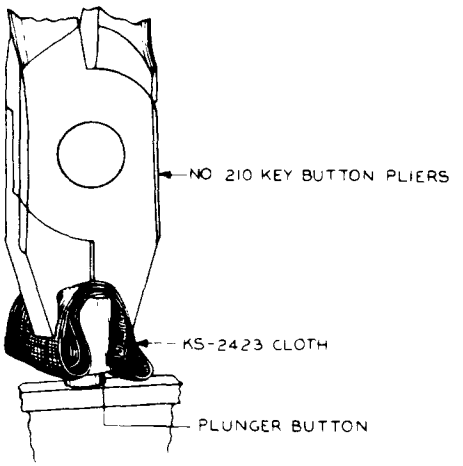

Fig. 5 - Method of Removing Plunger Button

(3) Nonindicator-type Keys: If it is necessary to replace the plunger of a nonindicator key, remove the key from the keyshelf and the spring mounting from the key as described in 3.002. Then remove the plunger buttons as described in (2) and finally the plunger. At this time clean each part thoroughly as described in (2) and reset making sure that no two grooved ends of the plunger barrels are adjacent.

(4) After the cleaning has been completed and all parts have been reset except the plunger buttons, place a small drop of shellac on the threaded portion of each plunger rod and mount the plunger buttons taking care that they are approximately in line with each other and with the plunger buttons on adjacent keys. Take care not to allow any shellac to get on the surface of the plunger rod.

3.03 Visibility of Indicator (Rq 2.03)
3.04 Indicator Slide Movement (Rq 2.04)

(1) If the indicator slide does not move so as to be plainly visible when the associated push button is operated, adjust

the indicator lugs on the faulty slide with the No. 259 spring adjuster until it moves properly. Take care in making this adjustment not to bend the lug in such a way as to increase the pressure required to operate a push button.

(2) If the indicator slides appear sticky or do not work freely in the indicator base, remove the indicator slides from the indicator base and clean them with KS-7860 petroleum spirits, first removing the plunger buttons and indicator base as described in 3.02(2). If the slide moves too freely, bend the small projections on either side of the slide slightly upward with the No. 259 spring adjuster so as to cause them to bear against the upper edge of their grooves. Notice also that although an individual slide may move freely, the pressure required to move all of the slides together may be considerable. Readjust the indicator slides to move as freely as possible without being free enough to move of their own weight when the keyshelf is raised to its extreme position. Slide the indicator slides into the grooves, replace the indicator base, and tighten the mounting screws securely.

(3) If the indicator slide is in proper position and adjustment and the red marking cannot be clearly seen, the indicator slides should be removed from the key for cleaning as described in (2). Clean the red marking of the indicators by wiping it with a clean dry KS-2423 cloth moistened with KS-7435 thinner. Following the cleaning operation, completely remove all traces of the thinner by wiping with a clean dry cloth. If, after cleaning, the red marking does not show clearly, it should be refinished with one coat of KS-8286 red multiple marking paint, using the KS-14162 brush. When refinishing the indicators, care should be taken not to paint outside the indented area in order to insure satisfactory movement of the slide when placed in operation. The indicators should be left to dry before being reassembled to the key. The KS-8286 red paint should be thoroughly stirred with the No. 465A stirring rod before being applied. The stirring rod should be wiped with a clean dry KS-2423 cloth immediately after being used. The KS-7435 thinner is for use in thinning the KS-8286 red paint when required. A small quantity of the thinner should also be used for cleaning the brush following the painting operation.

3.05 Lever Movement (Rq 2.05)

(1) On keys equipped with a lever unit, if the cam does not move freely in its bearings, it is probably due to dirt. Remove the screw holding the cam to the lever stand with the KS-6854 screwdriver and remove the lever. Clean the cam and the lever stand thoroughly with KS-7860 petroleum spirits.

(2) After cleaning, depress the plunger by hand to determine whether or not the plunger still binds. If no bind occurs, remount the cam. If binding still occurs, remove the plunger unit and proceed as outlined for nonindicating keys in 3.02(3).

3.06 Contact Separation (Rq 2.06)
3.07 Spring Clearance (Rq 2.07)
3.08 Contact Pressure (Rq 2.08)
3.09 Contact Follow (Rq 2.09)
3.10 Contact Sequence (Rq 2.10)

(1) When making these adjustments, consult the associated circuit drawing and give proper consideration to the maintenance of any requirement for contact sequence which may be specified thereon. Do not straighten kinked springs unless the kink interferes with the proper adjustment of the key. Removing kinks tends to weaken the spring and shorten the life of the key. Adjust the springs so that there will be the specified clearance between the springs and the helical spring, in both the operated and unoperated positions of the key. Straightening the springs will usually rectify any trouble that may exist because of springs touching each other which are designed to clear at all times.

(2) When adjusting for these requirements, adjust the springs, unless otherwise specified, close to the point where they leave the clamping plates and insulators as shown in Fig. 6 using the No. 303 spring adjuster for adjusting the outside and plunger springs and the No. 371 spring adjuster for adjusting the inside heavy springs. In adjusting the springs exercise care to adjust them in line with their movement so as not to twist them off center.

(3) Contact Alignment: Check the spring to see that the edges of the springs

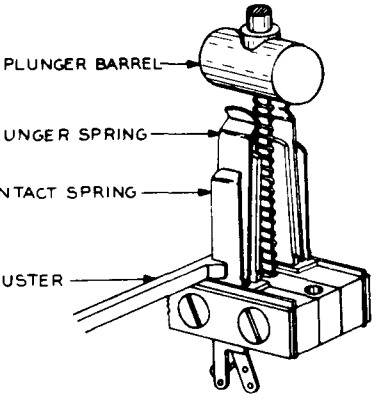

Fig. 6 - Method of Adjusting for Contact Separation

are in approximate alignment. If it is necessary to shift the springs, loosen the clamping plate screws slightly with the 4-inch regular screwdriver on that side of the key where the springs are out of alignment. Then shift the springs so that they are all in alignment and tighten the screws securely. The contacts should rest wholly within the corresponding discs and as near the center as possible. In the case of springs equipped with saw-tooth contacts the springs should line up so that all the saw teeth make contact with the corresponding spring when the plunger is depressed.

(4) Contact Separation and Spring Clearance: Failure to meet the specified clearance between the inner contact spring and the helical spring is probably due to plunger springs being too close to the plunger thereby forcing the inner springs close to the helical springs. Adjust the plunger spring with a No. 303 spring adjuster so as to decrease the contact gap between plunger spring and the normally open contact. Then adjust the inner contact spring with the No. 371 spring adjuster from the helical spring sufficiently to meet the clearance requirement. Take care that the minimum contact separation is maintained at all times.

(5) Contact Pressure: Foreign matter wedged between the contact springs may prevent the springs from making contact when the lever or plunger is operated. Remove the foreign matter with a toothpick which has been dipped in KS-7860 petroleum spirits. Do not use the same toothpick for more than one operation.

(6) The plunger springs of lever-type keys should never be tensioned against the plunger when the plungers are in the normal position. If this condition exists, correct by adjusting the plunger spring slightly at the straight portion of the spring nearest the offset portion using No. 303 spring adjuster. Take care not to bend the spring sufficiently to produce a kink.

(7) Contact Follow: When readjusting for proper contact follow, adjust the stationary contact spring close to the point where the spring leaves the mounting strip, exercising care to maintain the minimum contact gap. If a satisfactory contact follow cannot be obtained in this manner, adjust the springs close to the contact disc using the No. 303 spring adjuster applied as shown in Fig. 7. This adjustment should not be great enough to make a visible kink in the spring.

(8) Contact Sequence: To adjust for contact sequence, increase or decrease the contact operation, contact pressure, contact follow, and spring clearance as outlined in (3) through (7).

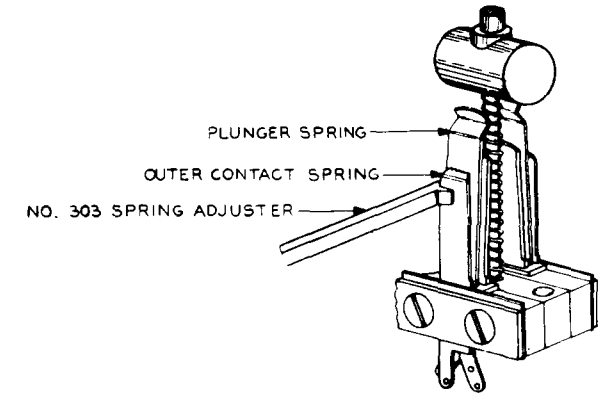

Fig. 7 - Method of Adjusting for Contact Follow

3.11 Plunger Operate Pressure (Rq 2.11)
3.12 Lever Operate Pressure (Rq 2.12)
3.13 Lever Release Pressure (Rq 2.13)

(1) When readjusting for lever operate pressure or lever release pressure, apply the pressure at the top of the straight portion of the handle and perpendicular to it.

(2) If the key fails to meet any of these requirements, examine the helical spring to determine whether it is broken or distorted in any way and, if necessary, replace it taking the key apart in the manner described in 3.02 (2) and (3).

(3) Next, examine the plunger springs to determine whether a gummy substance has formed on them. Clean the surface of the spring nearest the rollers with a toothpick which has been dipped in KS-7860 petroleum spirits. Do not use the same toothpick for more than one operation. Clean the hard-rubber plunger with a clean dry KS-2423 cloth.

(4) If, after cleaning the springs, the key still fails to meet the plunger operate or lever operate pressure requirement, determine whether the plunger spring tension is excessive and, if necessary, weaken the tension on these springs by adjusting them with No. 303 spring adjuster.

(5) Do not use any lubricant on the key plunger to facilitate adjustment, except that in those cases where the lever operate and lever release pressures exceed the maximum values shown in requirements 2.12 and 2.13 but all other requirements are met, a few drops of KS-8496 lubricating compound shall be applied on the top and side surfaces of the plunger rod buffer in the lever stand.

(6) If a key fails to meet the lever release requirement, it is an indication

that the plunger spring tension is insufficient. In this case increase the plunger spring tension with the No. 303 spring adjuster.

REASONS FOR REISSUE

1. To revise the list of tools, gauges, and materials (3.001).
2. To amplify the procedure for plunger movement [3.02(2)].
3. To add a procedure for visibility of indicator [3.03 and 3.04(3)].
4. To revise Figs. 6 and 7 to change the spring adjuster.
5. To amplify a procedure for lever operate and lever release pressures [3.11 to 3.13 (5)].