

## KEYS

### STROMBERG-CARLSON 307 AND 311 TYPES

### REQUIREMENTS AND ADJUSTING PROCEDURES

#### 1. GENERAL

1.01 This section covers Stromberg-Carlson 307 and 311 type keys and replaces specification X-70306-01, Issue 1-D.

This section is reissued to incorporate material from the addendum in its proper location.

1.02 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.

1.03 Part 1, "General" and Part 2, "Requirements" form part of the Western Electric Co. Inc. Installation Department Handbook.

1.04 Requirements are marked with an asterisk (\*) when to check for them would necessitate the dismantling or dismantling 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 or unoperated position of a lever is that position in which the lever is perpendicular to the key top with the normally open contacts open and the normally closed contacts closed.

1.06 The operated or locked position of a lever is that position in which the lever is thrown either to the extreme front or rear with all normally open contacts of the associated spring assembly closed and all associated normally closed contacts open.

#### 2. REQUIREMENTS

##### NO. 311 TYPE KEY

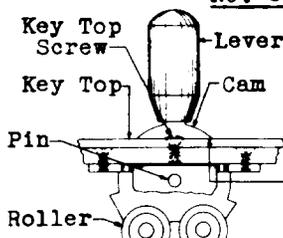


Fig. 1

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 Cam Movement The cam shall not bind in the key top.

See Fig. 2

\*2.03 Relation of the Plunger Springs to the Rollers

(a) The plunger springs of the locking spring combinations shall rest against the rollers and the buffer spring shall rest against the

opposite side of the rollers so that in the normal position, the lever will be held in a vertical position. Gauge by eye.

(b) The clearance between the plunger springs of the non-locking spring combinations and the rollers shall be:

Min. .020"  
Gauge by eye.

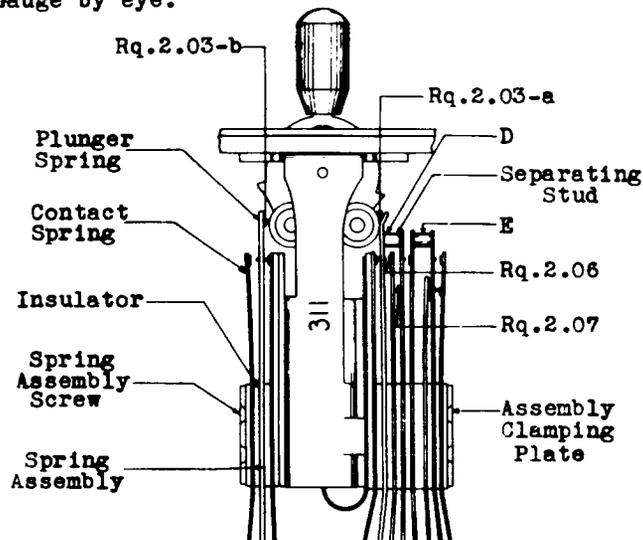


Fig. 2

See Fig. 4

\*2.04 Relation of the Buffer Spring to the Key Frame The buffer spring shall clear the sides of the key frame. Gauge by eye.

See Fig. 3

\*2.05 Contact Alignment The contacts shall line up so that the point of contact falls wholly within the circumference of the opposing contact disc. Gauge by eye.

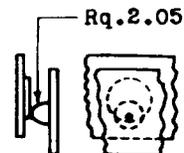


Fig. 3

See Fig. 2

\*2.06 Contact Separation The separation between open contacts shall be min. .010" except between the plunger springs and normally open contacts of the non-locking spring combinations in which case the separation shall be min. .040". Gauge by eye.

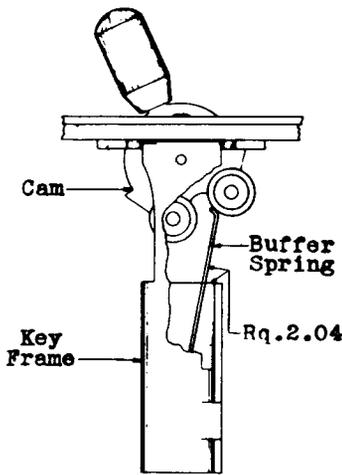


Fig. 4

See Fig. 2

**\*2.07 Spring Clearance** There shall be a clearance between springs designed never to make contact and between any spring and the frame, whether in the operated or unoperated position of the key of:

Test - Min. .010"

Readjust - Min. .012"

Gauge by eye.

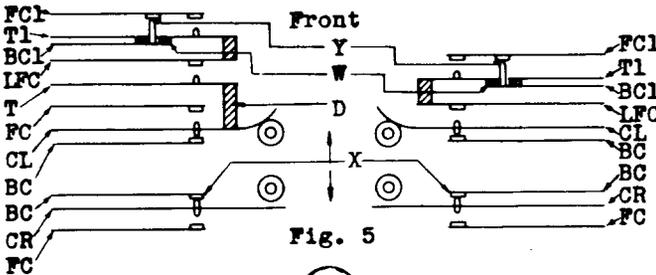


Fig. 5

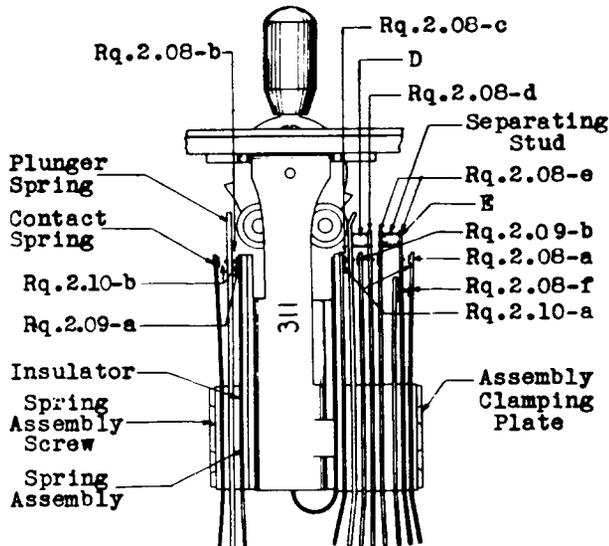


Fig. 6

See Fig. 6

**\*2.08 Contact Pressure**

(a) Unless otherwise specified the pressure

between closed contacts shall be:

Test - Min. 50 grams

Readjust - Min. 55 grams

Use the No. 68-B gauge.

(b) The plunger springs (CR) shall be heavily tensioned (approximately 850 grams) against back contacts (BC) sufficiently to prevent opening these back contacts when the lever is allowed to release with a snap from the locked to the normal position. Gauge by feel.

(c) The plunger springs (CL) shall be heavily tensioned (approximately 575 grams) against back contacts (BC) sufficiently to prevent overthrow of the lever to the locking position when allowed to release with a snap from the non-locking position. Gauge by feel.

(d) The spring (T) on the left of the key shall have just enough tension against the rubber separating stud "D" to hold it against spring (CL). Excess tension will cause a tendency to click.

(e) The (LFC) spring and the (T-1) spring shall be tensioned against the rubber stud "E". This tension shall be so balanced as to permit spring (T-1) to press the insulating washer "W" against the heavy spring (BC-1). The tension is correct in the (LFC) spring when in the unrestrained position of this spring there is a separation of min. .040" between its contact and the contact on the adjacent facing spring. Gauge by eye.

(f) The (FC-1) springs shall be tensioned firmly (approximately 225 grams) against the long contact points of the (BC-1) springs to prevent the reopening of these contacts when the lever is allowed to release with a snap from the locked to the normal position. Gauge by feel.

See Fig. 6

**\*2.09 Contact Follow**

(a) On the non-locking side, contact (BC) shall have a follow of:

Test - Min. .018"

Readjust - Min. .020"

Gauge by eye.

(b) On the locking side, contact (FC) shall have a follow of:

Test - Min. .008"

Readjust - Min. .010"

Gauge by eye.

See Fig. 6

**\*2.10 Contact Sequence**

(a) When the lever is thrown to the locked position, all normally open contacts shall make before the normally closed contacts break by:

Test - Min. .004"

Readjust - Min. .005"

Gauge by eye.

(b) When the lever is thrown to the non-locking position all normally closed contacts shall break before the normally open contacts make by:

Test - Min. .004"

Readjust - Min. .005"

Gauge by eye.

See Fig. 7

**2.11 Non-Click** When the lever is restored unrestrained from the locked position to the normal position there shall be no momentary opening of contacts "X" and "Y".

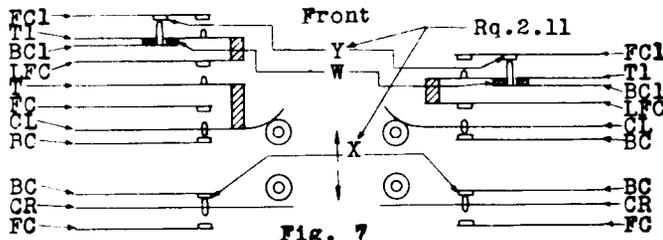


Fig. 7

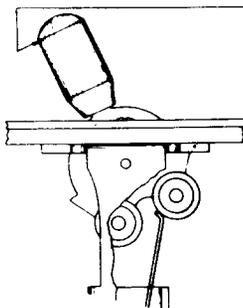


Fig. 8

**2.12 Lever Release**  
(a) The pressure required to restore the lever from the locked position shall be:

Test - Min. 50 grams  
Readjust - Min. 55 grams  
Use the No. 68-B gauge.

(b) In checking this requirement the pressure shall be applied at the top portion of the handle, and perpendicularly to it. The lever shall return unaided from the locked

position before the lever has traveled 10 degrees (a movement of the top of the handle of about 1/2 of the diameter of the rubber handle) from the extreme locked position.

**307 TYPE KEY**

**2.13 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.

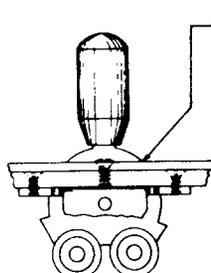


Fig. 9

**2.14 Cam Movement** The cam shall not bind in the key top.

See Fig. 11

**\*2.15 Relation of the Plunger Springs to the Rollers** The plunger springs shall rest against the back contacts and allow a very slight gap between the rollers and the springs, and in the normal position the lever shall be held in a vertical position. Gauge by eye.



Fig. 10

**\*2.16 Contact Alignment** The contacts shall line up so that the point of contact falls wholly within the circumference of the opposing contact disc. Gauge by eye.

See Fig. 11

**\*2.17 Contact Separation** There shall be a separation between all open contacts of:

Test - Min. .013"  
Readjust - Min. .015"

except on the make before break spring combination in which case the separation shall be:

Test - Min. .008"  
Readjust - Min. .010"

Gauge by eye.

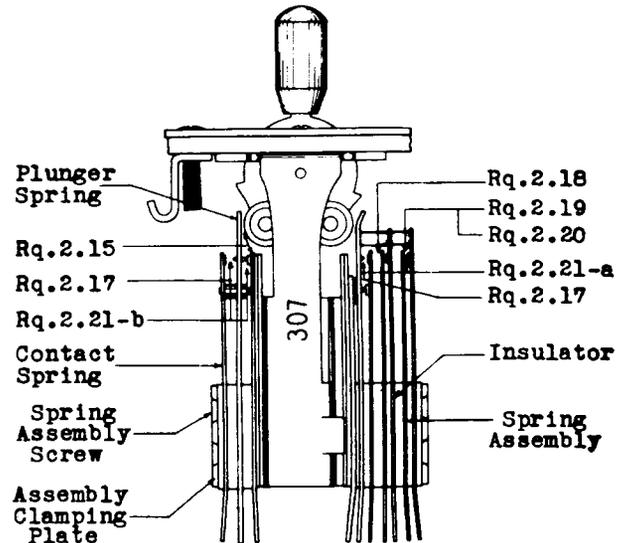


Fig. 11

See Fig. 11

**\*2.18 Spring Clearance** There shall be a clearance between springs designed never to make contact and between any spring and the frame whether in the operated or unoperated position of the key of:

Test - Min. .010"  
Readjust - Min. .012"

Gauge by eye.

See Fig. 11

**\*2.19 Contact Pressure**

(a) There shall be a pressure between all closed contacts of:

Test - Min. 50 grams  
Readjust - Min. 55 grams

Use the No. 68-B gauge.

(b) This requirement shall be met except in the case of the plunger springs (CR) and (CL) which shall be firmly tensioned (approximately 350 grams) against their respective back contacts (BC) to prevent excessive overthrow of the lever on release from the locking or non-locking position. Use the No. 68-B gauge.

See Fig. 11

**\*2.20 Contact Follow** There shall be follow on all contacts except on the heavy (BC) spring of the make before break spring combination of:

Test - Min. .013"  
Readjust - Min. .015"

Gauge by eye.

See Fig. 11

**\*2.21 Contact Sequence**

(a) When the lever is thrown to the locked position, all normally open contacts shall make before the normally closed contacts break by:

Test - Min. .004"  
Readjust - Min. .005"

Gauge by eye.

(b) When the lever is thrown to the non-locking position, all normally closed contacts shall break before the normally open contacts make by:

Test - Min. .004"  
Readjust - Min. .005"

Gauge by eye.

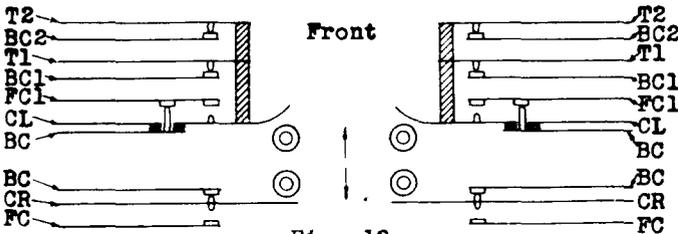


Fig. 12

**2.22 Lever Release**

(a) The pressure required to restore the lever from the locked position shall be:

Test - Min. 50 grams  
Readjust - Min. 55 grams

Use the No. 68-B gauge.

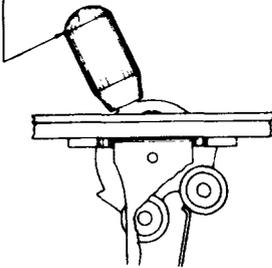


Fig. 13

(b) In checking this requirement the pressure shall be applied at the top portion of the handle, and perpendicularly to it. The lever shall return unaided from the locked position before the lever has traveled 10 degrees, (a movement of the top of the handle of about 1/2 of the diameter of the rubber handle) from the extreme locked position.

**3. ADJUSTING PROCEDURES**

TOOLS

Code No.	Description
35	Screw-driver - 3-1/2"
KS-2993	Cleaning Brush
KS-6015	Duck-bill Pliers
-	Bell System Cabinet Screw-driver - 3-1/2" per A.T.&T. Co. Drawing 46-X-40

GAUGES

62-B (or the replaced 62)	0-700 Gram Gauge
68-B (or the replaced 68)	70-0-70 Gram Gauge

MATERIALS

-	No. 6 Dry Cells (2 required)
-	Operator's Head Receiver
-	KS-7860 Petroleum Spirits
-	Toothpicks Hardwood, Flat at One End and Pointed at the Other

NO. 311 KEY

**3.01 CLEANING (Rq.2.01)**

M-1 Clean the contacts in accordance with the section covering cleaning procedures for cleaning key contacts. Clean other parts in accordance with procedures 3.02, M-3 and 3.08, M-18.

**3.02 CAM MOVEMENT (Rq.2.02)**

M-1 Cracked, warped or broken key tops may cause the levers 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 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 If the bind is not removed by the above procedures, it may be corrected as follows: Unscrew the lever handles, remove the key top mounting screws with the No. 35 screw-driver and the mounting bracket screws with the 3-1/2" cabinet screw-driver. If the key top is not readily removable push it up from the bottom with the screw-driver. Examine the cam and the slots in the key frame and key base for dirt. Clean the parts if necessary with the KS-2993 brush.

M-4 If the cam binds in the slot, remove the key top mounting screws with the No. 35 screw-driver, remove the key top and slightly enlarge its slot.

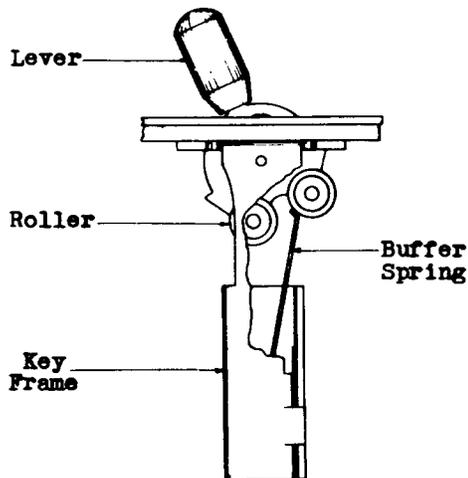
**3.03 RELATION OF THE PLUNGER SPRINGS TO THE ROLLERS (Rq.2.03)**

**3.04 RELATION OF THE BUFFER SPRING TO THE KEY FRAME (Rq.2.04)**

M-1 If the pressure of the plunger springs against the rollers on the locking spring combinations is unsatisfactory, it will prevent the lever from restoring to the vertical position. To correct this condition adjust the plunger springs with the duck-bill pliers close to the point where they leave the assembly clamping plates and insulators so that they just rest against the rollers.

**M-2** If the lever still fails to restore to the vertical position, operate it to the locked position to see whether or not the bronze buffer spring is in the correct relation to the roller as shown in Fig. 14. In this position tension the bronze buffer spring against the rollers. Failure of the bronze buffer spring to rest properly against the rollers will prevent the lever from restoring to the vertical position. If this condition exists, correct as follows.

**M-3** Restore the lever to the normal position and then loosen the locking spring assembly screws slightly with the No.35 screw-driver. The bronze buffer spring being provided with elongated holes can be raised or lowered with respect to the rollers. Raise or lower it by forcing the rounded portion of the buffer spring with the upper portion of the blade of a screw-driver. Before tightening the spring assembly screws operate the lever to the locked position to determine whether or not the spring is set properly. When the bronze buffer spring has been set in the correct relation to the rollers tighten the spring assembly screws firmly, seeing that none of the springs touch, which are designed never to make contact.



**Fig. 14 - Relation of Buffer Spring to Rollers**

**M-4** If the bronze buffer spring is not in correct relationship to the key frame, that is, fails to clear the sides of the key frame, correct this condition by loosening the spring assembly screws slightly as indicated in paragraph M-3, force the phosphor bronze spring to the desired position, and tighten the spring assembly screws securely.

**M-5** If the lever fails to assume a vertical position due to the impossibility of setting the bronze buffer spring in the correct relationship to the rollers by shifting the

spring as outlined in paragraphs M-3 and M-4, it is due to the bronze buffer spring being distorted. In this case replace the buffer spring. Do not attempt to increase or decrease the tension of this spring.

3.05	<u>CONTACT ALIGNMENT</u> (Rq.2.05)
3.06	<u>CONTACT SEPARATION</u> (Rq.2.06)
3.07	<u>SPRING CLEARANCE</u> (Rq.2.07)
3.08	<u>CONTACT PRESSURE</u> (Rq.2.08)
3.09	<u>CONTACT FOLLOW</u> (Rq.2.09)
3.10	<u>CONTACT SEQUENCE</u> (Rq.2.10)
3.11	<u>NON-CLICK</u> (Rq.2.11)

**M-1** In making these adjustments consult the associated circuit drawing and circuit requirement table and give proper consideration to the maintenance of any requirement for contact sequence which may be specified thereon. Unless otherwise specified, adjust the springs close to the point where they leave the clamping plates and insulators, using the duck-bill pliers.

**M-2** At the time the other spring adjustments are being made, see that the edges of all of the springs and contacts are in approximate alignment. If necessary to shift the springs, loosen the spring assembly screws with the No. 35 screw-driver on that side of the key where the springs are out of alignment. Then shift the springs so that they are all in alignment with the contacts resting wholly within the corresponding discs and as near the center as possible. Then tighten the screws securely. If the springs are out of alignment on that side of the key where the No. 35 screw-driver cannot be used directly remove the unit from the frame as follows: Remove the key top screws with the No. 35 screw-driver, unscrew the two lever handles, and remove the key mounting screws with the 3-1/2" cabinet screw-driver. Then remove the key top and remove the unit mounting screws with the 3-1/2" cabinet screw-driver and remove the unit. Loosen the spring assembly screws and shift the springs as described above. If the unit is removed from the key base, it is advisable to make all the following checks and readjustments before remounting the unit.

**M-3** See that the back contact springs (BC) of the locking spring combinations have sufficient follow to insure that they will not break until after all the normally open contacts are made. If the back contact springs fail to follow properly, operate the lever to the locked position and then wedge the edge of one blade of the duck-bill pliers between the back contact and the insulators as shown in Fig. 15, until sufficient follow has been obtained. This follow, however, should not be great enough to prevent the back contact springs from opening when the lever is thrown to the operated position.

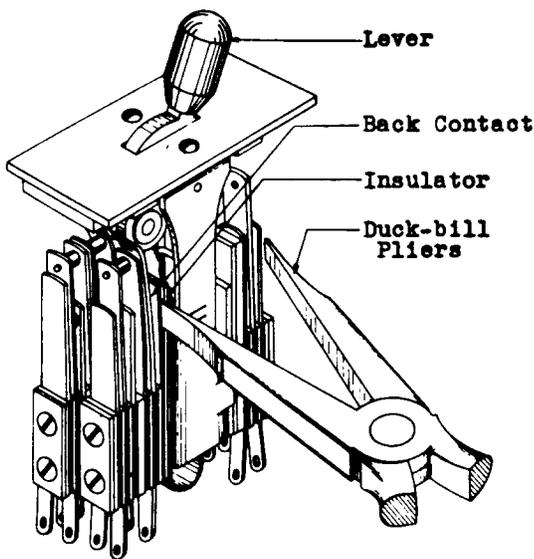


Fig. 15 - Method of Adjusting for Follow on Back Contact Springs

M-4 Now test the tension of the long front contact spring (LFC) on the right-hand side of the key by lifting the traveling spring (T-1) of the make-before-break combination until the rubber separator is free from the end of the long front contact spring. The tension in the (LFC) spring is correct when the unrestrained position of this spring leaves a clearance of min. .040" between its contact and the contact on the plunger spring (CL).

M-5 Now tension the traveling spring (T-1) of the make-before-break contact on the right-hand side of the key sufficiently so that this spring will rest firmly against the separating washer (W) and through it against the back contact spring (BC1). It is imperative that this tension be sufficient to hold the separating washer (W) tightly between these two springs but it should not be too heavy as increased tension at this point increases the tendency to click.

M-6 Now see that the front contact (FC1), that is, the outside spring on this portion of the key, has a fairly heavy tension against the long contact point of the back contact spring (BC1) of the make-before-break combination.

M-7 Next adjust the contact separation between the plunger spring (CL) and the long front contact spring (LFC) on the right-hand side to min. .010". It is advisable to keep this contact separation as close to .010" as possible since any increase in the separation will decrease the amount of movement available for the make-before-break combination. This can be accomplished by adjusting the back contact spring (BC1) of the make-before-break combination or by slightly bending the long front contact spring (LFC) close to the contact point. In every case be sure that when the key is operat-

ed to the locked position, there is a clearance between the ends of the plunger spring (CL) and the long contact spring (LFC) so as to assure that the electrical circuit is made through the contact points and not through the ends of the springs.

M-8 Adjust the contact separation between the traveling spring (T-1) and the front contact spring (FC1) of the make-before-break combination by bending the end of the traveling spring (T-1) close to the break contact as shown in Fig. 16 so that the contact separation is min. .010". This is to insure the full opening of the break contact of this portion of the spring combination when the key is operated.

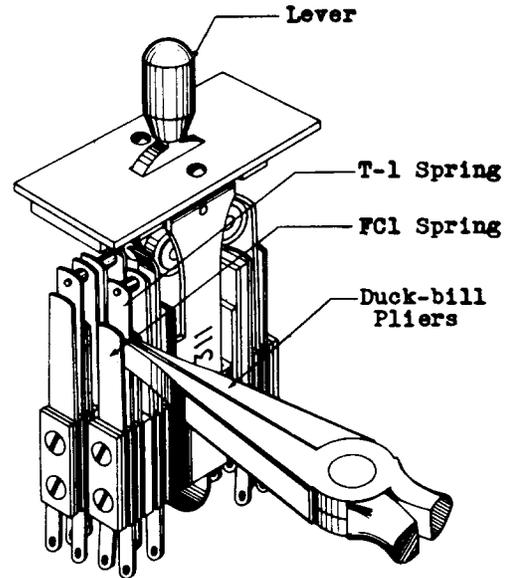


Fig. 16 - Method of Adjusting for Contact Separation on T-1 Spring

M-9 Now operate the lever to the locked position and observe whether the break contact of this make-before-break combination opens min. .010". If the springs have been correctly tensioned all of these contact adjustments on the right-hand side of the key will be provided.

M-10 The left-hand side of the locking key is adjusted in a similar way, first being sure that the plunger spring (CL) has a good heavy tension against its back contact and that the front contact spring (FC) (which is now a floating spring and not held by a rubber stop) has a separation of min. .010" between contacts.

M-11 Now test the adjustments of the traveling spring (T) to see that it has just sufficient tension to hold the separating stud against the plunger spring (CL).

M-12 The make-before-break spring combination on the left-hand side of the key should

be adjusted exactly as explained in the previous paragraphs M-4, M-5 and M-6 for the make-before-break spring combinations on the right-hand side of the key.

M-13 Adjust the contact separation between the traveling contact spring (T) and the long front contact spring (LFC) on the left-hand side of the key to min. .010" and as outlined in paragraph M-7.

M-14 Complete the adjustment of the make-before-break combination on the left-hand side of the key as described in paragraphs M-8 and M-9.

M-15 Adjust the non-locking side of this key as follows. First adjust the plunger springs (CR) so as to provide a clearance of min. .020" between the rollers and the plunger springs. When making this adjustment be sure that both rollers strike the plunger springs (CR) at the same time. If one is ahead of the other that side will open contact easily when the key is snapped from the locked position to the normal position resulting in a click in the circuit.

M-16 See that the back contact springs (BC) on the non-locking side have a follow of min. .020". If this follow is not sufficient there will be a greater tendency for the contacts to open when the cam is snapped from the locked position. On the other hand, if the follow is too great there is danger in having the plunger springs (CR) make contact with the front contact springs (FC) before the back contacts (BC) are open. In order to prevent this happening be sure that there is min. .010" separation between contacts of the plunger springs (CR) and the front contact springs (FC) when the back contacts (BC) are just breaking.

M-17 Check the previous adjustments on the non-locking side by operating the lever to the non-locking position and observe whether the front contact springs (FC) have sufficient follow to insure a reliable contact.

M-18 Foreign matter wedged between the contact spring may prevent springs from making contact when the lever is operated. Remove the foreign matter with a toothpick which has been dipped in petroleum spirits.

M-19 After making the foregoing mechanical adjustments, the back contacts (BC) on the non-locking side should be connected in series and into a closed test circuit containing two dry cells and an operator's head receiver. If the adjustments are correctly made, the lever can be released unrestrained from the locking position to the normal position without producing a click in the receiver. This click should not occur when the key is snapped from the locking position slowly or when this operation is repeated rapidly several times. Hold the key rigidly in a fixture while making this test.

M-20 If the key clicks when making the above test see that the plunger springs (CR) on the non-locking side are both tensioned alike with a fairly heavy tension and that the back contact springs (BC) have a follow of min.

.020". Also see that the clearance between the rollers and the plunger springs (CR) on the non-locking side is min. .020" when the lever is in its normal position.

M-21 If a click is still heard observe the position of the end of the bronze buffer when the cam is operated to the locking position. This spring should rest against the rubber rollers and there should be sufficient tension in this spring so that it will rest firmly against the roller as indicated in Fig. 14. It will be noted that the end of this bronze spring should engage the roller at the left of a center line through the roller pivot and spring as shown in Fig. 14.

M-22 Be sure that there are no burrs on the inside of the frame to interfere with the free action of the bronze spring, also that the spring assembly screws do not extend through the key frame and, therefore, interfere with the action of this spring.

M-23 If all the above precautions fail to prevent the click in the test receiver circuit then as a final remedy, increase the angle of bend at the ends of the plunger springs (CL), on the locking side with the duck-bill pliers as shown in Fig. 17. In performing this operation take care to adjust both plunger springs an equal amount but not enough to reduce the throw of the springs on the locking side and interfere with the contact adjustment. Take care that separating studs on the ends of the springs are not broken or damaged when making this adjustment.

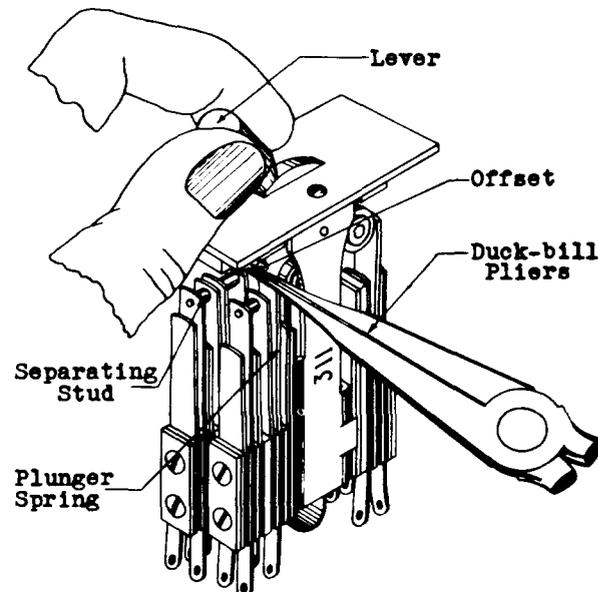


Fig. 17 - Method of Adjusting For Non-Click

M-24 Test for clicks in the test receiver on the T-1 and FC-1 contacts of the make-before-break combination on the locking side. Clicks that occur at these contacts are due to a slight vibration of the spring FC-1 against the heavy spring BC-1 and are overcome by increasing the contact pressure at this point.

M-25 After removing the click from the key as explained in paragraphs M-20 to M-24 inclusive, test the key to see whether the lever will snap from the non-locking position into the locking position. Hold the key in a fixture when this test is made and snap the lever several times slowly as well as rapidly to be sure that there is no over throwing to the locking position.

M-26 If the lever snaps over into the locking position when making the previous test, this can be remedied in two ways; first by slightly increasing the tension on the plunger springs (CL) of the locking side, secondly by slightly decreasing the tension on the plunger springs (CR) of the non-locking side. When either of these adjustments are made be sure to test the key for click as described in paragraphs M-19 to M-23 inclusive.

M-27 The correct adjustment of this key is a balance between the non-click and non-over-throw conditions and it is well to test for the non-over-throw while making adjustments for the non-click. However, if the key is correctly adjusted for contact separation and spring tension there should be no over-throw from the non-locking position to the locking position.

### 3.12 LEVER RELEASE (Rq.2.12)

M-1 When making a check for the lever release pressure apply the pressure to the top of the straight portion of the handle and perpendicularly to it.

M-2 If the lever restores from the locked position when a pressure of less than the specified value is applied, tension the plunger springs on the locking side with the duck-bill pliers against the rollers so that the rollers will have a greater drag on the spring.

M-3 If the key still fails to meet the requirements, adjust the offset portion of the plunger spring very slightly with the duck-bill pliers so as to cause a greater drag on the lever roller when returning to normal. This drag however should not be great enough to prevent the lever from returning unaided from the locked position before the lever has travelled not more than 10 degrees (a movement of the top of the handle of about 1/2 of the diameter of the rubber handle) from the extreme locked position when the pressure is applied at the top portion of the handle and perpendicularly to it. No lubricant should be used on the key roller to facilitate this adjustment.

M-4 If it is found necessary to adjust the plunger springs in order to meet this requirement, recheck all the previous adjustments.

### NO. 307 KEY

#### 3.13 CLEANING (Rq.2.13)

M-1 Clean the contacts in accordance with the section covering cleaning procedures for cleaning key contacts. Clean other parts in

accordance with procedure 3.14, paragraph M-3 and procedure 3.19, paragraph M-10.

#### 3.14 CAM MOVEMENT (Rq.2.14)

M-1 Cracked, warped or broken 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 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 If the bind is not removed by the above procedures, it may be corrected as follows: Unscrew the lever handles, remove the key top mounting screws with the No. 35 screw-driver and the bracket mounting screws with the 3-1/2" cabinet screw-driver. If the key top is not readily removable, push it up from the bottom with the screw-driver. Examine the cam and the slots in the key frame and key base for dirt. Clean the parts if necessary with the KS-2993 brush.

M-4 If the cam binds in the slot, remove the key top mounting screws with the No. 35 screw-driver, remove the key top and slightly enlarge the slot.

#### 3.15 RELATION OF THE PLUNGER SPRINGS TO THE ROLLERS (Rq.2.15)

M-1 If the position of the plunger spring of any spring combination is unsatisfactory adjust the spring close to the point where it leaves the clamping plates and insulators using the duck-bill pliers. It is advisable to keep the clearance between the plunger springs and the rollers as near the minimum as possible as any increase in the clearance will decrease the amount of movement available for the spring movement. It may be necessary, in some cases, to bend the upper portion of the plunger springs just above the contact. In this case, take care not to kink the spring.

- 3.16 CONTACT ALIGNMENT (Rq.2.16)
- 3.17 CONTACT SEPARATION (Rq.2.17)
- 3.18 SPRING CLEARANCE (Rq.2.18)
- 3.19 CONTACT PRESSURE (Rq.2.19)
- 3.20 CONTACT FOLLOW (Rq.2.20)
- 3.21 CONTACT SEQUENCE (Rq.2.21)

M-1 In making these adjustments consult the associated circuit drawing and circuit requirement table and give proper consideration to the maintenance of any requirement for contact sequence which may be specified thereon. Unless otherwise specified adjust the springs close to the point where they leave the clamping plates and insulators, using the duck-bill pliers.

**M-2** At the time the other spring adjustments are being made, see that the edges of all of the springs and contacts are in approximate alignment. If necessary to shift the springs, loosen the spring assembly screws with the No. 35 screw-driver on that side of the key where the springs are out of alignment. Then shift the springs so that they are all in alignment with the contacts resting wholly within the corresponding discs and as near the center as possible. Then tighten the screws securely. If the springs are out of alignment on that side of the key where the No. 35 screw-driver cannot be used directly, remove the unit from the base as follows: Remove the key top screws with the No. 35 screw-driver, unscrew the two lever handles and remove the key mounting screws with the 3-1/2" cabinet screw-driver. Then remove the key top and remove the unit mounting screws with the 3-1/2" cabinet screw-driver and remove the unit. Loosen the spring assembly screws and shift the springs as described above. If the unit is removed from the key base, it is advisable to make all the following checks and readjustments before remounting the unit.

**M-3** Tension the plunger springs (CL) of the locking spring combinations with the duck-bill pliers so that they will rest firmly against the separating washers (W). In tensioning these springs take care to keep the tension approximately equal and not to tension the springs against the hard rubber rollers.

**M-4** See that the front contacts (FC), that is, the outside springs of the make-before-break combinations, have a fairly heavy tension against the long contact point on the back contact springs (BC). If the tension is not satisfactory adjust the springs with the duck-bill pliers.

**M-5** Now tension the traveling springs (T1) sufficiently so that they will rest firmly against the rubber studs (F) and against the back contacts (BC).

**M-6** Then tension the traveling springs (T2) so that the rubber studs will be held firmly by the combined tensions of the (T1) and (T2) springs.

**M-7** Next adjust the contact separation between the plunger springs (CL) and the front contact springs (FC) to min. .010". It is advisable to keep this contact separation as close to .010" as possible as any increase in the separation will decrease the amount of movement available for the make-before-break spring combination. This can be accomplished by adjusting the back contact springs (BC) of the make-before-break combinations or by slightly bending the front contact springs (FC) close to the point of contact.

**M-8** Operate the lever to the locking position and adjust the contact separation between the traveling springs (T1) and the back contact springs (BC1) and between the travel-

ing springs (T2) and the back contact springs (BC2), and adjust the front contact springs (FC1) so that the contact separation is min. .015". This will insure full opening of the break contacts of this portion of the combination when the key is operated and at the same time will insure sufficient follow.

**M-9** Now operate the lever to the locking position and observe whether the break contact of the make-before-break spring combination opens min. .010". If the springs have been correctly tensioned all these contact adjustments will be provided.

**M-10** Foreign matter wedged between the contact springs may prevent springs from making contact when the lever is operated. Remove the foreign matter with a toothpick which has been dipped in petroleum spirits.

**M-11** Adjust the non-locking side of this key by first adjusting the plunger springs (CR) so as to provide a slight clearance between the rollers and the plunger springs. When making this adjustment be sure that both rollers strike the plunger spring (CR) at the same time. If one is ahead of the other, that side will open contact easily when the key is snapped from the locking position to the non-locking position.

**M-12** See that the back contact springs (BC) on the non-locking side have a follow of min. .015". If this follow is not sufficient there will be a greater tendency for the contacts to open when the lever is snapped from the locking position. On the other hand, if the follow is too great, there is danger in having the plunger springs (CR) make contact with the front contact springs (FC) before the back contacts (BC) are open. In order to prevent this happening, be sure that there is min. .010" separation between the contacts of the plunger springs (CR) and the front contact springs (FC) when the back contacts (BC) are just breaking.

**M-13** Check the previous adjustments by operating the lever to the non-locking position and observe whether the front contact springs (FC) have sufficient follow to insure a reliable contact.

### 3.22 LEVER RELEASE (Rq.2.22)

**M-1** When making a check for the lever release pressure apply the pressure to the top of the straight portion of the handle and perpendicularly to it.

**M-2** Should the lever restore from the locked position when a pressure of less than the specified value is applied, tension the plunger springs on the locking side with the duck-bill pliers against the rollers so that the rollers will have a greater drag on the spring.

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**M-3** If the key still fails to meet the requirements, adjust the offset portion of the nickel silver plunger spring very slightly with the duck-bill pliers so as to cause a greater drag on the lever roller when returning to normal. This drag however should not be great enough to prevent the lever from returning unaided from the locked position before the lever has travelled not more than 10 degrees (a movement of the top of the handle of about 1/2 of the diameter of the

rubber handle) from the extreme locked position when the pressure is applied at the top portion of the handle and perpendicularly to it. No lubricant should be used on the key roller to facilitate this adjustment.

**M-4** If it is necessary to adjust the plunger springs in order to meet this requirement, a recheck should be made of all the previous adjustments.