

## KEYS

479, 497, 501, 503, 504, 506, 507, 512, 514, 516, 526, 529, 531,  
532, 540, 546, 548, 555, 557, 558, 571, 578, 586, 6008, 6009, 6011,  
A1, A2, A5, A6, A7, A8, A9, A10, A11, A13, A14, A15, A17,  
A18, A20, A23, A24, A25, A26, A27, A29, A30, A31, A32, A33, A35, B1, B3,  
B5, B6, B7, B8, B10, B14, B15, B17, B18, B19, B21, C1, C2, C3, C5, C6,  
C7, C8, E5, G1, G2, AND G6 TYPES

## REQUIREMENTS AND ADJUSTING PROCEDURES

### 1. GENERAL

- 1.01 This section covers the keys enumerated above.
- 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 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 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 operated position of a spring assembly** is that position in which the normally open contacts are closed and the normally closed contacts are open.
- 1.06 **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.
- 1.07 **A straight lever** is one which, in its vertical position, is capable of being operated to the front or rear or both.
- 1.08 **An offset lever** is one which has two operated positions toward the front; an intermediate position and a way-down position.
- 1.09 **Plunger-type Keys:** Table A indicates those requirements which apply to the plunger-type keys covered by this section.
- 1.10 **Lever-type Keys:** Unless otherwise specified, all the requirements specified for lever-type keys apply to all the lever-type keys covered by this section.
- 1.11 **The normal (unoperated) position of a plunger** is that position in which the plunger lock or stop cone rests flat against the bearing plate or buffer plates, and the spring assemblies are unoperated.
- 1.12 **The operated position of a locking plunger** is that position in which the plunger lock or stop cone rests under and against the slide plate or roller and is held depressed by the slide plate. In this position, the spring assembly is operated.
- 1.13 **The intermediate position of an intermediate locking plunger** is that position in which the plunger lock or stop cone rests under and against the slide plate or roller and the plunger is held depressed by the slide plate, but has not operated the spring assembly.
- 1.14 **The operated position of a nonlocking plunger** or an intermediate locking plunger is that position in which the plunger is depressed to the end of its stroke, and operates the spring assembly.



**1.15** *The normal (unoperated) position of a key equipped with a straight lever* is that position in which the lever is perpendicular to the keytop, and the spring assemblies are unoperated.

**1.16** *The operated position of a key equipped with a straight lever* is that position in which the lever is thrown either to the extreme front or rear, and the spring assemblies involved are operated.

**1.17** *The normal position of a key equipped with an offset lever* is that position in which the lever is perpendicular to the keytop, and the spring assemblies involved are operated.

**1.18** *The intermediate position of a key equipped with an offset lever* is that position of the lever in which the spring assemblies involved are unoperated, and the lever can be moved to either front or rear.

**1.19** *The way-down position of a key equipped with an offset lever* is that position in which the lever is operated to the extreme front of the key, and the spring assemblies involved are operated.

**1.20** *One drop of oil*, for the purpose of this section, is the amount of oil that adheres to the nozzle of the No. 486A oil can when the sides of the container are depressed lightly and released. The drop adhering to the nozzle under this condition should be approximately twice the diameter of the nozzle.

**1.21** *One dip of KS-8496 Lubricating Compound No. 3*, for the purpose of this section, is the amount of lubricant retained on the KS-14164 brush after being dipped into the lubricant the full length of the bristles, and then removed without allowing the bristles to touch the side of the container.

## 2. REQUIREMENTS

### Plunger-type Keys

#### \*2.01 *Cleaning*

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

#### 2.02 *Lubrication*

(a) (Applies only to keys of the A11 type used as master ringing keys after turnover to the telephone company.) Each plunger rod at the lower plunger guide shall be adequately lubricated with KS-8496 lubricating compound No. 3. When lubrication is necessary, one dip shall be applied.

(b) **Recommended Lubrication Intervals:**  
After turnover, it is recommended that the lower plunger guide be lubricated once every two years.

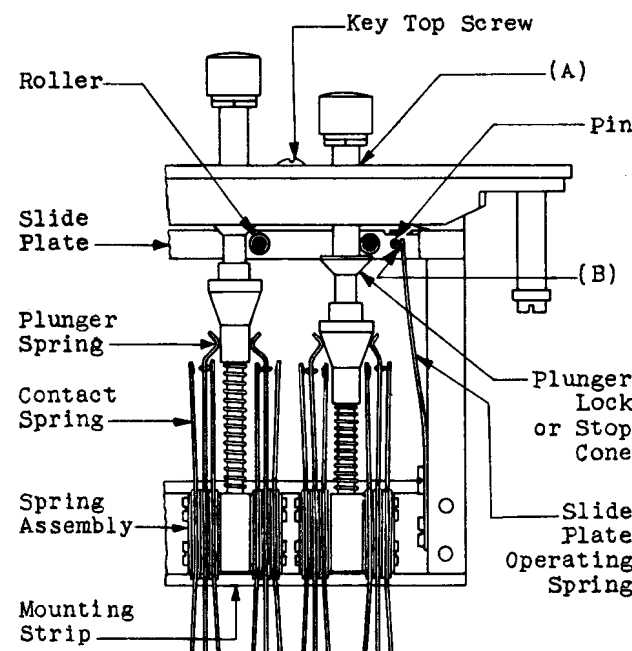


Fig. 1 - A9-type Key

**2.03 *Plunger Movement:*** Fig. 1(A) — 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.

#### \*2.04 *Slide Plate Operating Spring Tension:*

Fig. 1(B) — The pressure of the slide plate operating spring against the pin in the slide plate, with all the plungers in the normal position, shall be as indicated in the following table.

	TEST		READJUST	
	GRAMS MIN	GRAMS MAX	GRAMS MIN	GRAMS MAX
(a)	130	200	140	200
(b)	100	—	115	—
(c)	105	200	115	170
(d)	65	125	70	115

Use the No. 79C gauge.

**Note:** Reference shall be made to the requirement table for requirements for the particular key.

**2.05 Plunger Release**

- (a) Any plunger locked in the intermediate or in the locked position shall release when any other plunger is depressed to the intermediate or locked position.
- (b) When any nonlocking plunger is operated, the locking plunger immediately in front of it shall be released, if it is in the locked position.
- (c) The locking plunger shall lock reliably and shall release when the nonlocking plunger is depressed to the end of its stroke.
- (d) It shall be possible to depress the locking plunger an appreciable amount after it has engaged with the roller of the slide plate in the locked position.

Gauge by eye.

**\*2.06 Contact Alignment:** Fig. 2(A) — The contacts shall line up so that the point of contact falls wholly within the boundary of the opposing contact at all times during contact. Gauge by eye.

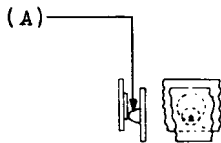


Fig. 2 — Contact Alignment

**\*2.07 Contact Separation:** Fig. 3(A)

- (a) Unless otherwise specified, 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"  
**Readjust** — Min 0.016"

Gauge by eye.

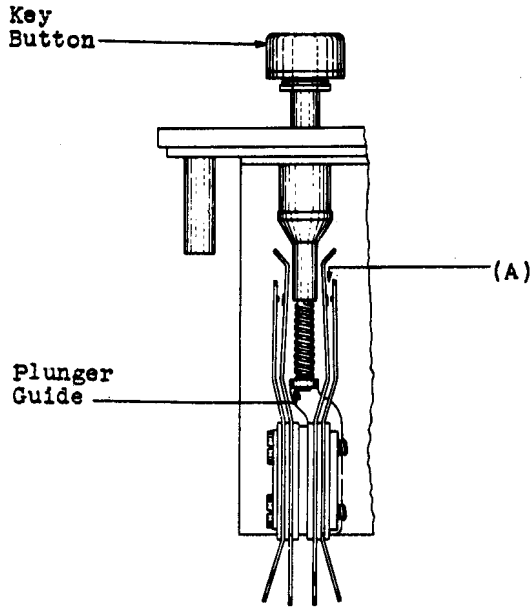


Fig. 3 — 512-type Key

- (b) On the "W" contacts of the spring combination shown in Fig. 4 and all the contacts of the spring combination shown in Fig. 5, there shall be a separation of

**Test** — Min 0.010"  
**Readjust** — Min 0.012"

Gauge by eye.

- (c) On make-before-break spring combinations (continuity) and make-make spring combinations, there shall be a separation of

**Test** — Min 0.010"  
**Readjust** — Min 0.012"

Gauge by eye.

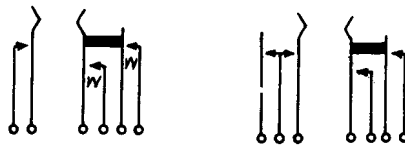


Fig. 4

Fig. 5

Illustrating Contact Separation

(d) The separation, except as covered by (e), 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 0.008"  
**Readjust** — Min 0.010"

Gauge by eye.

(e) When the circuit requirement table specifies a sequence adjustment for keys having spring combinations, as shown in Figs. 6 and 7, the contact separation on the contact which closes first when the key is operated shall be

**Test** — Min 0.010"  
**Readjust** — Min 0.012"

Gauge by eye.



Fig. 6 Fig. 7  
 Illustrating Contact Separation

**\*2.08 Spring Clearance**

(a) Fig. 10(D) — There shall be a clearance between the 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 0.014"  
**Readjust** — Min 0.016"

Gauge by eye.

(b) Fig. 8(A) (Applies to keys equipped with 1- or 6-type key units.) — There shall be a clearance between any contact spring and the helical spring of

**Test** — Min 0.018"  
**Readjust** — Min 0.020"

Gauge by eye.

(c) Fig. 9(A) — With the plunger in the normal position, there shall be a clearance between the plunger spring and plunger in at least one position of the plunger as the plunger is rotated. This applies on all spring combina-

tions, excepting those associated with plungers which lock in the intermediate position.

Gauge by eye.

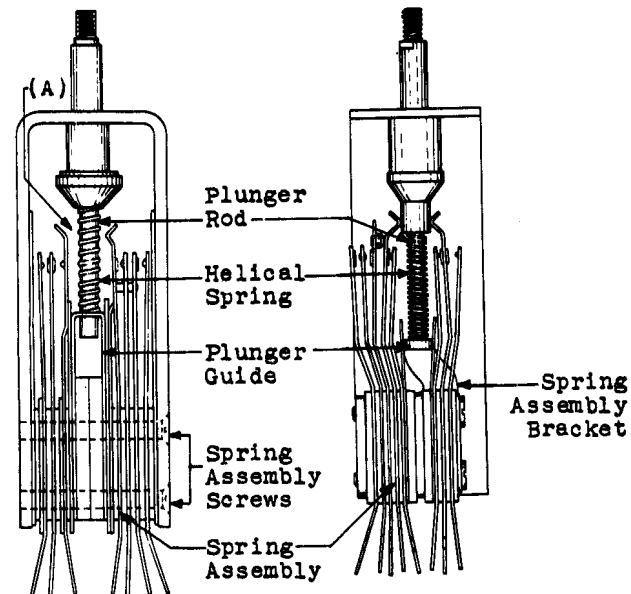


Fig. 8 - 1-, 6-, 8-, and 9-type Key Units

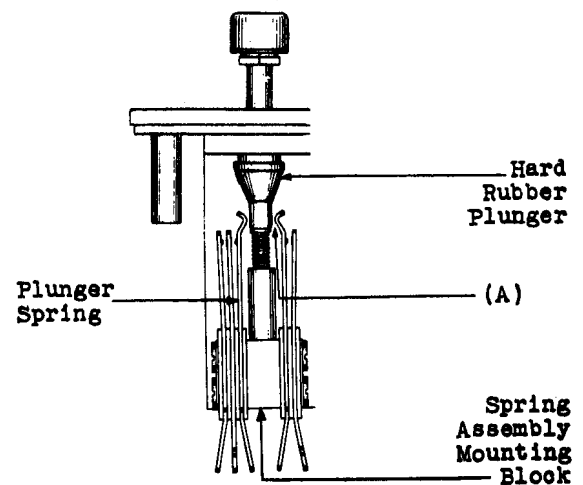


Fig. 9 - C2-type Key

(d) Fig. 10(A) — The helical spring shall not rub against the hard rubber separator.

Gauge by eye.

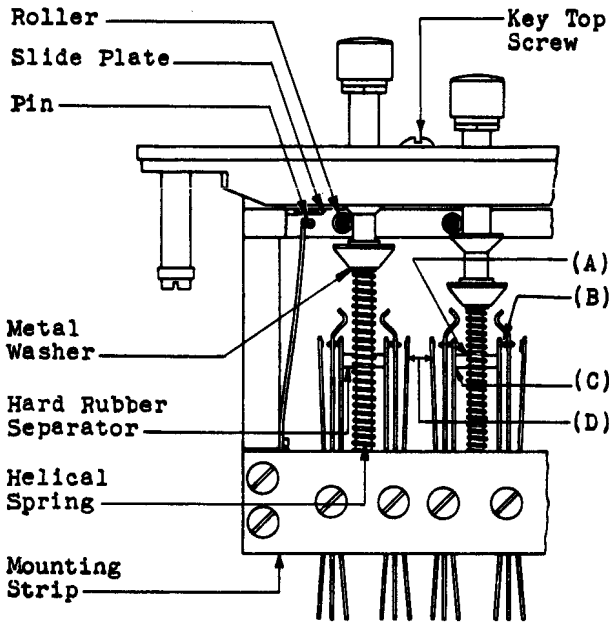


Fig. 10 - A6-type Key

**\*2.10 Other Spring Pressures:** Fig. 10(C) —

The inside contact springs, which are held apart by the hard rubber separators, shall be tensioned against the shoulders of the rubber separators so as to prevent the stud from coming out of the hole in either spring when the inside contacts are open.

Gauge by eye and feel.

**\*2.11 Contact Follow:** Fig. 11(A)

(a) There shall be a follow on all contacts of

**Test** — Min 0.008"

**Readjust** — Min 0.010"

Gauge by eye.

(b) This requirement does not apply to the inside contacts which are held apart by hard rubber separators and the heavy inside closed contact of make-before-break (continuity) spring combinations.

(e) The distance between contact springs designed to make contacts shall be

Min 0.016"

except at the contacts when the contacts are open, and

Min 0.008"

when the contacts are closed.

Gauge by eye.

**\*2.09 Contact Pressure:** Fig. 10(B) — There shall be a pressure between all closed contacts of

	TEST GRAMS MIN	READJUST GRAMS MIN
(a)	50	55
(b)	45	50
(c)	50	55
1/2 of split spring	25	30
(d)	30	35

Use the No. 68B gauge.

**Note:** Reference shall be made to the requirement table for requirements for the particular key.

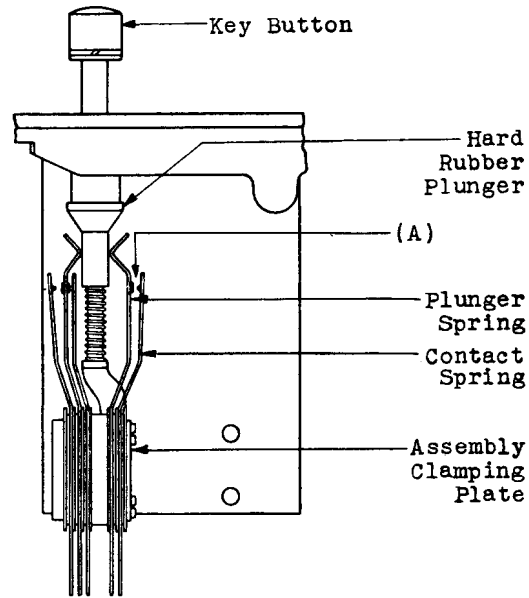


Fig. 11 - B18-type Key

**\*2.12 Contact Sequence**

(a) **Normal Contact Sequence — Break-Make Combinations:** Fig. 12(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 0.005"  
**Readjust** — Min 0.006"

Gauge by eye.

(b) **Cross Sequence — Break-Make Combination on Ringing and Coin Control Spring Assemblies or When Specified on Circuit Drawing:** Fig. 12(B) — 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"  
**Readjust** — Min 0.006"

Gauge by eye.

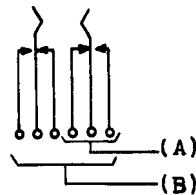


Fig. 12 — Illustrating Cross Sequence

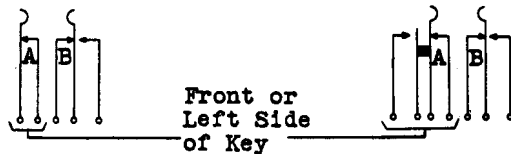


Fig. 13

Fig. 14

Illustrating Special Sequence

(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. 13 and 14, the "A" contact shall break before the "B" contact breaks.

Gauge by eye.

(d) **Other Contact Sequence:** When specified on the circuit requirement table or circuit drawing.

**2.13 Plunger Operate Pressure:** Figs. 15(A) and 16(A) — The pressure required to depress a plunger to the end of its stroke shall be

	TEST GRAMS	READJUST GRAMS	GAUGE	TYPE OF KEY
(a)	Max 2150	2050	79F	On 503- and 6008-type keys, this reqt applies to non-locking plungers only.
(b)	Max 2400	2300	79F	On B18E, B18H, and B18J keys, this reqt applies to front units only.
(c)	Max 1950	1850	79F	On B18E, B18H, and B18J keys, this reqt applies to rear units only.
(d)	Min 600	675	79B	On 503- and 6008-type keys, this reqt applies to locking plungers only.
	Max 1500	1400	79F	
(e)	Max 1250	1150	79F	This reqt applies to locking plungers only.
(f)	Max 575	500	79B	

**Note:** Reference shall be made to the requirement table for requirements for the particular key.

**2.14 Plunger Nonoperate Pressure:** Fig. 17(A)

(a) A pressure of

**Test** — 200 grams  
**Readjust** — 225 grams

shall not move a plunger which locks in the intermediate position from its normal position. All other plungers shall not move out of their normal position by a pressure of

**Test** — 180 grams  
**Readjust** — 200 grams

Use the Nos. 79B and 79C gauges.

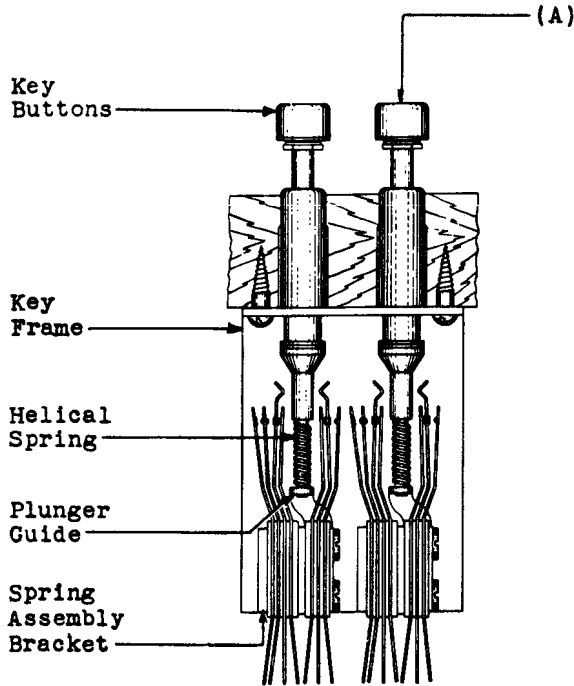


Fig. 15 - 497-type Key

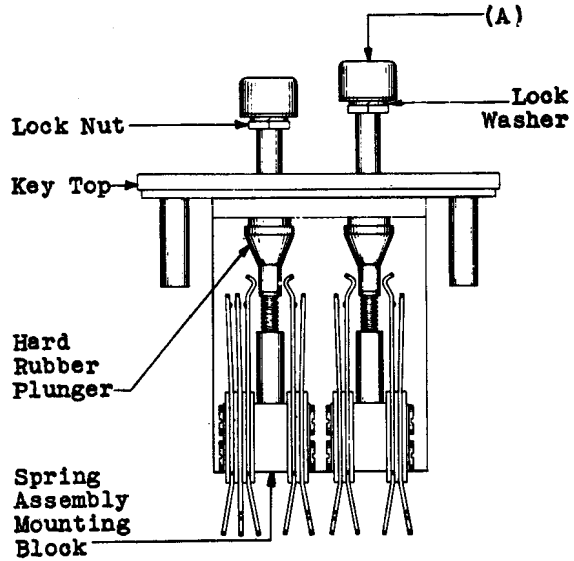


Fig. 17 - C2-type Key

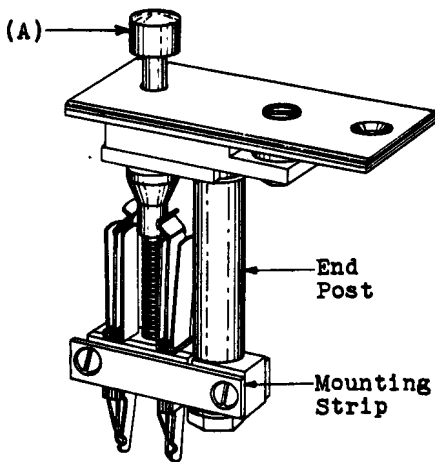


Fig. 16 - 503-type Key

(b) A pressure of

*Test* — 800 grams  
*Readjust* — 900 grams

applied on the plunger shall not cause any contacts to operate.

Use the No. 79B gauge.

(c) Requirement (b) shall apply to coin control units only.

(d) Requirement (b) shall not apply to the Nos. A11B, A11L, A11M, A11AG, A13C, A13D, A13F, A13G, A2C, A2D, A2G, A2N, A2Y, A2AB, A2AC, A2AE, A2AF, A2AG, A2AH, A2AJ, A2AK, A2AL, A2AM, A2AN, A2AP, A2AR, A2AS, A2AT, A2BB, A2BC, A2BF, A2BG, A2BH, A2BJ, A2BK, A2BL, A2BM, A2BW, A2BY, A2CE, A2CS, and A2DA keys.

(e) Requirement (b) shall apply to the non-locking units of the 503- and 6008-type keys and to the A6N key.

(f) A pressure of

*Test* — 200 grams  
*Readjust* — 225 grams

shall not move a plunger from its normal position.

Use the No. 79B gauge.

**Lever-type Keys**

**\*2.15 Cleaning**

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

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



**2.16 Lubrication** (Applies only to A1PW, A1PY, A1SH, A1TM, A1UT, B1FU, B1FW, B1GS, B1JA, B1JK, and B1KK keys used in No. 3 toll switchboards and A1A, A1NL, and A1UW keys used in the No. 1 toll switchboard.)

(a) Fig. 18(A) — The bearing pin of the front unit shall be adequately lubricated with KS-6232 oil. When lubrication is necessary, one drop shall be applied to the point where the phosphor-bronze bushing and the key frame meet at the right side of the key (when facing the keyshelf).

(b) **Recommended Lubrication Intervals:** After turnover, it is recommended that the bearing pin be lubricated at intervals of two years. This interval may be extended if periodic inspections have indicated that local conditions are such as to insure that the requirement will be met during the extended interval.

**2.17 Record of Lubrication:** During the period of installation, a record shall be kept by date of the lubrication of the keys, and this record shall be turned over to the telephone company with the equipment. If no lubrication has been done, it shall be so stated.

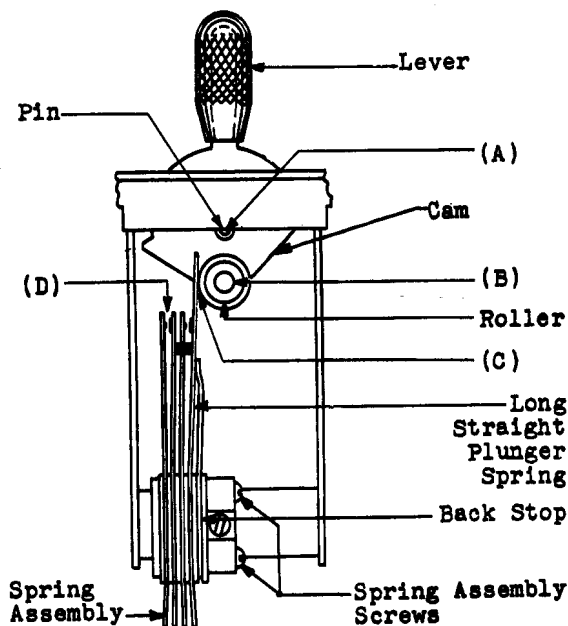


Fig. 18 — One-way Lever-type Key

## 2.18 Lever Movement

(a) Fig. 18(A) — The cam shall turn freely in its bearings.

Gauge by eye and feel.

\* (b) Fig. 18(B) — The hard rubber rollers shall turn freely on their bearings.

Gauge by eye and feel.

## \*2.19 Relation of Plunger Springs to Rollers and Cam

(a) Fig. 18(C) — *On keys equipped with a straight lever*, the pressure of the plunger springs against the rollers shall be such that the lever will be held normally in the vertical position, and when the lever is released slowly, it shall return to the vertical position by the pressure exerted by the springs.

Gauge by eye.

\***Note:** To check for this requirement on 571-type keys, remove the handle from the key as follows. Twist a rubber band around each end of the handle, thus holding the handle and spacer together as a unit. Remove the nuts with a 4" regular screwdriver and the lockwashers under the nuts. Lift off the handle and spacer. The plain washers on the levers need not be removed. After the test is made on each of the two key units individually, assemble the handle and spacer on the levers, insert the lockwashers and nuts in the handle, and tighten the nuts securely. Remove the rubber bands.

(b) Fig. 19(A) — *On keys equipped with an offset lever*, the pressure of the plunger springs against the rollers shall be such that when the lever is in the intermediate position the center of the roller shall line up approximately with the vertical center line of the unit. When the lever is released slowly from the normal or way-down position, it shall return to the intermediate position by the pressure exerted by the springs.

Gauge by eye.

(c) Fig. 20(A) (Applies at the time of turnover to the telephone company only.) — On keys equipped with crook plunger springs, there shall be a clearance between the lip and the bend at the top of the vertical portion of

the phosphor-bronze spring, of the unoperated spring combination, when the roller on the cam has operated the spring combination on the opposite side of

Min 0.004", Max 0.022"

Gauge by eye.

**Caution:** *If the phosphor-bronze spring is not in accordance with this requirement, do not attempt to adjust it.*

(d) Fig. 19(B) — With the lever in the vertical position where the key is equipped with a straight lever, or with the lever in the intermediate position where the key is equipped with an offset lever, the inclined part of the crook spring should preferably be pressed against the vertical part. However, a slight airgap will be satisfactory provided the inclined portion of the crook rests on the vertical portion of the spring during the greater part of the movement of the lever from the normal to the extreme operated position where the key is equipped with a straight lever, or from the intermediate to the normal or way-down position where the key is equipped with an offset lever.

Gauge by eye.

**\*2.20 Relation of Plunger Springs to Cam and Key Frame**

(a) Fig. 21(A) — The plunger springs shall clear the cam by

Min 1/32"

Gauge by eye.

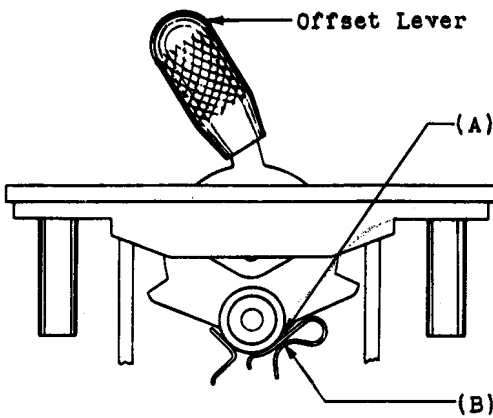


Fig. 19 — Illustrating Relation of Plunger Springs to Roller and Cam

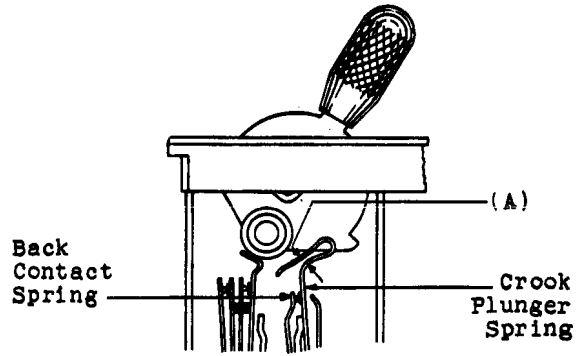


Fig. 20 — Illustrating Relation of Plunger Springs to Roller and Cam

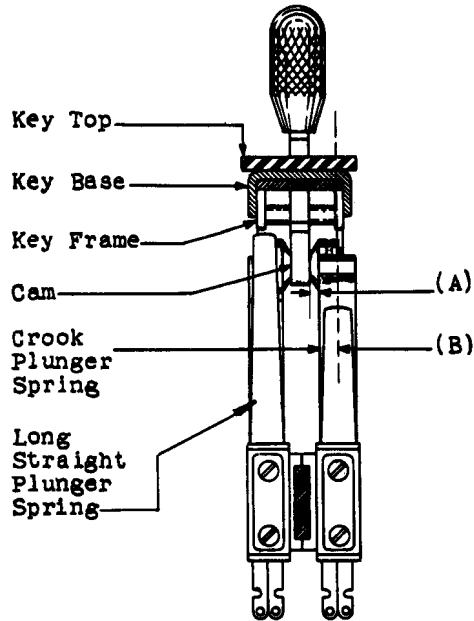


Fig. 21 — Illustrating Relation of Plunger Springs to Cam and Key Frame



Fig. 22 — Illustrating Contact Alignment

(b) Fig. 21(B) — The vertical centerline of each spring shall be approximately perpendicular to the keytop.

Gauge by eye.

On keys equipped with 27/32" keytops, this requirement shall be considered being met if there is some clearance between the plunger springs of the key under consideration and its adjacent keys.

**\*2.21 Contact Alignment:** Fig. 22(A) — The contacts shall line up so that the point of contact falls wholly within the boundary of the opposing contact at all times during contact.

Gauge by eye.

**\*2.22 Contact Separation:** Fig. 18(D)

(a) Fig. 23A(A) — Unless otherwise specified, 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"  
**Readjust** — Min 0.016"

Gauge by eye.

**Note:** On two-way keys equipped with either straight or offset handles when the lever is operated to one side, the contact springs of the unoperated spring combination shall not change their adjustment beyond their requirements for the normal position.

Gauge by eye.

**Exceptions to Requirement (a)**

(b) Fig. 23A(B) — *On contacts* which function by being acted upon by the making or breaking contact of another spring, instead of either by a plunger spring or by a spring actuated directly by a plunger spring by means of a stud, there shall be a contact separation of

**Test** — Min 0.010"  
**Readjust** — Min 0.012"

Gauge by eye.

**Note:** See note following Reqt 2.22(a).

(c) Fig. 23B(A) — Where a key is equipped with a continuity (make-before-break) combination on each side of the plunger spring, the separation between the contacts which function by being acted upon by the making or breaking contact of another spring

instead of by a plunger spring, shall be

**Test** — Min 0.008"  
**Readjust** — Min 0.010"

Gauge by eye.

**Note:** See note following Reqt 2.22(a).

(d) Fig. 24(A) — Where a key is equipped with an offset lever, the separation between those contacts which are broken by the action of a spring which is operated directly by a plunger spring by means of a stud, shall be

**Test** — Min 0.010"  
**Readjust** — Min 0.012"

Gauge by eye.

**Note:** See note following Reqt 2.22(a).

(e) **526A, 526B, and 540E:** The separation between any pair of contacts normally open, or any pair of contacts that are opened when the key is operated, shall be

**Test** — Min 0.010"  
**Readjust** — Min 0.012"

Gauge by eye.

**Note:** See note following Reqt 2.22(a).

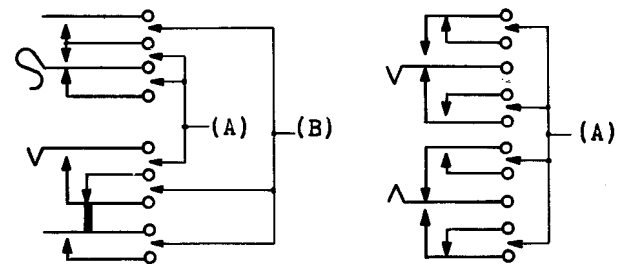
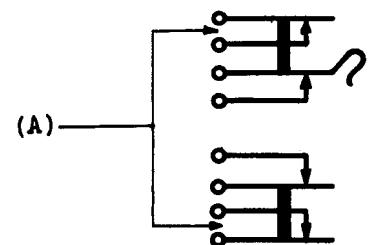


Fig. 23A Fig. 23B  
**Fig. 23 — Illustrating Contact Separation**



**Fig. 24 — Illustrating Contact Separation**

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(f) **BIHU:** The separation between any pair of normally open contacts of the locking key unit when the key is in the normal position shall be

**Test** — Min 0.010"  
**Readjust** — Min 0.012"

Gauge by eye.

**Note:** See note following Reqt 2.22(a).

(g) **B1KW, B1KY, B1LA:** The separation between the normally closed contacts of the locking side of the key when the key is operated, or between the normally open contacts when the key is in the normal position, shall be

**Test** — Min 0.010"  
**Readjust** — Min 0.012"

Gauge by eye.

**Note:** See note following Reqt 2.22(a).

(h) **C8A:** The separation between the normally closed contacts when the key is operated shall be

**Test** — Min 0.010"  
**Readjust** — Min 0.012"

Gauge by eye.

**Note:** See note following Reqt 2.22(a).

(j) **557 and 558 Type:** The separation between the normally open contacts of the continuity when the key is normal shall be

**Test** — Min 0.010"  
**Readjust** — Min 0.012"

Gauge by eye.

**Note:** See note following Reqt 2.22(a).

(k) **C3F:** Requirement (a) shall apply on the outer break contact operated by the throw of the lever to the way-down position.

**Note:** See note following Reqt 2.22(a).

**\*2.23 Spring Clearance:** Fig. 25(A)

(a) 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 0.014"  
**Readjust** — Min 0.016"

Gauge by eye.

**Note:** See note following Reqt 2.22(a).

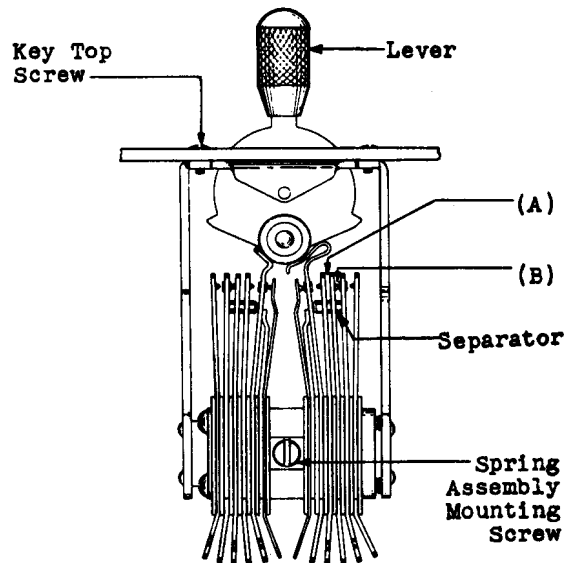


Fig. 25 - Illustrating Spring Clearance

(b) The separators shall not rub on the springs through which they pass when the lever is operated.

Gauge by eye.

(c) The distance between springs designed to make contact shall be

**Test** — Min 0.007"  
**Readjust** — Min 0.008"

except at the contacts.

Gauge by eye.

**\*2.24 Contact Pressure**

(a) Fig. 25(B) — There shall be a pressure between all closed contacts of

**Test** — Min 50 grams  
**Readjust** — Min 55 grams

Use the No. 68B gauge.

**Note:** See note following Reqt 2.22(a).

**Exceptions to Requirement (a)**

(b) **479AW, 540G:** There shall be a pressure on all normally open contacts making on the plunger springs of

**Test** — Min 25 grams  
**Readjust** — Min 30 grams

Use the No. 68B gauge.

**Note:** See note following Reqt 2.22(a).

(c) **540G:** There shall be a pressure on the normally closed contacts of the outside transfer contacts of

**Test** — Min 25 grams  
**Readjust** — Min 30 grams

Use the No. 68B gauge.

**Note:** See note following Reqt 2.22(a).

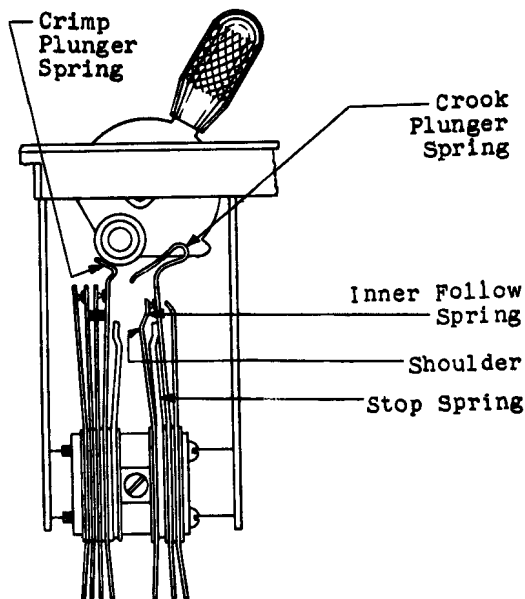
**\*2.25 Other Spring Pressures**

(a) Fig. 27 (A) — *On keys which are equipped with springs mounted on only one side of the roller and a one-way lever, the pressure of the plunger springs against the rollers shall be*

Max 225 grams

Use the No. 68B gauge.

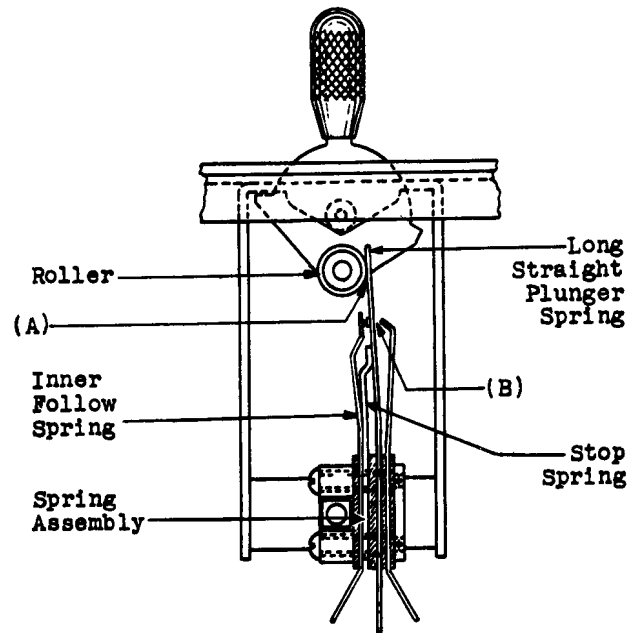
Fig. 26 — *In the case of the crimp plunger springs, the pressure shall be measured at the*



**Fig. 26 — Key With Lever Operated to One Side**

point where the spring bends from the straight portion to the crimp.

Fig. 27 — *In the case of long straight plunger springs, the pressure shall be measured as close as practicable to the point where the spring rests against the roller.*



**Fig. 27 — Illustrating Key Equipped With Long Straight Plunger Spring**

(b) *On keys equipped with straight levers, when the lever is in the normal position, the plunger spring shall rest against its associated stop spring or have a clearance of*

Max 0.010"

Gauge by eye.

(c) *On keys equipped with offset levers, when the lever is in the intermediate position, the plunger spring shall rest against its associated stop spring or have a clearance of*

Max 0.010"

Gauge by eye.

**\*2.26 Contact Follow:** Fig. 27(B) — There shall be a contact follow on all contacts of

**Test** — Min 0.008"

**Readjust** — Min 0.010"

Gauge by eye.

In make-before-break spring combinations, where the long thin spring makes contact with the short heavy spring that acts as a stop spring, this requirement does not apply.

*Note:* See note following Reqt 2.22(a).

**\*2.27 Contact Sequence**

(a) Fig. 28(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"  
*Readjust* — Min 0.006"

Gauge by eye.

(b) Fig. 29(A) — **Cross Sequence — Break-Make Spring Combinations on Ringing Spring Assemblies or When Specified on Circuit Drawing:** 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 0.005"  
*Readjust* — Min 0.006"

Gauge by eye.

(c) **Other Contact Sequences:** When specified on the circuit drawing.

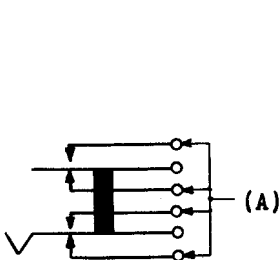


Fig. 28

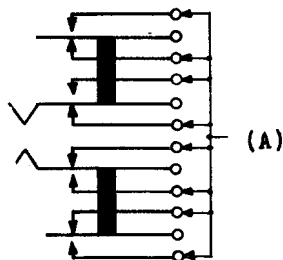


Fig. 29

Illustrating Contact Sequence

**2.28 Nonclick:** Unless otherwise specified, this requirement shall apply where the lever unit is equipped with talking and ringing spring combinations on the same unit, and shall apply to both combinations.

(a) **Keys With Straight Levers:** 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.

(b) **Keys With Offset Levers:** When the lever is restored unrestrained from the normal or way-down position to the intermediate position, no normally closed contacts of the opposite side shall break and no normally open contacts of the opposite side shall make.

*Note:* On the C3F key, this requirement shall not apply.

**2.29 Lever Release:** Fig. 30(A)

(a) The pressure required to restore the lever from one position to another shall be as follows.

KEY TYPE	KEY RESTORED		Test Grams Min	Read- just Grams Min	Use Gauge
	FROM	TO			
Straight lever keys (unless otherwise specified below)	Locked Position	Normal	50	55	68B
	Offset lever keys	Normal	100	110	79C
	Way-down	Inter- mediate	50	55	68B
C7	Locked Position	Normal	100	110	79C

(b) The lever shall return unaided from the locked position before the lever has traveled a maximum of 15 degrees.

*Note:* On 571-type keys, this requirement shall apply to each of the two key units individually.

(c) In checking (a) and (b), the pressure shall be applied at the top portion of the handle and as nearly perpendicular to it as possible.

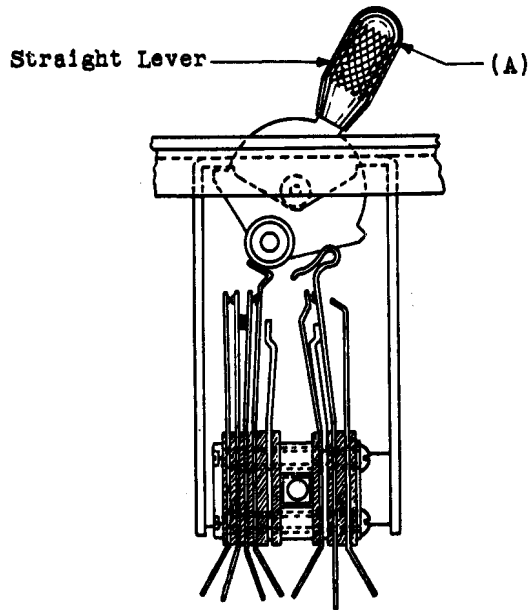


Fig. 30 - Illustrating Lever Release

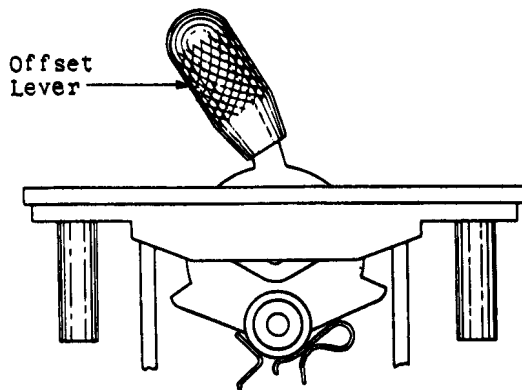


Fig. 31 - Illustrating Key Equipped With Offset Lever

**2.30 Visibility of Indicator:** Fig. 32(A) — The indicator shall be exposed to view in one opening of the escutcheon when operated by either lever being thrown to the extreme position.

Gauge by eye.

**2.31 Operation of Indicator**

(a) The indicator shall not bind.

Gauge by feel.

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

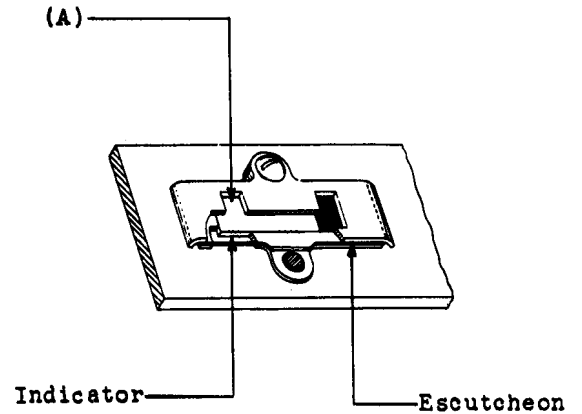


Fig. 32 - Illustrating Visibility of Indicator

**\*2.32 Ticket Clip Tension:** The tension of the ticket clip spring against the clip base shall be

Min 87.5 grams

Max 112.5 grams

Use the No. 70J gauge.

**2.33 Handle Movement of 571-type Keys:**

Fig. 33

(a) The stop pin of the handle shall hold the key locked in either operated position, and in the operated position it shall not be possible to move the handle sufficiently to open closed contacts or close open contacts.

Gauge by eye and feel.

(b) The grip and stop pin of the handle shall operate and restore freely.

Check by eye and feel.

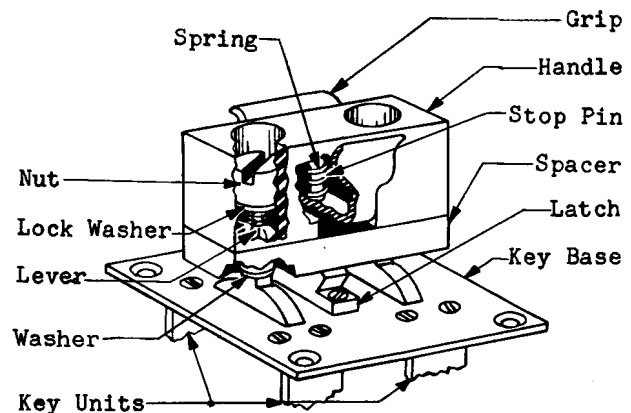


Fig. 33 - 571-type Key Showing Handle Section and Details, Including Locking Device

**SECTION 032-714-701**

**3. ADJUSTING PROCEDURES**

**3.001 List of Tools, Gauges, and Materials**

CODE OR SPEC NO.	DESCRIPTION
<b>TOOLS</b>	
46	3/8" Hex. Single End Socket Wrench
48	Combination 7/32" and 1/4" Hex. Double End Socket Wrench and Screwdriver
206	30° Offset Screwdriver
207	90° Offset Screwdriver
209	5/16" Hex. Open Single End Offset Wrench
210	Key Button Pliers
211	Key Button Pliers
303	Spring Adjuster
363	Spring Adjuster
429A (2 re-quired)	Key Support
429B (2 re-quired)	Key Support
483A	Adjuster
485A	Smooth Jaw Pliers
486A	Oil Can
KS-2663	5-3/8" Jeweler's File
KS-2993	Flat Brush
KS-6320	Orange Stick
KS-6854	3-1/2" Screwdriver
KS-7782	Parallel Jaw Pliers
KS-14164	Brush
—	6" Smooth Round File
—	3-1/2" Cabinet Screwdriver
—	4" Regular Screwdriver
—	No. 1 Gem Paper Clip

CODE OR SPEC NO.	DESCRIPTION
<b>GAUGES</b>	
62B	0-700 Gram Gauge
68B	70-0-70 Gram Gauge
70J (or the replaced 70E)	0-150 Gram Gauge
79B	0-1000 Gram Push-Pull Tension Gauge
79C	0-200 Gram Push-Pull Tension Gauge
79F (or the replaced 79E)	0-6000 Gram Push-Pull Tension Gauge
<b>MATERIALS</b>	
KS-2423	Cloth or
KS-14666 (or replaced D-98063)	Cloth
KS-6232	Oil
KS-7860	Petroleum Spirits
KS-8496	Lubricating Compound No. 3
—	Toothpicks, Hardwood, Flat at One End and Pointed at the Other
—	Rubber Bands

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

**3.003** To remove a universal-type key from a keyshelf, raise the keyshelf and loosen the key mounting screws with the 3-1/2" cabinet screwdriver and shift the butterfly so that the key can be removed. Force the key slightly upward. Lower the keyshelf in place. Raise the key slowly out of its position in the keyshelf. If interference is felt between the key and adjacent



key, do not apply force as this may damage the springs. Instead, remove the adjacent key mounting screws, as outlined above, and raise both keys high enough to permit the removal of the first key without interfering with the second. Then return the second key to its position in the keyshelf. Raise the key to be adjusted as far as is permitted by the skinners. Place a No. 429A or 429B key support inside the lugs on each end of the key to support it while making adjustments. In order to reach the springs of keys equipped with fiber key shields, swing the flaps of the shield vertically upward and fasten them together with a No. 1 Gem paper clip. All key adjustments shall be made after the key is completely assembled, including shield, keytop, and lever handles. However, it is not intended that the shield shall serve as a means of enabling the key to meet any requirement. After the key is satisfactorily adjusted, remove the key supports and return it to its position in the keyshelf. Securely fasten the key in position. When replacing the keys in the keyshelf, take care not to damage the fiber shields on keys so equipped.

**3.004** To remove a key from a keyshelf when the keyshelf is equipped with retaining strips, remove the retaining strip screws with the 3-1/2" cabinet screwdriver and then remove both retaining strips. Remove the key mounting screws with the 3-1/2" cabinet screwdriver and raise and support the key, as outlined in 3.003.

**3.005** To remove a key from the keyshelf when the key is mounted from the top of a keyshelf, remove the mounting screws with the 3-1/2" cabinet screwdriver and raise and support the key, as outlined in 3.003.

**3.006** When adjusting the 6008-, 6009-, or 6011-type keys, remove the key from the box using the 3-1/2" cabinet screwdriver to remove the mounting screws, and proceed as follows:

- (a) Adjust the 6008-type key the same as the 503-type keys.
- (b) Adjust the 6009-type key the same as the 504-type keys.
- (c) Adjust the 6011-type key the same as the 507-type keys.

### **Plunger-type Keys**

#### **\*3.01 Cleaning (Reqt 2.01)**

(1) Clean the contacts as outlined in the section covering cleaning of key and jack contacts. Clean other parts as outlined in 3.03(7) and (16), 3.04 and 3.05(1), 3.13 and 3.14(1).

(2) In the case of keys of A11 type used as master ringing keys, apply a few drops of KS-7860 petroleum spirits to the helical spring and plunger rod at the plunger guide. Operate the plunger rod a few times and wipe the spring and rod with a clean KS-2423 or KS-14666 cloth. Remove dirt or metallic particles that may remain with a clean toothpick which has been dipped in petroleum spirits. Repeat these operations until all debris has been removed, and then lubricate as covered in 3.02.

#### **3.02 Lubrication (Reqt 2.02)**

(1) Before relubricating the plunger rod of keys of the A11 type used as master ringing keys, remove the old lubricant and any accumulation of dust or metallic particles, as covered in 3.01(2). Then lubricate the plunger rod at the lower plunger guide with one dip of the lubricating compound applied with the KS-14164 brush.

#### **3.03 Plunger Movement (Reqt 2.03)**

(1) Cracked, warped, or broken keytops may cause the plunger to bind and thus prevent or delay the release of a plunger. In this case, replace the keytop. To remove the keytop, it will first be necessary to remove the key buttons. If the key is equipped with lever units, it will also be necessary to remove the lever handles.

(2) When removing the key button from plunger units equipped with locknuts, loosen the locknut by turning it away from the button with the No. 209 wrench. Place three or four thicknesses of KS-2423 or KS-14666 cloth over the button, grip it firmly with the No. 210 or 211 pliers, as required, and then while holding the locknut with the No. 209 wrench, remove the button. Where No. 1A or 2A cushions or the equivalent are available, slide them over each jaw of the

No. 210 or 211 pliers and grip the button with the cushion-covered pliers rather than with the cloth-protected pliers. With the KS-6854 screwdriver, remove the keytop screws. If the keytop is not readily removable, push it up from the bottom with the screwdriver.

(3) When removing the plunger buttons with the pliers from a plunger unit not equipped with locknuts, hold the plunger rod firmly with the No. 485A pliers just below the plunger locking or stop cone in order to facilitate this operation. Take care in holding the plunger rod with the pliers to prevent burring of the rod. See Fig. 34.

(4) Loose or missing screws in the keytop may cause it to move and thereby cause the plunger rods to bind. Replace any missing screws and tighten all screws with the KS-6854 screwdriver.

(5) Key buttons, loose or not properly seated on the plunger rod may, when the plunger is depressed far enough, allow the plunger springs to slip over the top of the rubber plunger and thereby prevent or delay the release of the key plunger. If this has occurred, pry the plunger springs apart by hand and allow the plunger rod to restore to its normal position. Replace any defective buttons.

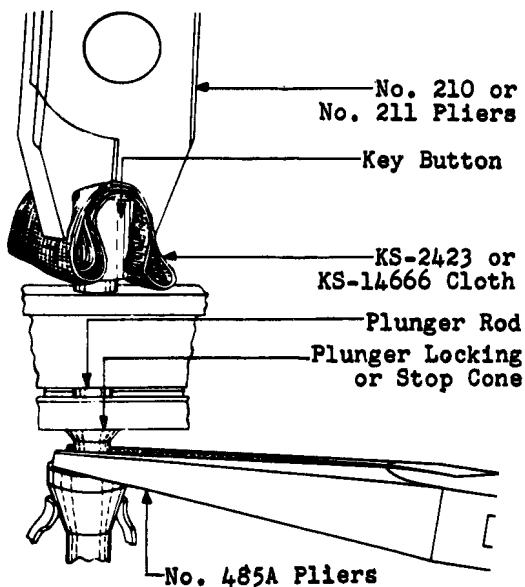


Fig. 34 – Method of Removing Plunger Buttons From Plunger Units Not Equipped With Locknuts

(6) If the plunger rod binds in the keytop slot, loosen the keytop mounting screws with the KS-6854 screwdriver and shift the keytop, if possible, until no bind occurs. If binding still occurs, file out the plunger slot in the keytop slightly, using the round file.

(7) If a plunger rod binds in the key frame, it is probably due to dirt. Place a few drops of petroleum spirits in the slot between the plunger rod and the key frame. Operate the plunger rod a few times, and then wipe the plunger rod with a clean dry KS-2423 or KS-14666 cloth. Repeat this operation until all dirt has been removed.

(8) If the bind is not due to any of the conditions mentioned, see whether the plunger rod is binding in the plunger guide of the spring assembly mounting bracket, or whether it is due to the plunger rod being bent. If the rod is bent, replace it.

(9) **Keys Equipped With Spring Assembly Mounting Brackets Having Plunger Guides:** If the plunger rod binds in the plunger guide of the spring assembly mounting bracket, loosen the screws holding the spring assembly mounting bracket to the key frame with the 3-1/2" cabinet screwdriver, and shift the bracket very slightly so as to elimi-

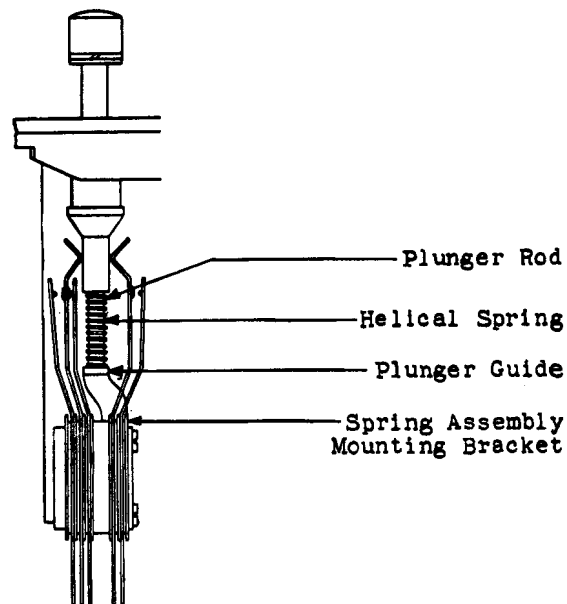


Fig. 35 – Key Equipped With Spring Assembly Mounting Bracket Having Plunger Guide

nate the bind. Then retighten the bracket firmly. If this procedure does not eliminate the bind, it may be necessary to adjust the plunger guide portion of the spring assembly mounting bracket slightly up or down with the No. 485A pliers. If this is required, be careful not to nick the plunger rod with the pliers.

(10) **Keys Equipped With Spring Assembly Mounting Blocks:** If the plunger rod binds in the spring assembly mounting block, loosen the screws holding the spring assembly mounting block to the key frame with the 3-1/2" cabinet screwdriver, and shift the block slightly so as to eliminate the bind, then retighten the screws securely.

(11) Bind may be due to a roughened, bent, or dirty plunger rod. To determine whether the plunger rod is bent, revolve it and watch for side motion of the rubber plunger. At the same time, it is advisable to see whether the rubber plunger is worn. Whenever necessary, take the key apart in the following manner.

(12) Remove the key button, lockwasher where provided, and locknut, as described in (2) and (3), and proceed as follows.

(13) **Keys Equipped With Spring Assembly Mounting Brackets or Blocks:** Loosen the spring assembly mounting bracket or block screws with the 3-1/2" cabinet screwdriver and remove the spring mounting bracket or block, the helical spring, and finally the plunger rod.

(14) **Keys Equipped With 1-, 6-, 8-, 9-type Units:** Remove the keytop screws with the KS-6854 screwdriver and remove the keytop. Then remove the key unit mounting screws with the KS-6854 screwdriver and remove the unit. If necessary to remove the helical spring and plunger rod, remove the spring assembly screws on 1- and 6-type units, or the spring assembly bracket mounting screws on 8- and 9-type units with the KS-6854 screwdriver. Remove the spring assembly, the plunger rod, and the helical spring.

(15) **Other Types of Keys:** On all other types of keys, the spring combinations for each plunger are mounted on a common mounting strip. Therefore, to remove a plunger rod

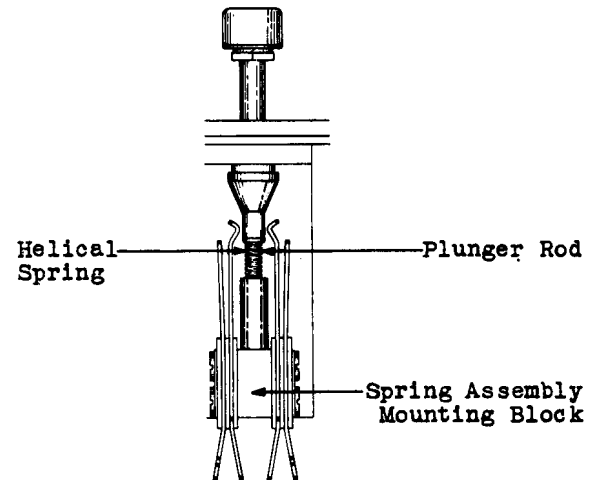


Fig. 36 - Key Equipped With Spring Assembly Mounting Block

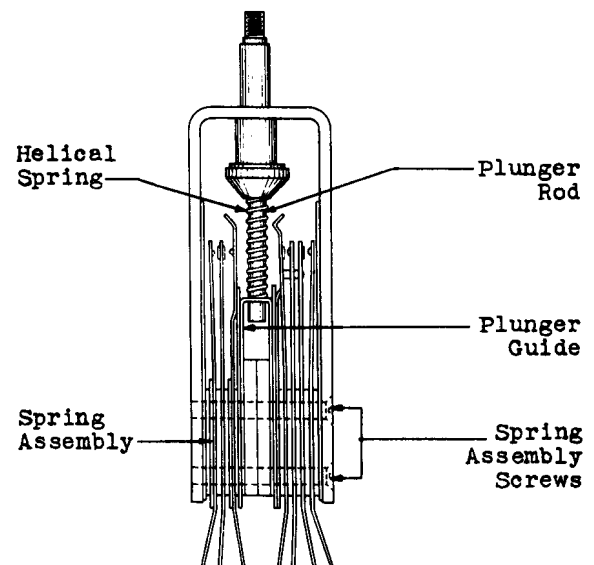


Fig. 37 - 1- or 6-type Key Unit

or helical spring, it is necessary to remove the mounting strip. To do this, remove the nuts holding the mounting strip to the end posts and remove the washers and the mounting strip. Then remove the plunger rod and helical spring. Use the No. 46 wrench to remove the nuts from the 503- and 6008-type keys, and the wider end of the wrench portion of the No. 48 combination wrench and screwdriver on the other types of keys. When removing the mounting strip, exercise care not to lose any of the parts.

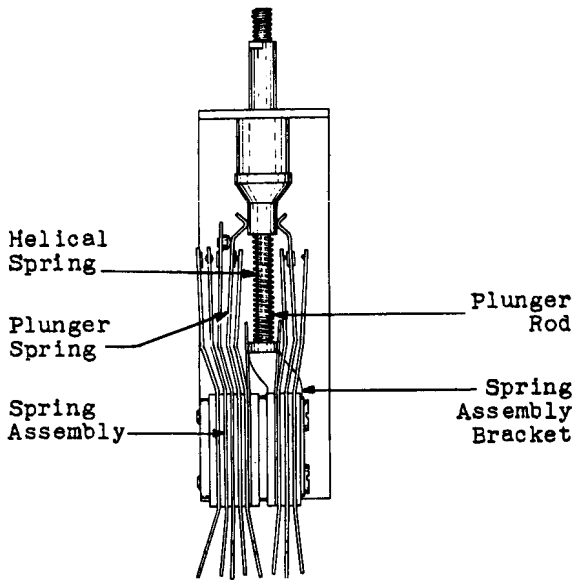


Fig. 38 - 8- or 9-type Key Unit

(16) If the bind is merely due to a dirty plunger rod, clean it and the plunger slot thoroughly with a toothpick which has been dipped in petroleum spirits. Do not use the same toothpick for more than one operation. When thoroughly dry, rub a small amount of KS-6232 oil over the plunger rod and wipe it off with the KS-2423 or KS-14666 cloth.

(17) Replace any plungers which show flat spots. If the bind is due to a bent or roughened plunger rod, replace it with a new one. Reassemble the key.

(18) In resetting the key buttons, turn down the locknut as far as it will go and set the button so that it will line up with the buttons on adjacent keys. Place three or four thicknesses of the KS-2423 or KS-14666 cloth over the button, grip it firmly with the No. 210 or 211 pliers, as required, and then while holding it firmly, tighten the locknut up against the key button.

(19) **Keys Equipped With Buffer Plates:** If the bind still occurs, examine the key to determine whether it is caused by friction between the phosphor-bronze buffer plates and the plunger rod. This trouble, and trouble caused by worn bushings allowing dirt to enter around the plunger rods, may be detected by

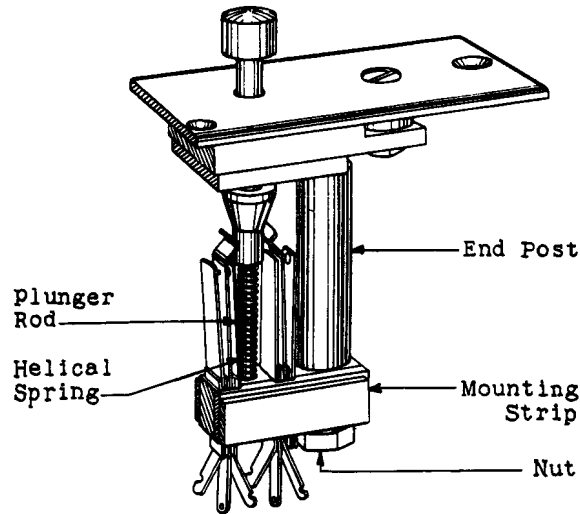


Fig. 39 - 503-type Key

removing the key from the keyshelf and holding the slide plate over against the slide plate operating spring so that the plungers operate clear of the slide plates. Any excessive friction will then be noted. If friction occurs and is caused by the buffer plates, change the key.

#### 3.04 Slide Plate Operating Spring Tension (Reqt 2.04)

#### 3.05 Plunger Release (Reqt 2.05)

(1) See that the slide plate has full travel when any plunger is depressed. Foreign matter between the slide plate and key base will hamper the movement of the slide plate and thereby prevent the proper release of a plunger from the locked to the normal position. Place a few drops of petroleum spirits between the slide plate and key base with a clean toothpick and operate the slide plate by hand a number of times. Then take a toothpick which has been dipped in petroleum spirits and remove whatever dirt may remain. Exercise care not to break the toothpick so as to leave portions of it between the key base and slide plate. At the same time, remove any dirt that might have collected on the rollers.

(2) A weakened or damaged slide plate spring will result in failure to lock the plungers in the operated position. To increase the tension of a weak spring, adjust it close to the base of the spring with the KS-7782 pliers, so that a greater pressure will be exerted against

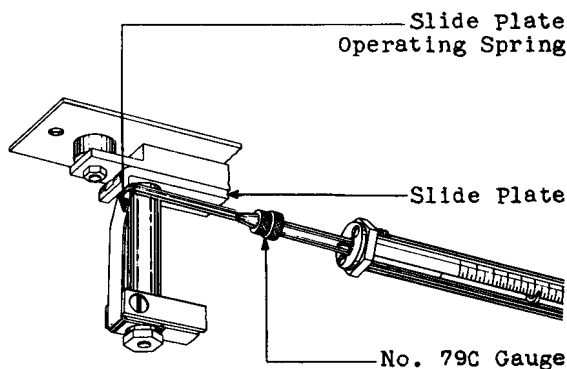
the slide plate. Replace damaged springs, using the Nos. 206 and 207 screwdrivers to remove the mounting screw. In some cases, if the key is equipped with a spring assembly in the extreme rear position, it will first be necessary to remove this assembly. To do this, remove the spring assembly mounting bracket or block screws as outlined in 3.03, and remove the spring assembly mounting bracket or block.

(3) After this adjustment is made, check to determine that the plunger operate pressure requirement is met.

(4) To replace a slide plate operating spring on a 503- or 6008-type key, remove the mounting strip nut with the No. 46 wrench and remove the spring.

(5) Observe whether the slide plate is bent. This would cause bind and prevent the proper operation of the slide plate. In this case, replace the key.

(6) Observe whether the helical spring is broken or distorted in any way. The tension of this spring should be sufficient to release the plunger from a locked or intermediate position with a snap when any other plunger is depressed to a locked or intermediate position. If the helical spring is broken or distorted replace it, taking the key apart as outlined in 3.03 (12) to (15), inclusive.



**Fig. 40 – Method of Gauging Slide Plate Operating Spring Tension**

### 3.06 Contact Alignment (Reqt 2.06)

(1) If the contacts do not line up satisfactorily, loosen the spring assembly screws with the 3-1/2" cabinet screwdriver and shift

the springs until each contact point lies wholly within the opposing contact, preferably as near the center as possible. Then tighten the screw securely. When mounted, the springs should be as nearly parallel to the mounting strip as can be judged by eye. After aligning the contacts, check that the requirements, as covered in 2.07 to 2.12, are met.

(2) On some keys, due to the proximity of the spring assembly brackets, it may be impossible to shift the springs while the brackets are mounted. If necessary, loosen and remove the spring assembly mounting bracket screws and remove the spring assembly mounting bracket. Then proceed as outlined in 3.07 to 3.12.

### 3.07 Contact Separation (Reqt 2.07)

### 3.08 Spring Clearance (Reqt 2.08)

### 3.09 Contact Pressure (Reqt 2.09)

### 3.10 Other Spring Pressures (Reqt 2.10)

### 3.11 Contact Follow (Reqt 2.11)

### 3.12 Contact Sequence (Reqt 2.12)

(1) When 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.

(2) Before making any adjustments, make certain that the spring assembly clamping screws are tight. If these screws are tight, it will still be necessary to adjust the springs. On all keys, except the A9-, A14-, and A23-type keys, adjust the springs with the KS-7782 pliers, as covered below. On the A9-, A14-, and A23-type keys, use the No. 303 spring adjuster.

(3) **Spring Clearance:** If the spring is excessively bowed or bent, or if there is not the proper clearance between springs, straighten the spring before adjusting to meet the contact pressure requirement. To straighten the spring, apply the specified adjuster to the spring just back of the bow or bend, and while exerting pressure to the right or left as required, draw the adjuster upward the length of the bow. Repeat this operation, as required, until the spring is approximately straight. Take care, when adjusting the springs, to adjust them in line with their movement and to avoid tilting the spring.

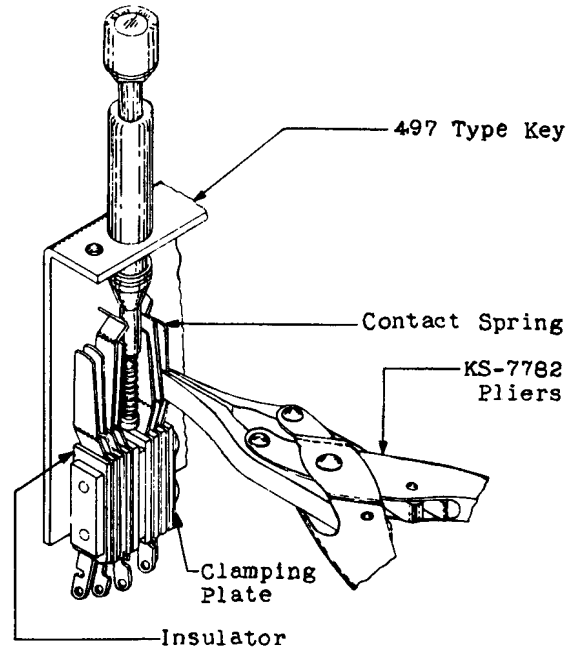
(4) **Contact Pressure, Other Spring Pressures, Contact Separation, and Contact Follow:**

Foreign matter wedged between the contact springs may prevent the springs from making contact when the plunger is operated. Remove the foreign matter with a clean toothpick which has been dipped in petroleum spirits. If the requirement is still not met, proceed as follows. Place the specified adjuster on the spring just back of the contact, slide it back to where the spring leaves the clamping plates and insulators, and adjust the spring to the right or left as required, exercising care not to disturb adjacent springs.

(5) If the desired pressure can not be obtained by adjusting, as outlined in (4), without bowing the spring beyond its permissible limit or reducing the clearance between the springs below the specified minimum, place the specified adjuster on the spring just below the contact and slide it down to where the spring leaves the clamping plates and insulators, as shown in Fig. 41. Draw the adjuster upward the length of the spring, meanwhile applying pressure as required, so that the spring is formed into a slight gradual bow with the concave surface facing the associated spring. The magnitude of the bow to be formed in the spring must be learned by experience and should be such that, when the final tension adjustment is made at the base, the spring will be approximately straight. Move the adjuster to the base of the spring and adjust as covered in (4).

(6) Do not straighten kinked springs unless the kink interferes with proper adjustment of the spring assembly. Removing kinks tends to weaken the spring and to shorten its life. Normally, straight springs that have been adjusted should have no sharp bends due to adjustment. A gradual bow, however, is permissible.

(7) If, after the above adjustments have been made, it is necessary to change the contact separation or contact follow, place the specified adjuster just below the contact and adjust the spring toward or away from the associated spring, as required. In no case should the bend be enough to make a visible kink in the spring. In making this adjustment, it may be necessary to readjust the tension as outlined in (5).



**Fig. 41 – Method of Adjusting for Contact Separation, Spring Clearance, Contact Pressure, Contact Follow, and Spring Sequence**

(8) **Contact Sequence:** When adjusting for contact sequence, increase or decrease the contact separation, contact pressure, or contact follow as outlined in (1) to (7), inclusive.

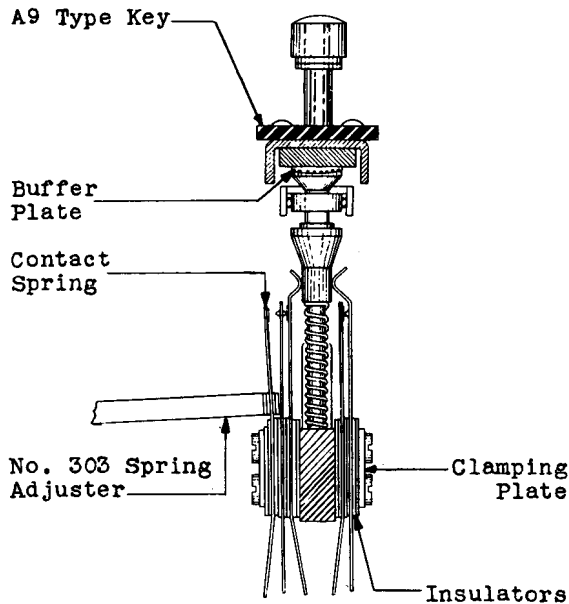
**3.13 Plunger Operate Pressure (Reqd 2.13)**

**3.14 Plunger Nonoperate Pressure (Reqd 2.14)**

(1) If a plunger is stiff and fails to meet the plunger operate pressure requirement, examine the plunger springs to determine whether a gummy substance has formed on them. Clean the surface of the plunger springs, as required, with a toothpick which has been dipped in petroleum spirits. Do not use the same toothpick for more than one cleaning operation. Wipe the plunger with a clean dry KS-2423 or KS-14666 cloth.

(2) If, after the petroleum spirits have dried off, the key still fails to meet the requirement, it may be necessary to reduce the tension of the contact or plunger springs towards the minimum limit.

(3) Do not use any lubricant on the key plunger to facilitate this adjustment.



**Fig. 42 – Method of Adjusting for Contact Separation, Spring Clearance, Contact Pressure, Contact Follow, and Spring Sequence**

(4) When readjusting a plunger spring, see that the relationship of the plunger springs to the plunger is correct. Make the test to determine whether the plunger springs clear the plunger in any one normal position by revolving the plunger and noting that, in at least one position of the plunger, the specified clearance between the plunger and plunger spring exists.

(5) If a plunger fails to meet the plunger nonoperate pressure requirement, examine the helical spring to determine whether it is broken or distorted in any way. If necessary, replace the helical spring as outlined in 3.03 (12) to (15).

#### Lever-type Keys

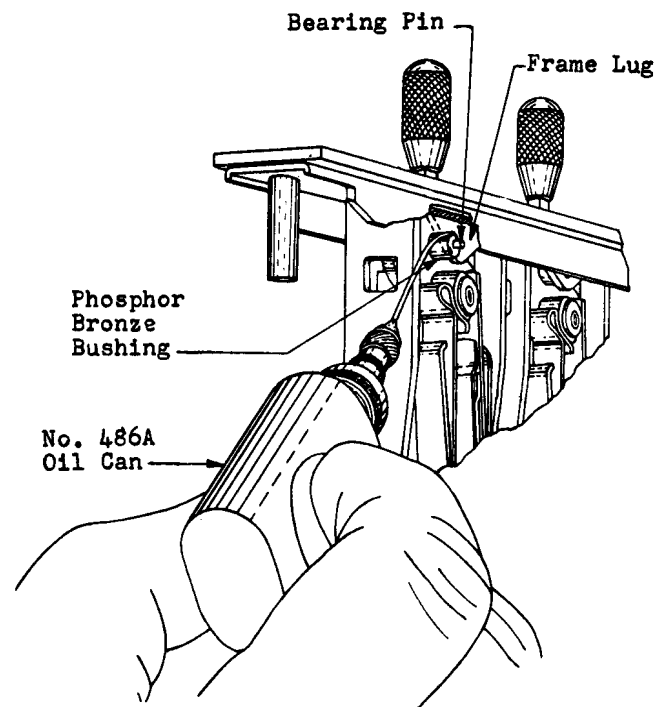
##### \*3.15 *Cleaning* (Reqt 2.15)

(1) Clean the contacts as outlined in the section covering cleaning of key and jack contacts. Clean other parts as outlined in 3.18 (2) and (6) and 3.22 to 3.28 (4).

##### 3.16 *Lubrication* (Reqt 2.16)

(1) To lubricate the bearing pins, raise and secure the keyshelf in place and proceed as follows, using the No. 486A oil can. Hold

the can so that the curved end of the nozzle is downward. Press the sides of the container inward until a drop is formed on the end of the nozzle. Touch the end of the nozzle at a point where the frame lug and bushing meet, as shown in Fig. 43. In order to insure the proper application of the lubricant, the wiring form may be used as a rest for the hand. When inserting the nozzle between the keys, take care that the drop of oil does not drop off prematurely or that the nozzle does not touch against the key frame or contact springs. Operate the lever several times so that the lubricant will be drawn into the bearing. If any lubricant is deposited on any part other than that requiring lubrication, remove it with the KS-14666 cloth. In certain cases, to remove this lubricant it may be necessary to remove the key from the keyshelf as outlined in 3.003.



**Fig. 43 – Method of Lubricating Bearing Pins**

**3.17 *Record of Lubrication*** (Reqt 2.17)  
(No procedures)

**3.18 *Lever Movement*** (Reqt 2.18)

(1) If the lever, when released slowly, does not return to its normal position or if the movement is not smooth throughout its travel,

determine whether the rollers or cam binds on its bearings. To determine whether the rollers bind, move the lever slowly about one half its total movement in one direction and note whether the roller rotates on its bearing. If it does not appear to, remove the tension of the plunger springs with the fingers and attempt to rotate the roller with the KS-6320 orange stick. If the roller does not rotate, replace the frame as outlined in (8). To determine whether the lever binds, move the lever its full distance and release it, noting whether the operation is smooth throughout its movement. A slight drag is not considered objectionable so long as the lever returns consistently to the nonoperated position. If the lever fails to move satisfactorily, it may be due to any of the following.

(2) A foreign deposit on the surfaces of plunger springs, over which the plunger rollers ride, will prevent the lever from operating and restoring smoothly. If necessary, clean the springs with a clean toothpick which has been dipped in petroleum spirits. Do not use the same toothpick for more than one cleaning operation. When cleaning a plunger spring, operate the lever so as to operate the opposite spring combination. Do not permit petroleum spirits to get on the hard rubber rollers, as it will tend to remove the wax lubricant from the rollers.

(3) Cracked, warped, or broken keytops may cause the levers to bind and thus prevent or delay the release of the lever. In this case, replace the keytop. To do this, unscrew the lever handles, remove the keytop mounting screws with the KS-6854 screwdriver, and remove the keytop. Substitute a new keytop in place on the key, then insert and securely tighten the mounting screws. Screw the lever handles in place.

(4) Loose or missing screws in the keytop may cause it to move and bind the lever. Replace missing screws, and tighten all screws with the KS-6854 screwdriver.

(5) Rubbing of the cam against the keytop may be the cause of sluggish action. This is indicated by smooth bright spots on the cam. In some cases, it may be possible to correct this by loosening the keytop screws and shifting the keytop, as required. However, when this is not possible, due either to prox-

imity of other keys or to no sideplay in the keytop, enlarge the slot in the keytop with the KS-2663 file. To do this, remove the lever handles, remove the keytop mounting screws with the KS-6854 screwdriver, then remove the keytop. Take care, however, in filing the slots not to enlarge them any more than necessary to clear the trouble. Enlarging the slot, as outlined above, is not applicable to the 479-, 501-, 526-, 531-, 532-, or 540-type keys since the keytop is not removable on the 479- and 526-types, and no keytop is provided on the 501-, 531-, 532-, 540-, 557-, and 558-type keys.

(6) If the bind is not removed by the above procedure it may be corrected by removing the lever handles and keytop. Examine the cam and the slots in the key frame and key base for dirt. Clean the parts, if necessary, by means of the KS-2993 brush.

(7) Sluggish action may result from faulty adjustment of crook and locking plunger springs. In this case, adjust the springs as outlined in 3.29.

(8) If the cam is worn, attempt to compensate for the wear by adjusting the springs as outlined in 3.22 to 3.28, inclusive. Except for the A9-type keys, if the wear cannot be compensated for or if the cam binds on its bearing, replace the frame and lever assembly as follows. Remove the lever handles and keytop as outlined in (3). Remove the key unit mounting screws with the 3-1/2" cabinet screwdriver and remove the key unit from the mounting plate. Remove the spring assembly mounting screw with the 3-1/2" cabinet screwdriver and remove the mounting nut, where provided. Remove the spring assemblies from the frame and mount them on the replacing frame. Insert the mounting screw and nut and tighten the nut securely. Remount the unit securely in place on the mounting plate, then remount and securely fasten the keytop and lever handles. Check to see whether the key meets its requirements, and if not, adjust as required.

**3.19** *Relation of Plunger Springs to Rollers and Cam* (Reqt 2.19)

**3.20** *Relation of Plunger Springs to Cam and Key Frame* (Reqt 2.20)

(1) In the case of keys equipped with a straight lever, failure of a lever to be in the vertical position when the key is normal



is often due to the plunger springs not being set in correct relationship with respect to the rollers and the cam. Similarly, in the case of keys equipped with offset levers, failure of the lever to assume its correct position when in the intermediate position is often due to incorrect relationship between the plunger springs, rollers, and cam.

(2) In some cases, this incorrect relationship may be corrected by loosening the spring assembly mounting screws with the 3-1/2" cabinet screwdriver and shifting the spring assembly. Then tighten the mounting screws securely.

(3) If the lever still fails to assume its correct position, the trouble may be caused by improper positioning of one or more of the plunger springs, or to excessive or insufficient tension of the plunger spring against the roller. To correct this condition, operate the lever so that the rollers are away from the plunger spring under consideration, and grasp the free end of the stop spring with the No. 485A pliers. Adjust the stop spring toward the plunger spring to decrease the tension of the plunger spring against the roller, or away from it to increase the tension. It may also be necessary to increase or decrease the tension of the plunger spring or the opposite plunger springs. The tension of these springs should be sufficient to cause the lever to return to its correct position when the lever is released slowly from its operated position. Make all adjustments on the plunger springs (except those involving the crook of the plunger spring) with the KS-7782 pliers applied approximately 1/4" from the point where the springs leave the clamping plate and insulators.

### 3.21 *Contact Alignment* (Reqt 2.21)

(1) If the contacts do not line up satisfactorily, loosen the spring assembly screws slightly with the 3-1/2" cabinet screwdriver and shift the springs until each contact point lies wholly within the opposing contact, preferably as near the center as possible. Then tighten the screws securely. When mounted, the springs should be in correct relationship with the cam and key frame. After aligning the contacts, check that the requirements as covered by 2.22 to 2.28 inclusive, are met.

- 3.22 *Contact Separation* (Reqt 2.22)
- 3.23 *Spring Clearance* (Reqt 2.23)
- 3.24 *Contact Pressure* (Reqt 2.24)
- 3.25 *Other Spring Pressures* (Reqt 2.25)
- 3.26 *Contact Follow* (Reqt 2.26)
- 3.27 *Contact Sequence* (Reqt 2.27)
- 3.28 *Nonclick* (Reqt 2.28)

(1) When 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.

(2) Before adjusting the springs, tighten all the spring assembly screws. If these screws were tight, it will still be necessary to adjust the springs.

(3) *Spring Clearance:* If a separator rubs on the spring through which it passes, loosen the spring assembly screws slightly with the 3-1/2" cabinet screwdriver and shift the springs, as required. Tighten the mounting screws securely. Take care in making this adjustment that the contact alignment requirement is still met. If the spring is excessively bowed or bent or if there is not the proper clearance between springs, straighten the spring before adjusting to meet the contact pressure requirement. To straighten the spring, apply the KS-7782 pliers to the spring just back of the bow or bend, and while exerting pressure to the right or left as required, draw the pliers upward the length of the bow. Repeat this operation, as required, until the spring is approximately straight. Take care when adjusting the springs to adjust them in line with their movement and to avoid tilting the spring.

(4) *Contact Pressure, Other Spring Pressures, Contact Separation, and Contact Follow:* Foreign matter wedged between the springs may prevent the springs from making contact when the lever is operated. Remove the foreign matter with a clean toothpick which has been dipped in petroleum spirits. If the requirement is still not met, proceed as follows. Place the KS-7782 pliers on the spring just below the contact, slide it down to where the spring leaves the clamping plates and insulators, and adjust the spring to the right or left as required, exercising care not to disturb adjacent springs.

(5) If the desired pressure cannot be obtained by adjusting, as outlined in (4), without bowing the spring beyond its permissible limit or reducing the clearance between the springs below the specified minimum, place the pliers on the spring just back of the contact and slide them back to where the spring leaves the clamping plates and insulators, as shown in Fig. 44. Draw the pliers upward the length of the spring, meanwhile applying pressure as required, so that the spring is formed into a slight gradual bow with the concave surface facing the associated spring. The magnitude of the bow to be formed in the spring must be learned by experience, and should be such that when the final tension adjustment is made at the base, the spring will be approximately straight. Move the adjuster to the base of the spring and adjust, as covered in (4).

(6) Do not straighten kinked springs unless the kink interferes with proper adjustment of the spring assembly. Removing kinks tends to weaken the spring and to shorten its life. Normally, straight springs that have been adjusted should have no sharp bends due to adjustment. A gradual bow, however, is permissible.

(7) If, after the above adjustments have been made, it is necessary to change the contact separation or contact follow, place the KS-7782 pliers just below the contact and adjust the spring toward or away from the associated spring, as required. In the case of back contact springs associated with the stop springs, bend the spring slightly at the shoulder with the No. 485A pliers. However, exercise care when increasing the contact follow so that the contact pressure between the spring and plunger spring does not exceed the maximum specified. In no case should the bend be enough to make a visible kink in the spring. In making this adjustment, it may be necessary to readjust the tension as outlined in (5).

(8) On 2-way keys, the follow should be such that when the lever is moved over to one side, the contact springs of the nonoperated spring combination will not change their adjustments beyond the requirements for the normal position. Failure to meet this condition generally results from excessive pressure of the plunger springs against the plunger rollers or from incorrect adjustment of the stop springs. This should be corrected by adjusting the position of the stop springs or by reducing the tension of the plunger spring slightly, but not enough to interfere with any of the previous adjustments. Use the KS-7782 pliers.

(9) **Contact Sequence:** When adjusting for contact sequence, increase or decrease the contact separation, contact pressure, or contact follow as outlined in (1) to (8), inclusive.

(10) **Nonclick:** In readjusting for nonclick, operate the key lever to the locking position and push the handle until it reaches a point in its travel where it will release without further aid. On nonlocking 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 nonclick requirements, increase the follow on the normally closed contacts as outlined in (8). If the click is caused by the overthrow being so great as to momentarily make an open contact, increase the contact separation slightly and also reduce the tension of the contact springs which exert too great a pressure against the plunger spring on the side from which the roller was released. In either case, recheck all previous adjustments.

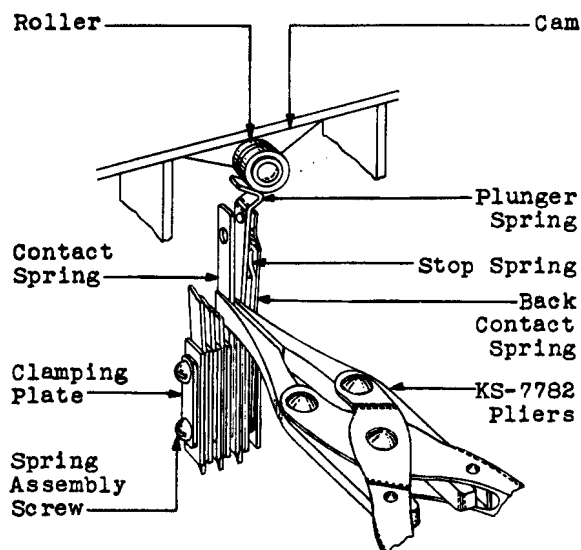
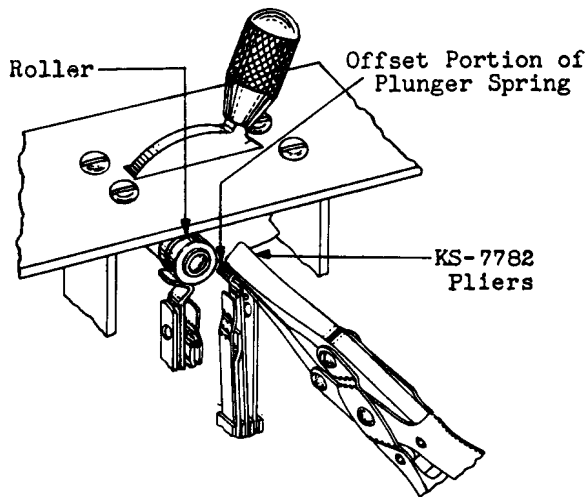


Fig. 44 – Method of Adjusting for Contact Separation, Spring Clearance, Contact Pressure, Other Spring Pressures, Contact Follow, Contact Sequence, and Nonclick

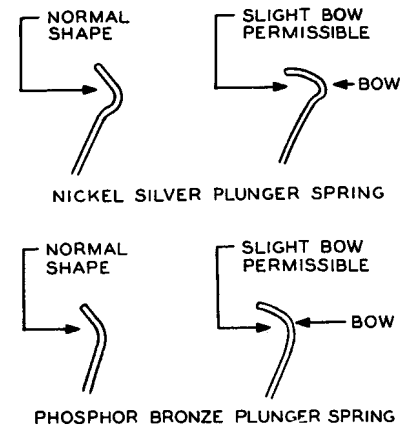
**3.29 Lever Release (Reqt 2.29)**

- (1) When making a check for the lever release pressure, apply the pressure to the top of the cylindrical portion of the handle and perpendicular to it.
- (2) If the key fails to meet the requirements, adjust the angle of the offset portion of the plunger spring very slightly with the KS-7782 pliers, as shown in Fig. 45, so as to cause a greater drag on the lever rollers when returning to normal. The bend in the offset should not be such as to permit the spring to slip back under the roller and to return partially to the nonoperated position, nor should it prevent the lever from returning unaided from the locked position after it has travelled 15° (a movement equivalent to about one half the travel of the lever) from the extreme locked position when the pressure is applied at the top of the cylindrical portion of the handle and perpendicular to it. Do not use any lubricant on the key roller to facilitate this adjustment.



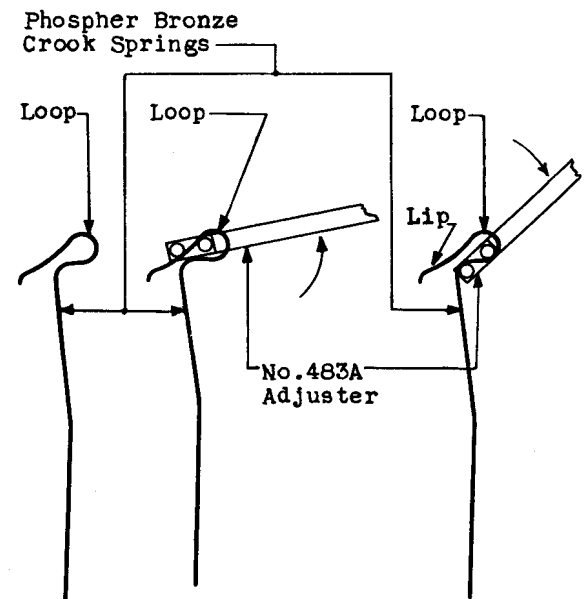
**Fig. 45 – Method of Adjusting Plunger Spring for Lever Release**

- (3) In order to obtain a satisfactory locking condition, it may sometimes be necessary to adjust the offset portion of the plunger spring so as to form a bow, as shown in Fig. 46.
- (4) If the key still fails to meet its requirements, attempt to obtain a satisfactory operation of the key by adjusting the vertical



**Fig. 46**

portion of the crook plunger spring before attempting to adjust the loop. Should it be found necessary to adjust the loop, either through the replacement of plunger springs or because of excessive sluggishness in the return of the lever from the operated to the normal position or excessive loss of spring travel, the angle of the loop may be adjusted by means of the No. 483A adjuster, as shown in Fig. 47. Make all adjustments at the curve



**Fig. 47 – Method of Adjusting Phosphor-Bronze Crook Spring**

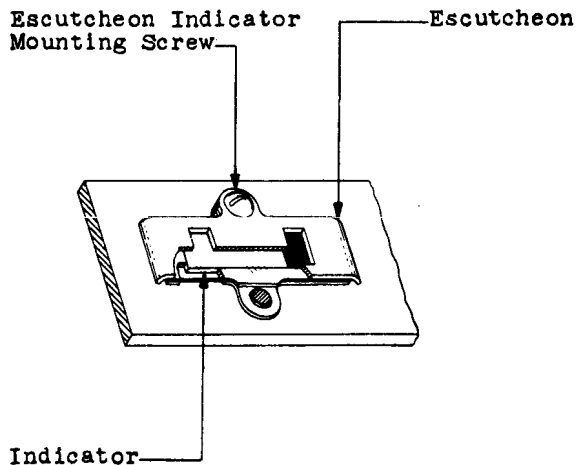


Fig. 48 - Nomenclature of Indicator Parts

between the vertical and horizontal part of the spring. Do not bend or change the shape of the spring. Do not bend or change the shape of the upper or loop part of the spring. The lip of the spring may be adjusted upward but the adjustment shall be in the form of a continuous curve not less than the radius of the roller. Raising the loop increases the travel of the spring when it is operated and increases its tendency to return the lever to its normal position. Lowering the loop tends to reduce the spring travel but increases the tendency for the lever to lock in the operated position. For this reason, the loop can be higher in non-locking than in locking spring combinations. A slight change in the position of the loop will have a considerable effect on the adjustments. Particular care must be taken to avoid excessive bending and to guard against sharp bends or tool marks, as these will result in early spring breakage.

### 3.30 Visibility of Indicator (Reqt 2.30)

(1) If the indicator is only partially exposed when operated by the lever of the front unit thrown to the extreme front position, it is probably due to a bent indicator arm. In this case, replace the indicator arm. If the indicator is only partially exposed when operated by the lever of the rear unit thrown to the extreme front position, it is probably due to the offset portion of the link not being bent to the correct angle. In this case, adjust the offset portion of the link with the No. 485A pliers so that the indicator arm will have a greater movement.

### 3.31 Operation of Indicator (Reqt 2.31)

(1) If the indicator binds, correct as follows.

Examine the indicator mechanism to see whether any dirt has collected between the indicator arm and washer. Remove the indicator escutcheon mounting screws with the KS-6854 screwdriver, and remove the escutcheon and indicator spacer. Then remove the shoulder screw with the 3-1/2" screwdriver and remove the indicator arm and washer. Clean each of the parts thoroughly with petroleum spirits, and when dry, assemble the parts. When resetting the parts, do not tighten the shoulder screw to such an extent as to cause bind. See Fig. 49.

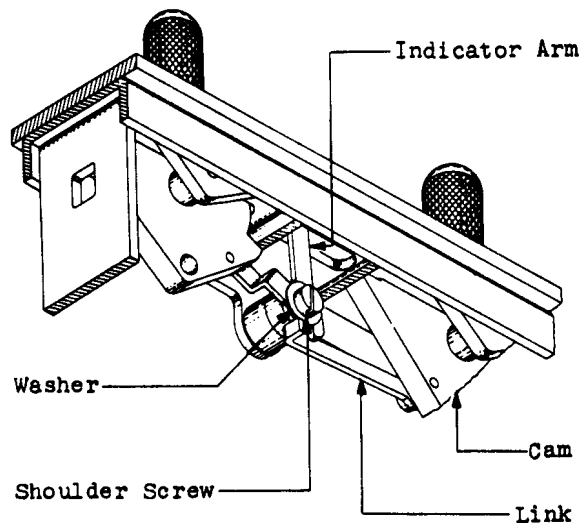


Fig. 49 - Nomenclature of Indicator Parts

(2) To check whether or not the indicator moves due to its own weight when the key is in a vertical position with the long axis of the mounting up, place the key in the vertical position, operate the lower key associated with the indicator, and observe whether the position of the indicator changes when the key is released.

(3) If the indicator does not change its position, tighten the shoulder screw with the 3-1/2" cabinet screwdriver, taking care not to cause any bind.

### 3.32 Ticket Clip Tension (Reqt 2.32)

(1) If the ticket clip does not hold the ticket properly, remove the clip mounting screws with the KS-6854 screwdriver and remove the clip from the keytop. Check the tension of the spring against the clip base with the No. 70J gauge, as shown in Fig. 50. To do this, apply the tip of the gauge reed to the spring between the tip of the spring and the point where the spring touches the clip base. Take care that the reed does not touch the clip base, as this will cause the spring to be pried away from the clip base causing a false indication. Adjust the clip spring, as required, with the No. 363 spring adjuster applied as near as possible to the point where the spring is clamped to the clip base. Remount the ticket clip on the key.

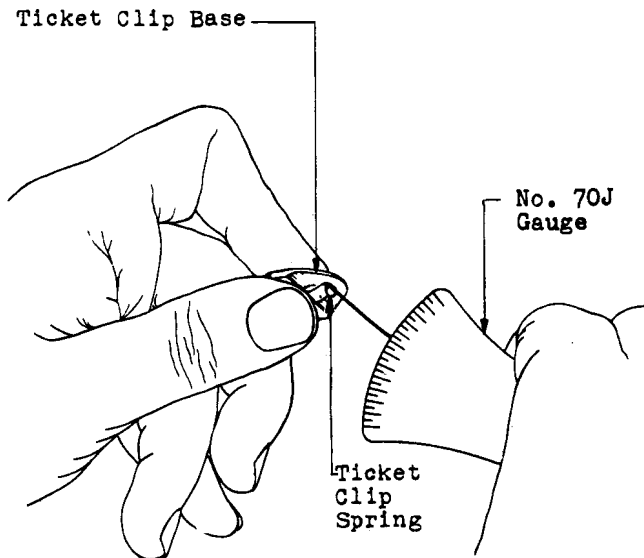


Fig. 50 – Method of Checking Tension of Ticket Clip Spring

### 3.33 Handle Movement of 571-type Key (Reqt 2.33)

(1) If the handle does not lock or does not function smoothly, or if there is excessive play, determine whether it is due to the handle locking device or the key unit lever movement. To determine whether the locking device is defective, proceed as covered in (2) and (4). If the locking device proves satisfactory, investigate the lever movement as covered in 3.18.

If the movement of the handle in the locked position opens closed contacts or closes open contacts, adjust the springs as covered in 3.22 to 3.28.

(2) If the handle does not lock properly, it may be due to either a stop pin which is bent or binding in the spacer, a defective spring in the handle, a loose latch or handle top, or sluggish action caused by foreign material wedged between parts.

(3) To determine whether the locking device works satisfactorily, note that when the key is in the normal position the stop pin is resting on the latch. If it does not appear to, lift the grip as far as permitted by the slot in the handle and then release it. Note that the stop pin rises with the grip, that both the grip and stop pin release with a snap, and the stop pin then rests on the latch. If it does not, the stop pin may be bent or binding in the spacer, the spring in the handle may be defective, or foreign material may have accumulated between parts. The handle should be disassembled and examined as covered in (5).

(4) If the operation of the grip and stop pin appear satisfactory in the normal position, operate the handle to either operated position. Note that the stop pin engages the latch so as to reliably lock the handle in the operated position. Then check the other operated position. If the locking action is defective in either or both positions, it may be due to a loose latch or handle top or to a bent stop pin. The handle should be disassembled as covered in (5).

(5) To disassemble the handle, remove the nuts with a 4" regular screwdriver. Lift the grip and handle top from the levers, taking care not to lose the lockwashers under the nuts. Separate the grip and handle top to expose the spring. Examine the parts to determine the cause of faulty operation, as covered in (6) and (7).

(6) Dirt or foreign matter may cause the binding. Remove any dirt or foreign matter from the hole in the spacer, through which the stop pin passes, by applying a few drops of petroleum spirits with a clean toothpick. Clean out the hole with a clean toothpick and wipe the spacer dry with a KS-2423 cloth. Remove

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any foreign matter from the stop pin or the latch with a KS-2423 cloth slightly moistened with petroleum spirits. Wipe clean and dry with another portion of the cloth.

- (7) If the stop pin does not rest on or lock with the latch properly, it may be due to

a damaged or a weak spring. If so, replace it. If the stop pin is bent or loose in the grip, replace the grip and stop pin as an assembly. If the notch of the latch is burred or damaged, replace the latch by removing, with a KS-6854 screwdriver, the two screws used to fasten it to the keytop.