

KEYS
438, 439, 450, 451, 453, 462 AND 463 TYPES
REQUIREMENTS AND ADJUSTING PROCEDURES

1. General

- 1.01 This section covers 438, 439, 450, 451, 453, 462 and 463 type keys.
- 1.02 This section is reissued to incorporate material from the addendum in its proper location. In this process marginal arrows have been omitted.
- 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 Part 1 "General" and Part 2, "Requirements" form part of the Western Electric Co. Inc. Installation Department Handbook.
- 1.05 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.
- 1.06 The operated position of a spring assembly is that position in which the normally open contacts are closed and the normally closed contacts are open.
- 1.07 The unoperated position of a spring assembly is that position in which the normally open contacts are open and the normally closed contacts are closed.
- 1.08 The normal (unoperated) position of a key equipped with a lever is that position in which the lever is perpendicular to the key top and the spring assemblies are unoperated.
- 1.09 The operated position of a key equipped with a lever is that position in which the lever is thrown either to the extreme front or rear and the spring assemblies involved are operated.
- 1.10 The normal (unoperated) position of a key equipped with a plunger is that position in which the metal shoulder portion of the plunger rod

assembly rests flat against the key frame and the spring assemblies are unoperated.

- 1.11 The operated position of a plunger is that position in which the plunger is depressed to the bottom of its stroke and operates the spring assembly.
- 1.12 Local Contact The term local contact means a contact which although operated by the plunger spring does not make contact with it.

2. REQUIREMENTS

Lever Type Keys

2.01 Cleaning

- (a) Contacts shall be cleaned in accordance with the section covering cleaning procedures for key contacts.
- (b) Other parts shall be cleaned in accordance with approved procedures.

2.02 Lever Movement

- (a) Cams shall move freely in their bearings and through the slot in the key frame.
- * (b) There shall not be sufficient side play to cause any of the contacts to make or break when the cam is moved sideways.

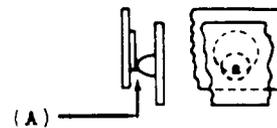


Fig. 1

- *2.03 Contact Alignment - Fig. 1 (A) - The contacts shall line up so that the point of contact falls wholly within the boundary of the opposing contact. Gauge by eye.
- *2.04 Spring Clearance There shall be a clearance between springs designed never to make contact and between any spring and the frame with the key in either the operated or unoperated position of
Test - Min. .014"
Readjust - Min. .016"
Gauge by eye.

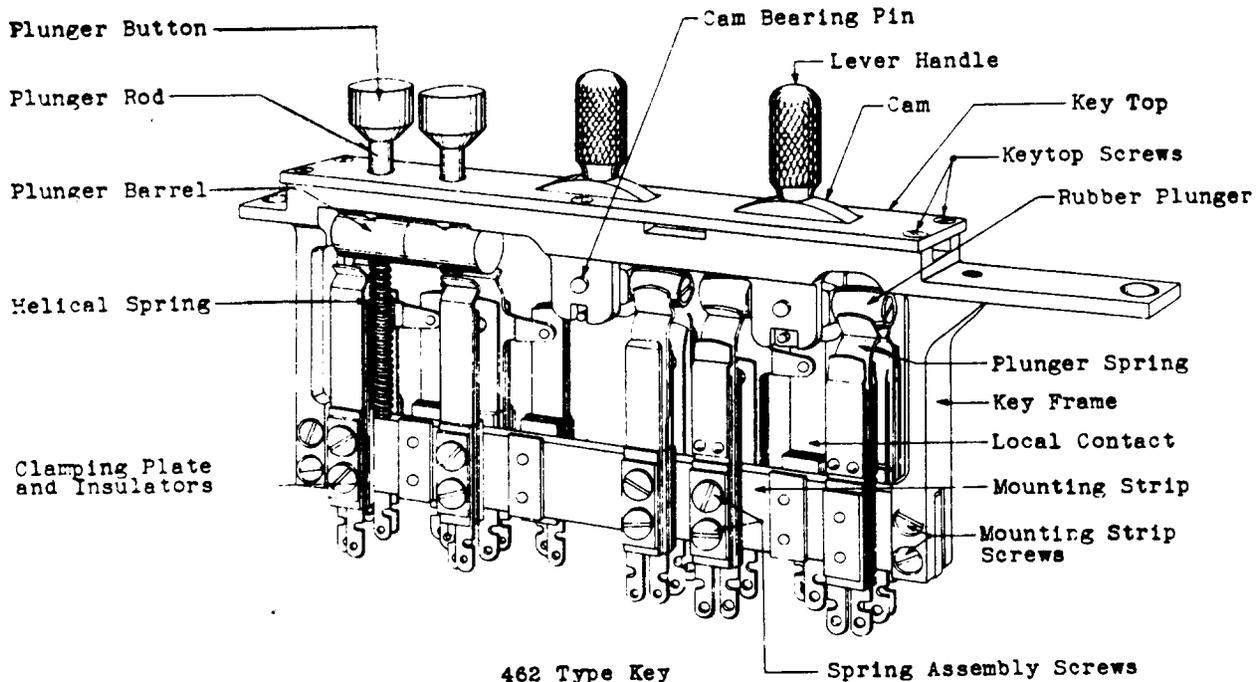


Fig. 2

*2.05 Relation of Plunger Springs to the Rubber Plungers - Fig. 3 (A) - The plunger springs shall clear the rubber plungers simultaneously but when the plunger is resting against the plunger springs of one combination or in one way lever combinations, against the

stop, the clearance between the plunger springs and the plunger of the opposite combination shall be
Test - Max. .012"
Readjust - Max. .010"
 Gauge by eye.

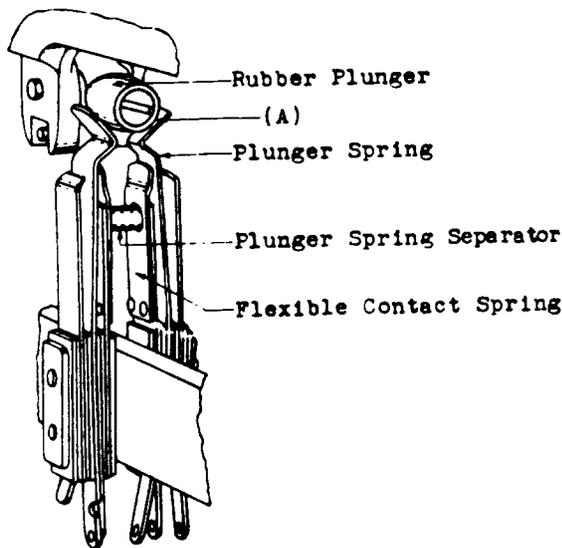


Fig. 3

*2.06 Plunger Spring Tension With the key lever in the normal position the tension of the plunger springs against their associated separators shall be
Test - Min. 100 Grams,
 Max. 1020 Grams
Readjust - Min. 115 Grams,
 Max. 1020 Grams
 Gauge by feel.

*2.07 Contact Separation 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. .010"
Readjust - Min. .012"
 Gauge by eye.

*2.08 Contact Pressure There shall be a pressure between all closed contacts of
Test - Min. 50 Grams
Readjust - Min. 55 Grams
 Use the No. 79-C Gauge

*2.09 Contact Follow All contacts shall have a follow after making or breaking contact of
Test - Min. .008"
Readjust - Min. .010"
 Gauge by eye.

2.09 (Continued)

This requirement does not apply where a thin spring makes contact with a much heavier spring.

*2.10 Contact Sequence

(a) Normal Contact Sequence - Break-Make Combinations - Fig. 4 (A) - 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 spring assembly directly associated with the plunger spring make by

Test - Min. .005"
Readjust - Min. .006"

Gauge by eye.

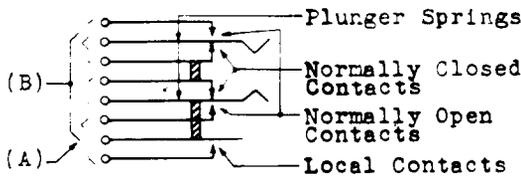


Fig. 4

(b) Cross Sequence Break-Make Spring Combinations on Ringing Spring Assemblies - Fig. 4 (B) - Unless otherwise specified all normally closed contacts operated by the throw of the lever shall break before any of the normally open contacts make by

Test - Min. .005"
Readjust - Min. .006"

Gauge by eye.

(c) Local Contact Sequence Local contacts on talking combinations shall either make or break as the case may be before the plunger spring contacts make. Gauge by eye.

(d) Other Contact Sequence When specified on the circuit drawing.

*2.11 Flexible Contact Springs Flexible contact springs shall rest on their respective stop springs, at least on the end of the spring nearest the contact, when the spring is in the unoperated position. Gauge by eye.

2.12 Non-Click When the lever is restored unrestrained from the operated to the normal position, no normally closed contacts of the opposite side shall break and no normally open contacts of the opposite side shall make. Unless otherwise specified, this requirement shall apply only where the key is equipped with talking and ringing spring combinations on the same lever unit.

2.13 Lever Operate Pressure The pressure required to operate the key lever in either direction to the extreme operated position shall be

Test - Min. 400 Grams,
Max. 1500 Grams
Readjust - Min. 450 Grams,
Max. 1400 Grams

Except on keys equipped with an indicator and keys consisting of two levers arranged so that only one lever can be operated at a time for which the pressure required to operate the lever to the extreme locking position shall be

Test - Min. 400 Grams,
Max. 2050 Grams
Readjust - Min. 450 Grams,
Max. 1850 Grams

Use the No. 79-B gauge for the minimum requirement and the No. 79-E gauge for the maximum requirement.

2.14 Lever Release Pressure

(a) On locking combinations the pressure required to restore the lever from the locked position applied at the top of the lever handle and in a direction perpendicular to it shall be

Test - Min. 75 Grams
Readjust - Min. 85 Grams

Use the No. 70-E gauge.

(b) Non-Locking Units Non-locking levers shall return unaided to the normal position when released.

2.15 Visibility of Indicator On indicator type keys only one color of the indicator shall be exposed to view on either of the resting points of the indicator.

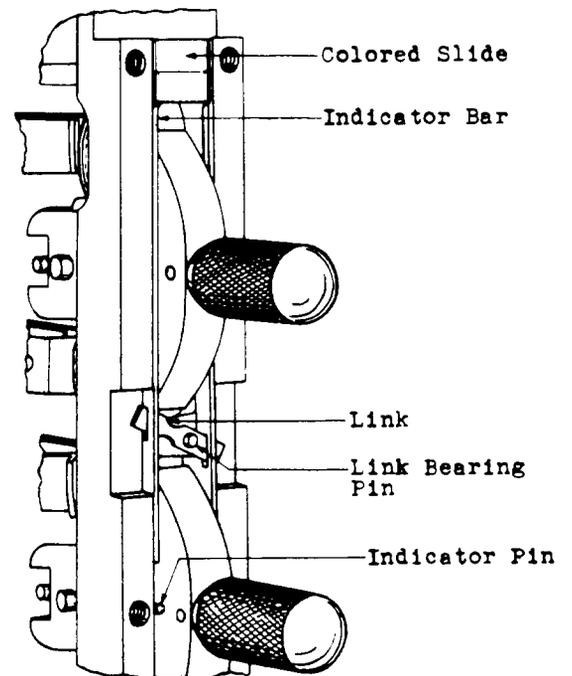


Fig. 5

2.16 Operation of Indicator The indicator shall not bind. Gauge by feel.

Plunger Type Keys

2.17 Cleaning

- (a) Contacts shall be cleaned in accordance with the section covering cleaning procedures for key contacts.
- (b) Other parts shall be cleaned in accordance with approved procedures.

2.18 Plunger Movement The plungers shall operate freely and shall not be sluggish in restoring from the operated position. Gauge by feel.

*2.19 Contact Alignment - Fig. 6 (A) - The contacts shall line up so that the point of contact falls wholly within the boundary of the opposing contact. Gauge by eye.

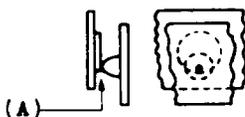


Fig. 6

*2.20 Spring Clearance There shall be a clearance between springs designed never to make contact and between any spring and the frame of
Test - Min. .014"
Readjust - Min. .016"
 Gauge by eye.

*2.21 Contact Separation 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. .014"
Readjust - Min. .016"
 Gauge by eye.

*2.22 Contact Pressure There shall be a pressure between all contacts of
Test - Min. 50 Grams
Readjust - Min. 55 Grams
 Use the No. 79-C Gauge.

*2.23 Contact Follow Contacts equipped with a follow spring either normally open or normally closed shall follow
Test - Min. .008"
Readjust - Min. .010"
 Gauge by eye.

*2.24 Contact Sequence
 (a) Normal Contact Sequence - Break-Make Combinations - Fig. 7 (A) - 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 spring assembly associated with the plunger spring make by

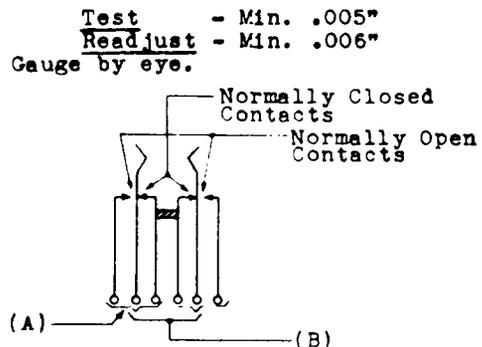


Fig. 7

(b) Cross Sequence - Break-Make Spring Combinations on Coin Control Spring Assemblies - Fig. 7 (B) - Unless otherwise specified all normally closed contacts operated by the depression of the plunger shall break before any of the normally open contacts make by
Test - Min. .005"
Readjust - Min. .006"
 Gauge by eye.

(c) Special Sequence - Coin Control Spring Assemblies - Unless otherwise specified, the normally closed contact on the ring side (rear or right) of the key shall break before the normally closed contact on the tip side (front or left) of the key breaks. Gauge by eye. Exception On spring combinations as shown in Figs. 8 and 9, the "A" contact shall break before the "B" contact breaks. Gauge by eye.

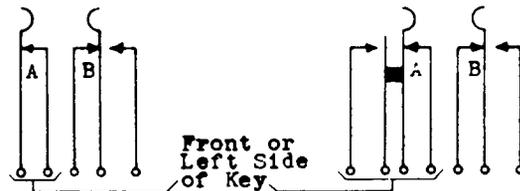


Fig. 8

Fig. 9

(d) Other Contact Sequences When specified on the circuit drawing.

2.25 Plunger Operate Pressure The pressure required to operate a plunger to the bottom of its stroke shall be
Test - Max. 2050 Grams
Readjust - Max. 1850 Grams
 Use the No. 79-E Gauge.

3. ADJUSTING PROCEDURES3.001 List of Tools, Gauges and Materials

<u>Code No.</u>	<u>Description</u>
<u>Tools</u>	
105	Spring Adjuster
371	Spring Adjuster
KS-6015	Duck-bill Pliers
KS-6320	Orange Stick
KS-6854 (or the re- placed 35)	Screw-driver - 3-1/2"
R-1572	Hammer - 4 Oz.
-	Pin Punch-4-3/8" x 1/16" Point
-	Bell System Cabinet Screw- driver 3-1/2" per A.T.&T.Co. Drawing 46-X-40
<u>Gauges</u>	
70-E	150-0-150 Gram Gauge
79-B	0-1000 Gram Push-Pull Tension Gauge
79-C	0-200 Gram Push-Pull Tension Gauge
79-E	0-3000 Gram Push-Pull Tension Gauge
<u>Materials</u>	
KS-2423	Cloth
KS-6232	Oil
KS-7860	Petroleum Spirits
-	Toothpicks (Hardwood, Flat at One End and Pointed at the other)
-	No. 20 Bare Tinned Copper Wire

3.002 General Due to the design and method of mounting 438, 439, 450, 451, 453, 462 and 463 type keys, it will be impossible to perform certain of the readjustments specified herein, unless the key is removed from the keyshelf. Whenever this becomes necessary the maintenance man should take advantage of the opportunity to inspect the entire key for possible faults and should 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. To remove the key from the keyshelf proceed as follows:

3.003 Removal of Key Top Unscrew the lever handles and if the key is equipped with plunger units also unscrew the buttons. Remove the key top screws with the KS-6854 screw-driver and then remove the key top. If the key top is not readily removable push it up from the bottom with the screw-driver.

3.004 Removal of Key From Keyshelf If the keyshelf is equipped with retaining strips, remove the retaining strip screws with the 3-1/2" cabinet screw-driver and then remove both retaining strips. Remove the mounting screws with the 3 1/2" cabinet screw-driver after which the key may be lifted out of the keyshelf as limited by the length of the wires attached to the terminals of the contact springs.

3.005 Separation of Mounting Strip From Key Frames Raise the key out of the keyshelf far enough to give access to the mounting strip screws. Remove the four mounting strip screws with the 3 1/2" cabinet screw-driver after which the mounting strip can be separated from the key frame. In separating the mounting strip from the key frame, on keys equipped with plunger units, exercise care not to lose the helical springs of the plunger units.

Lever Type Keys3.01 Cleaning (Rq.2.01)

M-1 Clean the contacts in accordance with the section covering cleaning procedures for key contacts. Clean other parts in accordance with 3.02, M-4 and 3.13, M-13.

3.02 Lever Movement (Rq.2.02)

M-1 Cracked, warped or broken hard rubber key tops may cause the lever to bind and thus prevent or delay the release of the lever. In this case replace the key top.

M-2 Loose or missing screws in the hard rubber key top may cause it to move and bind the lever. Replace missing screws and tighten all screws with the No. 35 screw-driver.

M-3 Smooth bright spots on the cam caused by rubbing are an indication that the cam binds on the key top. In some cases it may be possible to correct this condition by loosening the key top and shifting it slightly. However, when this is not possible due either to proximity to other keys or to no side play in the key top, it will be necessary to enlarge the slot in the key top.

3.02 (Continued)

M-4 In case the cam binds on its bearing pins or against the frame, the following procedure will usually rectify the trouble. Remove the key top as described in paragraph 3.003 and observe whether the cam is tight in the key frame. This can be done by moving it from side to side as in a test for side play. If it is tight remove the key from the keyshelf as described in 3.004 and 3.005. Drive out the pin by means of the R-1572 hammer and pin punch. Wipe off the cam and pin with petroleum spirits. When dry, lubricate the pin sparingly with KS-6232 oil and then wipe it off again with a clean, dry KS-2423 cloth. Replace the pin in the cam and the key in the keyshelf. This is usually sufficient to remove the bind.

- 3.03 Contact Alignment (Rq.2.03)
- 3.04 Spring Clearance (Rq.2.04)
- 3.05 Relation of Plunger Springs to Rubber Plungers (Rq.2.05)
- 3.06 Plunger Spring Tension (Rq.2.06)
- 3.07 Contact Separation (Rq.2.07)
- 3.08 Contact Pressure (Rq.2.08)
- 3.09 Contact Follow (Rq.2.09)
- 3.10 Contact Sequence (Rq.2.10)
- 3.11 Flexible Contact Springs (Rq.2.11)
- 3.12 Non-Click (Rq.2.12)
- 3.13 Lever Operate Pressure (Rq.2.13)
- 3.14 Lever Release Pressure (Rq.2.14)

M-1 General When adjusting for Contact Alignment, Spring Clearance, Relation of Plunger Springs to the Rubber Plungers, Plunger Spring Tension, Contact Separation, Contact Pressure, Contact Follow, Contact Sequence, Flexible Contact Springs and Non-Click it will be necessary to remove the key from the keyshelf as described in paragraphs 3.003 and 3.004. Unless otherwise specified adjust the springs close to the point where they leave the clamping plates and insulators as shown in Fig. 10 with the No. 105 spring adjuster. When adjusting the heavy contact

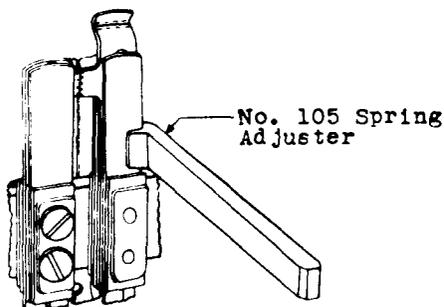


Fig. 10 - Method of Adjusting For Contact Separation, Contact Pressure, Contact Follow, Contact Sequence, Lever Operate Pressure and Lever Release Pressure

springs or springs riveted to flexible contact springs use the No. 371 spring adjuster. Exercise care when making this adjustment, to adjust the springs in line with their movement so as not to twist them off center.

M-2 When making these adjustments consult the associated circuit drawing and give proper consideration to the maintenance of any adjustment for contact sequence which may be specified thereon. Kinked springs should not be straightened 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 springs designed never to make contact and between any spring and the frame, in both the operated and non-operated position 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. No adjustment which will interfere with the proper contact sequence should be attempted.

M-3 Contact Alignment and Spring Clearance To adjust for contact alignment or spring clearance, loosen the spring assembly screws with the 3 1/2" cabinet screw-driver and shift the springs as required. Retighten the spring assembly screws and reassemble the key.

M-4 Relation of Plunger Springs to the Rubber Plungers If the plunger springs are not in the correct relationship to the plunger, adjust the plunger springs toward or away from the rollers as required with the No. 105 spring adjuster. In some cases it may be necessary to adjust the plunger spring slightly at the offset portion. This bend should not be great enough to produce a kink in the spring.

M-5 Plunger Spring Tension Adjust the plunger springs with the No. 105 spring adjuster towards the roller to increase the tension and away from the roller to decrease the tension.

M-6 Contact Separation, Contact Pressure and Contact Follow Foreign matter wedged between the contact springs may prevent the springs from making contact when the lever is operated. Remove the foreign matter with a toothpick that has been dipped in petroleum spirits. Do not use the same toothpick for more than one operation.

M-7 If the follow and separation requirements cannot be met by adjusting the springs close to the point where they leave the assembly clamping

3.03-3.14 (Continued)

plates and insulators, the upper part of the stationary spring may be given a slight bend towards the moving spring with the No. 105 spring adjuster as shown in Fig. 11. This bend should not be enough, however, to make a visible kink in the spring.

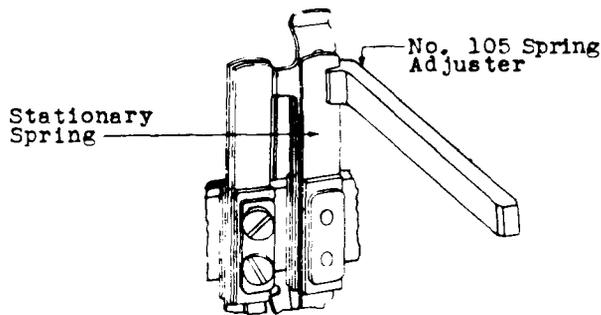


Fig. 11 - Method of Adjusting For Contact Follow and Contact Separation

M-8 Contact Sequence When adjusting for contact sequence increase or decrease the contact gap, contact pressure or contact follow as outlined in paragraphs M-1, M-6 and M-7.

M-9 Flexible Contact Springs If the flexible contact spring does not rest flat against its stop spring as specified, separate the mounting strip from the key frame as described in 3.005 and insert a piece of No. 20 bare tinned copper wire between the two springs

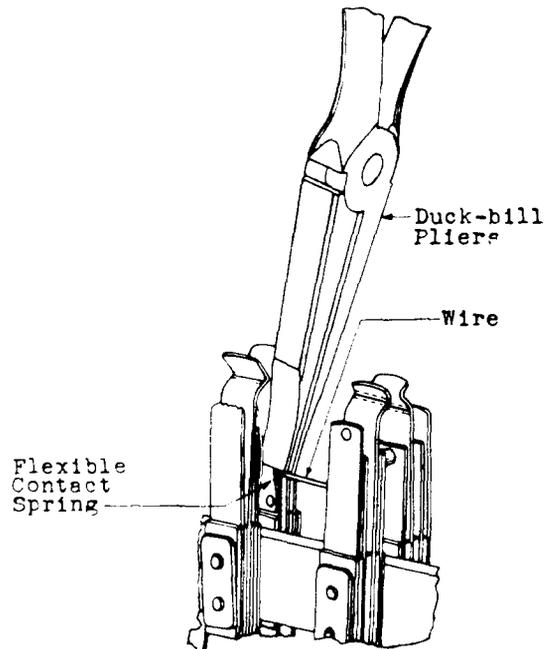


Fig. 12 - Method of Adjusting The Flexible Spring Against The Stop Spring

close to the point where they are riveted together. Then place the duck-bill pliers over both the stop spring and the flexible contact spring close to the wire as shown in Fig. 12 and pinch the two springs together with the pliers. It will be satisfactory to have a slight kink in the feather spring near the rivets which may be introduced in making this adjustment. Reassemble the mounting strip and the key frame.

M-10 Non-click In readjusting for non-click, operate the lever to the locked position, and then push the handle until it reaches a point in its travel where it will release without further aid. On non-locking units allow the lever handle to return from the operated to the normal position unaided or unrestrained in any way. Should the key fail to meet the non-click requirements increase the follow on the normally made contacts as outlined in paragraph M-7. If the click is caused by the overthrow being so great as to momentarily make an open contact, increase the contact gap slightly and also reduce the tension of the plunger springs on that side from which the roller was released. In either case all previous adjustments should be rechecked.

Lever Operate Pressure
Lever Release Pressure

M-11 When making a check for the lever operate or release pressure, apply the pressure to the top of the straight portion of the handle and perpendicular to it.

M-12 If a key fails to meet the minimum lever operate or lever release requirements, adjust the plunger springs with the No. 105 spring adjuster so that the lever will have a greater drag on the plunger springs when returning to normal. When readjusting the springs, move the lever against the opposite spring combination. However, always see that when the lever is in the normal position there is a perceptible clearance between the plunger springs and the plungers.

M-13 If a key fails to meet the maximum requirement for lever operate pressure, inspect the key for freedom of lever movement. In case it does bind, rectify the trouble as covered in procedure 3.02. Also inspect the plunger springs to determine whether or not a gummy substance has formed on them. Clean them with a toothpick which has been dipped in petroleum spirits. Clean the rubber plungers with a clean, dry KS-2423 cloth.

M-14 If after the plunger springs have been cleaned the key still fails to meet the maximum pressure re-

3.03-3.14 (Continued)

quirement it is probably due to excessive tension of the plunger springs. Check the tension of the plunger springs before remounting the key in the keyshelf and adjust the springs if necessary with the No. 105 spring adjuster as described in M-1. Recheck for requirements 2.03 to 2.14 inclusive and remount the key in the keyshelf.

3.15 Visibility of Indicator (Rq.2.15)

M-1 If more than one color of the indicator remains in view when a key lever is operated slowly to the extreme position of its throw, it is probably due to a bent link bearing pin or a bent indicator pin. To straighten the bearing pin, remove the key top as described in 3.003 which will give access to the indicator assembly. Remove the indicator link by lifting both ends of the link simultaneously until it clears its bearing pin, after which it may be withdrawn through the slots in the indicator bars. Straighten the bearing pin with the long nose pliers and reassemble the key. To straighten a bent indicator pin it will be necessary to remove the key from the keyshelf as described in 3.003, 3.004 and 3.005 and then to remove the cam by driving out the cam bearing pin as described in 3.02, M-4. Then straighten the indicator pin with the long nose pliers, reassemble the key and remount it in the keyshelf.

3.16 Operation of Indicator (Rq.2.16)

M-1 If the indicator binds adjust the short arm of the colored slide with the duck-bill pliers, outward to increase the resistance of the slide or inward to reduce the resistance. To do this it will be necessary to remove the key top as described in 3.003 and remove the indicator assembly. When finally adjusted, the indicator should not slide of its own weight when either end of the key is turned up.

Plunger Type Keys3.17 Cleaning (Rq.2.17)

M-1 Clean the contacts in accordance with the section covering cleaning procedures for key contacts. Clean other parts in accordance with 3.18, M-1 and 3.25, M-8.

3.18 Plunger Movement (Rq.2.18)

M-1 If the plunger rod binds in the key frame it is probably due to dirt. Clean the plunger rod by removing

the key top as described in 3.003 and separate the mounting strip from the key frame as described in 3.004 and 3.005. Wipe the plunger rod with a KS-2423 cloth which has been moistened with petroleum spirits and wipe the bushings in the key frame with a clean, dry KS-2423 cloth.

M-2 At this time, also note that the plunger rod is not bent or roughened. If necessary, replace the defective plunger. When reassembling the plunger rods in the key frame, be sure that no two center punched ends of the plunger barrels are adjacent to each other and that the center punched end of the barrel on the plunger nearest the key frame is facing the key frame. This is necessary to prevent bind between the plunger barrel and the frame and between adjacent plunger barrels, since the ends of the plunger barrel on each side of the plunger rod are of unequal length.

3.19	<u>Contact Alignment</u> (Rq.2.19)
3.20	<u>Spring Clearance</u> (Rq.2.20)
3.21	<u>Contact Separation</u> (Rq.2.21)
3.22	<u>Contact Pressure</u> (Rq.2.22)
3.23	<u>Contact Follow</u> (Rq.2.23)
3.24	<u>Contact Sequence</u> (Rq.2.24)
3.25	<u>Plunger Operate Pressure</u> (Rq.2.25)

M-1 General In adjusting for Contact Alignment, Spring Clearance, Contact Separation, Contact Pressure, Contact Follow, Contact Sequence and Plunger Operate Pressure, it will be necessary to remove the key from the keyshelf as described in 3.003 and 3.004. Unless otherwise specified adjust the springs close to the point where they leave the clamping plates and insulators as shown in Fig. 13 with the No. 105 spring adjuster exercising care to adjust the springs in line with their movement so as not to twist them off center.

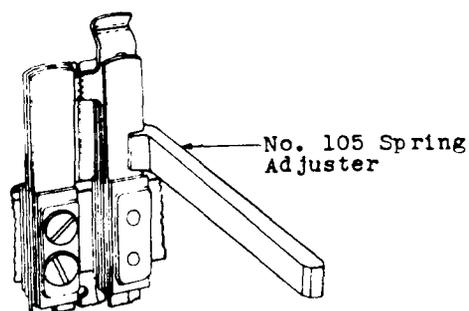


Fig. 13 - Method of Adjusting For Contact Separation, Contact Pressure, Contact Follow, Contact Sequence and Plunger Operate Pressure

M-2 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

3.19-3.25 (Continued)

specified thereon. Kinked springs should not be straightened 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 them so that there will be the specified clearance between springs designed never to make contact and between any spring and the frame in both the operated and non-operated position 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.

M-3 Contact Alignment and Spring Clearance To adjust for contact alignment and spring clearance, loosen the spring assembly screws with the 3-1/2" cabinet screw-driver and shift the springs as required. Retighten the screws securely.

M-4 Contact Separation, Contact Pressure and Contact Follow Foreign matter wedged between the contact springs may prevent the springs from

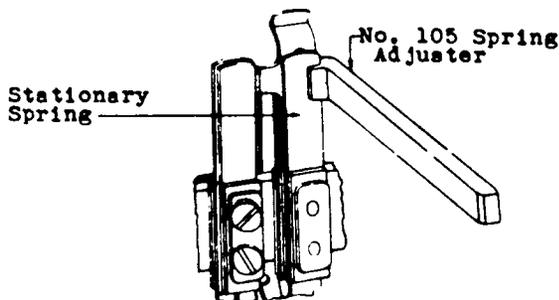


Fig. 14 - Method of Adjusting For Contact Separation and Contact Follow

making contact when the plunger is operated. Remove the foreign matter with a toothpick which has been dipped in petroleum spirits. Do not use the toothpick for more than one operation.

M-5 Contact Follow and Contact Separation If these requirements cannot be met by adjusting the springs close to the point where they leave the assembly clamping plates and insulators, the upper part of the stationary spring may be given a slight bend toward the moving spring with the No. 105 spring adjuster as shown in Fig. 14. This bend should not be sufficient, however, to make a visible kink in the spring.

M-6 Contact Sequence To adjust for contact sequence, increase or decrease the contact separation, contact pressure and contact follow as outlined in M-4 and M-5.

M-7 Plunger Operate Pressure If the plunger requires more than the specified pressure to operate it, or if it fails to restore properly from its operated position, clean the plunger rod as outlined in procedure 3.18, M-1.

M-8 If after cleaning the plunger rod, the key still fails to meet the plunger operate requirement, inspect the plunger springs to determine whether or not a gummy substance has formed on them. Clean them with a toothpick that has been dipped in petroleum spirits. Clean the plunger barrel with a clean, dry KS-2423 cloth. Also determine whether the plunger spring tension is excessive and if necessary weaken the springs by adjusting them with the No. 105 spring adjuster. No lubricant should be used on the key plunger to facilitate this adjustment.