

KEYS  
60-TYPE SELECTOR  
AND 491-TYPE  
REQUIREMENTS AND ADJUSTING PROCEDURES

1. GENERAL

1.01 This section covers 60 type selector and 491 type keys and replaces Section A432.019, Issue 2-D

1.02 This section is reissued to incorporate material from the addendum in its proper location. In this process marginal arrows have been omitted.

1.03 Reference shall be made to Section 020-010-711, covering General Requirements and Definitions for additional information necessary for the proper application of the requirements listed herein.

\*1.04 Asterisk: Requirements are marked with an asterisk (\*) when to check for them would necessitate the dismantling or dismounting of apparatus, or would affect the adjustment involved or other adjustments. No check need be made for these requirements unless the apparatus or part is made accessible for other reasons or its performance indicates that such a check is advisable.

1.05 The normal position is that position in which further movement of the rotating parts of the key is prevented by the stop on the main spring shaft contacting either with a stop on the key frame or with a stop on the pinion shaft. In the case of the No. 491B, C and D keys, the brush is contacting with the topmost segment of the commutator. In the case of the No. 491A and E keys the impulse springs of the middle and rear impulse wheels are approximately centered in their respective notches and in the case of the 60 type selector keys, the impulse spring is approximately centered in the notch in the impulse wheel. In this position all normally closed contacts are closed and all normally open contacts are open.

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

2. REQUIREMENTS

2.01 Cleaning

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

(c) Where petroleum spirits are used for cleaning, the key shall be allowed to dry and shall then be relubricated.

2.02 Lubrication

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

Main Shaft Bearings Fig. 1 (A)  
Worm Bearings Fig. 1 (B)  
Pinion Shaft Bearings Fig. 1 (C)  
Worm Fig. 1 (D)

(b) No lubricant shall be applied to the pinion teeth or gear teeth

(c) Recommended Lubrication Intervals  
After turnover, it is recommended that the parts listed above be lubricated at intervals of one year. These intervals may be extended if periodic inspections have indicated that local conditions are such that the requirements will be met during the extended interval.

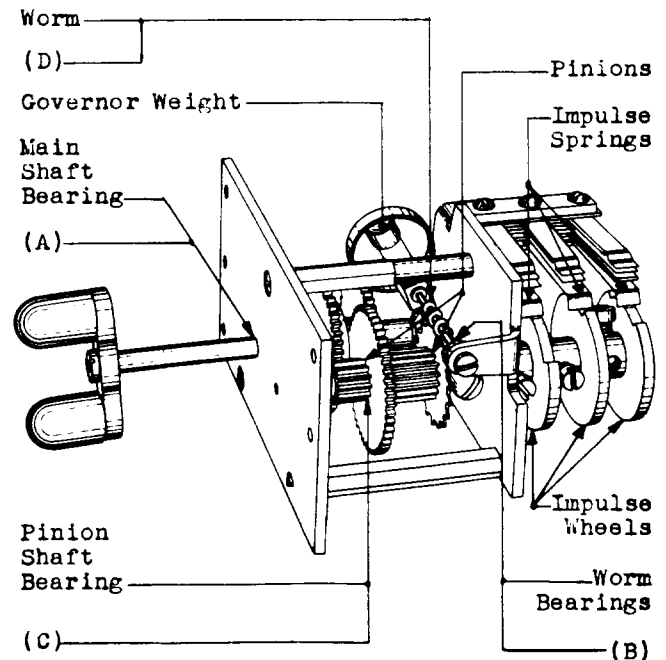


Fig. 1 - No. 491A Key

2.03 Record of Lubrication: During the period of installation a record shall be kept by date, of the lubrication of the key 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.

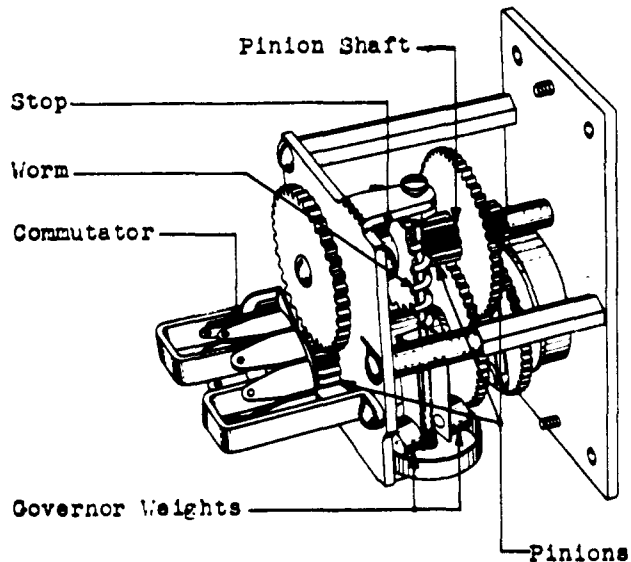


Fig. 2 - No. 491C Key

\*2.04 Contact Separation - Fig. 3 (A)

(a) 491A and E Keys: 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. .008"  
Readjust - Min. .010"  
 Use the KS-8909 gauge.

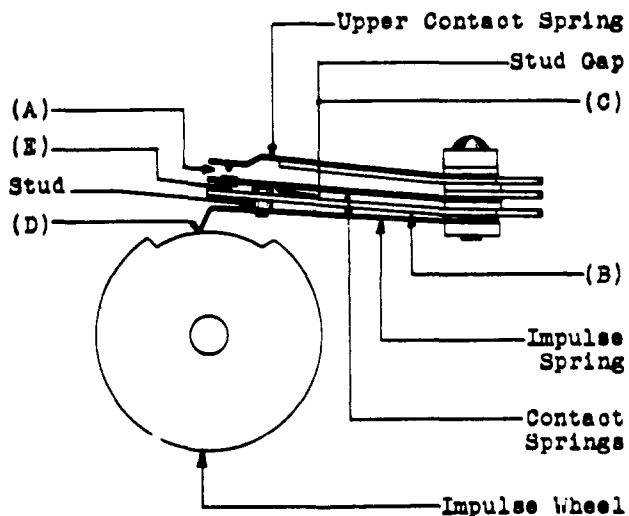


Fig. 3 - Impulse Wheel and Contact Spring Assembly

(b) 60 Type Selector Keys (Except 60B):  
 The separation between any pair of normally open contacts with the key in the normal position shall be  
Test - Min. .018"  
Readjust - Min. .020"  
 and the separation between any pair of normally closed contacts when the key is operated shall be  
Test - Min. .013"  
Readjust - Min. .015"  
 Use the KS-6909 Gauge

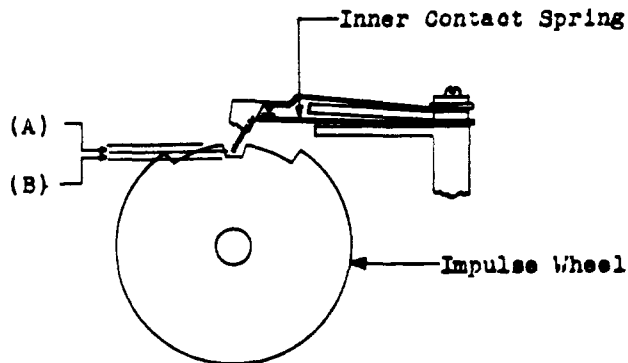


Fig. 4 - Inner Contact Spring Position

\*2.05 Inner Contact Spring Position - 60B Selector Key - Fig. 4 (A) and (B):

In the normal position the end of the inner contact spring shall enter the slot in the impulse wheel for a depth of  
 Min. .015"  
 but the clearance between the end of the spring and the bottom of the slot of the impulse wheel shall be  
 Min. .010"  
 Gauge by eye. Use the KS-8909 gauge as a reference.

\*2.06 Spring Clearance - Fig. 3 (B): The clearance between springs designed never to make contact shall be  
 Min. .010"  
 Gauge by eye.

\*2.07 Contact Alignment - Fig. 5 (A): Contacts shall line up so that the point of contact shall fall wholly within the boundary of the opposing contact. Gauge by eye.

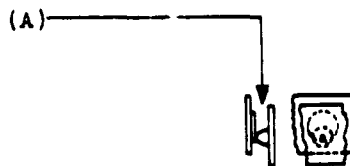


Fig. 5 - Contact Alignment

- \*2.08 Stud Gap - 491A and E Keys - Fig. 3 (C): The gap between the top of the stud and the middle contact spring of the rear unit, with the key in the normal position shall be:  
Min. .005"  
Gauge by eye.

- \*2.09 Contact Follow - 491A and E Keys: There shall be a follow on the upper springs of all three spring combinations, of  
Min. .010"  
Gauge by eye.

- \*2.10 Contact Sequence - Break-Make Combinations: Unless otherwise specified, the normally closed contacts operated directly by an impulse spring of an individual assembly shall break before the normally open contacts of the same assembly directly associated with that plunger spring make by  
Min. .006"  
Gauge by eye.

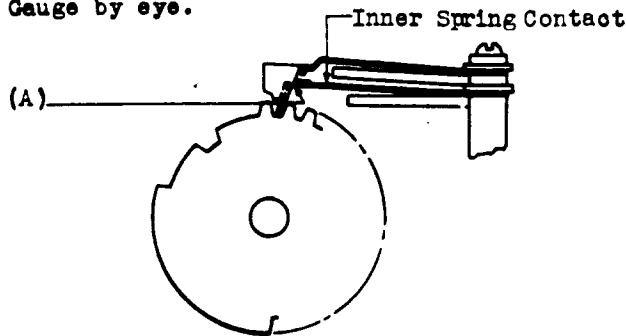


Fig. 6A

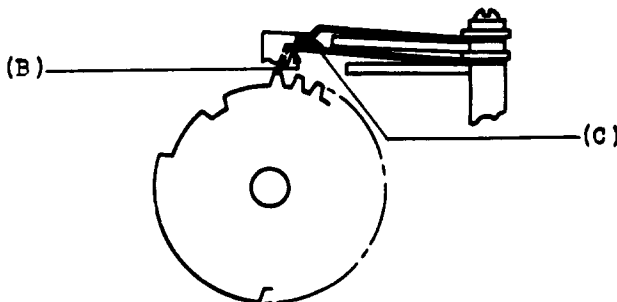


Fig. 6B

Fig. 6 - Impulse Spring Pressure - 60B Selector Key

\*2.11 Impulse Spring Pressure

- (a) 491A and E Keys - Fig. 3 (D): The pressure of the impulse spring against the impulse wheel measured with the spring in the notch in the impulse wheel shall be  
Min. 10 grams, Max. 20 grams  
This pressure excludes the pressure of the contact springs. Use the No. 68B gauge.

(1) When checking the impulse spring pressure lift the spring which rests on the impulse spring away from the stud.

(2) To check the pressure apply the gauge to the spring just back of the point where the spring is bent to make contact with the impulse wheel.

- (b) 60 Type Selector Keys (Except 60B) - Fig. 3 (D): The pressure of the impulse spring against the impulse wheel measured with the spring in the notch in the impulse wheel shall be  
Min. 10 grams

This pressure excludes the pressure of the break contact spring. Use the No. 68B gauge. See 2.11 (a) (1) and (2).

(c) 60B Selector Key

(1) Fig. 6(A) - The pressure of the inner contact spring against the impulse wheel when the spring is resting against the bottom of a tooth shall be  
Test - Min. 8 grams  
Readjust - Min. 10 grams  
Use the No. 70H gauge - See 2.11 (a) (2).

(2) Fig. 6(B) - The combined pressure of the inner and outer contact springs against the impulse wheel when the tip of the spring is resting on the top of a tooth shall be  
Test - Max. 125 grams  
Readjust - Max. 112.5 grams  
Use the No. 70E gauge - See 2.11 (a) (2).

- \*2.12 Lower Contact Spring Pressure - 491A and E Keys: The lower contact spring of the middle and front spring combinations shall have a pressure on the stud with the key in the normal position of  
Test - Min. 10 grams, Max. 30 grams  
Readjust - Min. 15 grams, Max. 30 grams  
Use the No. 70H gauge.

\*2.13 Contact Pressure

(a) 491A and E Keys - Fig. 3 (E): The contact pressure of the normally closed contacts shall be  
Test - Min. 25 grams, Max. 55 grams  
Readjust - Min. 30 grams, Max. 55 grams  
Use the No. 68B gauge.

(b) 60 Type Selector Keys - Fig. 3 (E): The contact pressure between normally closed contacts shall be  
Test - Min. 10 grams  
Readjust - Min. 15 grams  
Use the No. 68B gauge.

(c) 60B Selector Key - Fig. 6 (C): The contact pressure between the normally open contacts when the inside contact

**\*2.13 (Continued)**

These angular distances approximately equal

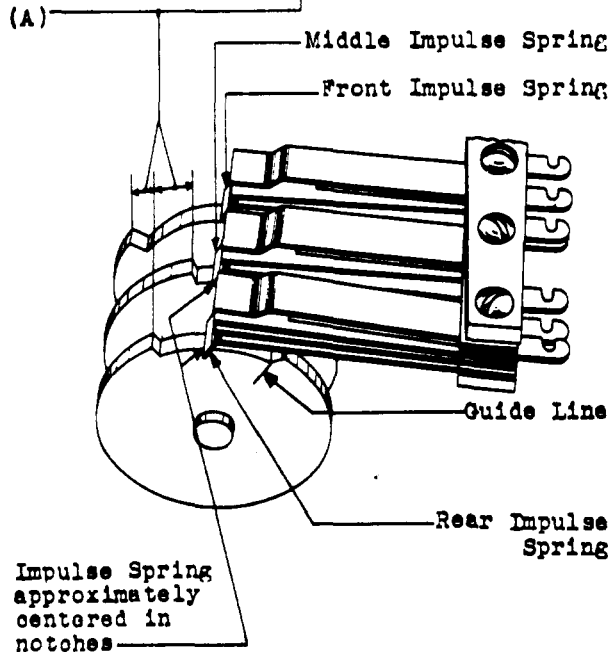


Fig. 7 - Setting of Impulse Wheels

spring is resting on top of a tooth shall be

Min. 15 grams  
Use the No. 70H gauge.

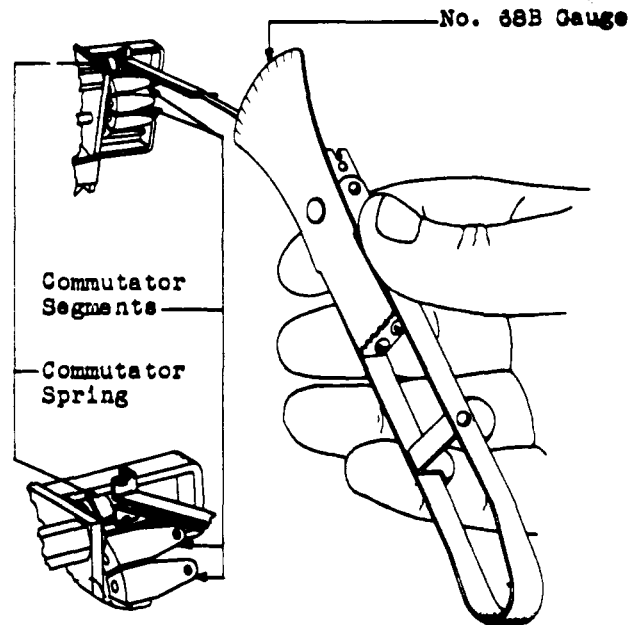
**\*2.14 Setting of Impulse Wheels - No. 491A Key - Fig. 7 (A)**

(a) With the trailing edges of the impulse springs in approximate alignment and with the key in the normal position, the middle and rear impulse wheels shall be set so that the impulse springs center in the recesses of the associated impulse wheels.

(b) The front impulse wheel shall be set so that the angular distance between the front edge of the front impulse wheel recess and the front edge of the rear impulse wheel recess measured on the periphery of the wheels shall be approximately equal to the angular distance between the front edge of the rear impulse wheel recess and the front edge of the middle impulse wheel recess. Gauge by eye.

**\*2.15 Setting of Impulse Wheels - No. 491E Key**

(a) The normally open contacts on the front impulse wheel shall make and the normally closed contacts on the rear impulse wheel shall break the instant that the key begins to operate.



Enlarged View Showing Application of Gauge to Commutator Spring

Fig. 8 - Method of Measuring Commutator Spring Pressure with the No. 68B Gauge

(1) This requirement may be checked by noting if the tips of the impulse springs point to the guide lines on the impulse wheels when the key is normal. These guide lines are stamped on the sides of the impulse wheels.

(b) The normally open contacts on the middle impulse wheel shall make the instant that the normally closed contact of the rear impulse wheel breaks the second time. This is equivalent to setting the tip of the impulse spring to coincide with the guide line of the impulse wheel. Gauge by eye.

**\*2.16 Setting of Impulse Wheel - No. 60B Selector Key - Fig. 4 (C):** With the key in the normal position the inner contact spring shall approximately center in the recess of the impulse wheel. Gauge by eye.

**\*2.17 Pressure of Brush on Commutator - Nos. 491B, C and D Keys - Fig. 9 (A):** The pressure of the brush against the commutator shall be

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

(a) To check this pressure use the No. 68B gauge, applying the tip of the gauge as close as possible to the part of the brush that rests on the commutator as indicated in Fig. 8. Where space

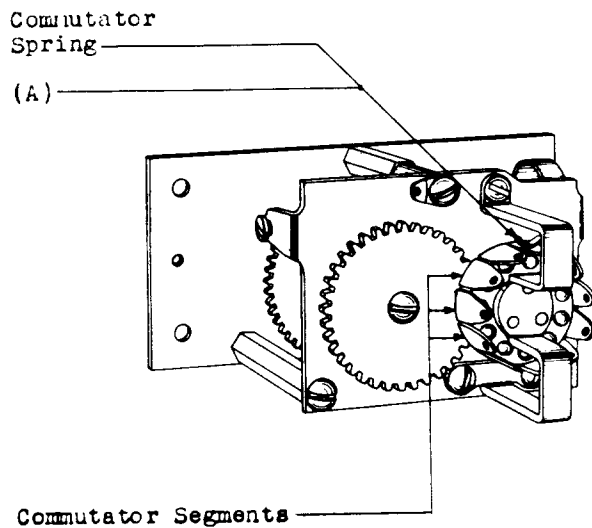
**\*2.17 (Continued)**

Fig. 9 - Brush Spring Pressure

does not permit manipulation of this gauge, the pressure may be checked by feel. Use an orange stick for this purpose. When it is desired to check this tension with the brush in other than the normal position, operate the key and block the driving mechanism as desired by holding a finger on the governor.

**2.18 Speed of Key**

- (a) No. 491A Key: When the key is fully wound and then released the impulse wheels shall make one complete revolution from the normal position in  
Min. 10 seconds, Max. 12 seconds  
Use the KS-3008 stop watch.
- (b) Nos. 491B, C and D Keys: When the key is fully wound and then released the commutator brush shall make three complete revolutions in  
Min. 14 seconds, Max. 16 seconds  
Use the KS-3008 stop watch.
- (c) No. 491E Key: When the key is fully wound and then released the impulse wheels shall make one complete revolution from the normal position in  
Min. 5 seconds, Max. 6 seconds  
Use the KS-3008 stop watch.
- (d) 60B Selector Key: When the key is fully wound and then released the impulse wheel shall make one complete revolution from the normal position in  
Min. 9.0 seconds, Max. 9.5 seconds  
Use the KS-3008 stop watch.
- (e) No. 60D and D-95147 and D-95579 Selector Keys: When the key is fully wound, and then released the impulse wheel shall make one complete revolution from the normal position in

Min. 7 seconds, Max. 7.5 seconds

Use the KS-3008 stop watch.

(f) No. 60E and D-94862 and D-95580 Selector Keys: When the key is fully wound and then released the impulse wheel shall make one complete revolution from the normal position in

Min. 10 seconds, Max. 11 seconds

Use the KS-3008 stop watch.

(g) 60C Selector Key: When the key is fully wound and then released, the impulse wheel shall make one complete revolution from the normal position in

Min. 5.0 seconds

Max. 5.5 seconds

Use the KS-3008 stop watch.

**2.19 Per Cent Make and Break - 60B Selector**

Key: The period of contact make shall be approximately 50% and the period of contact break shall be approximately 50% of the time required for passing over each tooth of the impulse wheel.

Note: This requirement is met if the per cent make or break is not less than 45% or more than 55%, as determined by taking the average of the 2 voltmeter readings outlined in (1).

- (1) To check this requirement connect the contact spring terminals of the key in series with a voltmeter which is connected across battery. To get most accurate readings for this test the voltage of the battery should approximate the maximum scale reading of the voltmeter. Operate and release the key. The voltmeter needle will vibrate as the inner contact spring passes over the teeth of the impulse wheel. Record the lowest voltage indicated by the meter needle during the pulsing interval. Repeat the operation and record the highest voltage indicated by the meter needle during the pulsing interval. Recheck the condition as often as necessary to determine the approximate lowest and highest reading of the needle. The average of the two readings should be approximately 1/2 of the steady voltage reading on the meter.

**\*2.20 Tension of Pawl Spring**

Test - The tension of the pawl spring shall be sufficient to insure that the pawl firmly engages the teeth in the driving wheel in any position.

Readjust - The tension of the pawl spring measured at the end of the spring shall be at least 70 grams. Use the No. 79C gauge.

- (1) To check the tension of the pawl spring apply the No. 79C gauge to the end of the spring as shown in Fig. 10 and note that the tension registered on the gauge is not less than 70 grams.

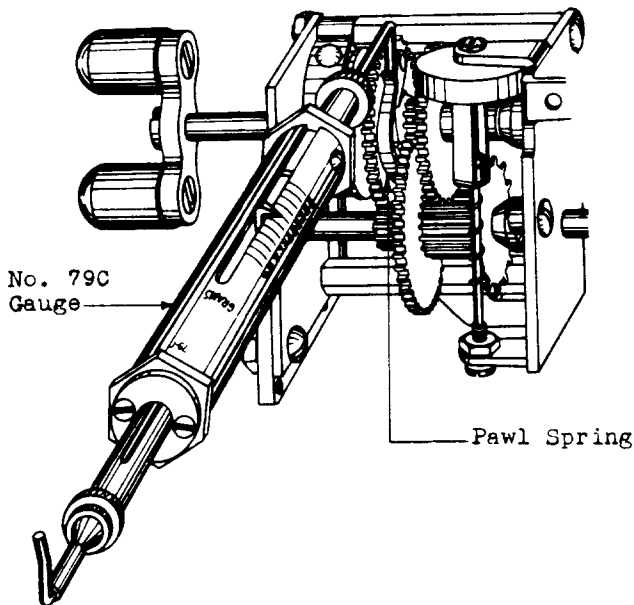


Fig. 10 - Method of Checking  
Pawl Spring Tension

\*2.21 Setting of Code Segments - No. 60B Selector Key: The segments on the impulse wheel shall be set to provide the series of impulses specified on the circuit drawing.

### 3. ADJUSTING PROCEDURES

#### 3.001 List of Tools and Materials

<u>Code No.</u>	<u>Description</u>
<u>Tools</u>	
105	Spring Adjuster
259	Spring Adjuster
305	Spring Adjuster
371	Spring Adjuster
485A	Smooth Jaw Pliers
-	KS-6015 6" Duck-bill Pliers
-	KS-6320 Orange Stick
-	3" Cabinet Screwdriver
-	No. 4 Artist's Show Card Brush R1575
<u>Gauges</u>	
68B	70-0-70 Gram Gauge
70E	150-0-150 Gram Gauge
70H	0-30 Gram Gauge

<u>Code No.</u>	<u>Description</u>
79C	0-200 Gram Push-Pull Tension Gauge
-	KS-6909 Thickness Gauge Nest
-	KS-3008 Stop Watch
-	Weston Model No. 1 D.C. Voltmeter (or equivalent)

#### Materials

-	KS-2423 Cloth or
-	KS-14666 Cloth
-	KS-6232 Oil
-	KS-7860 Petroleum Spirits
-	No. 22 Bare Tinned Copper Wire

3.002 Caution: Do not take the key apart. There is danger of springing the frame or bending the governor spindle if this is attempted. All readjustments necessary to maintain the key in good operating condition can be made without taking it apart. It will be necessary, however, to remove the key from the mounting.

3.003 Where the key is provided with a cover, remove the cover mounting screws with the 3" cabinet screwdriver and remove the cover. After making the necessary adjustments, remount and secure the cover in place.

#### 3.01 Cleaning (Rq.2.01)

(1) Contacts: Clean the contacts in accordance with the section covering cleaning procedures for key contacts.

(2) Bearings, Worm, Pinions and Pinion Shafts: If upon inspection there is found to be an accumulation of gummy oil or foreign matter on these parts clean them thoroughly with the No. 4 Artist's Show Card brush which has been dipped in petroleum spirits.

(3) Impulse Wheel: To clean the impulse wheel of 60 type selector keys and the No. 491A and No. 491E keys, moisten a clean dry KS-14666 cloth with petroleum spirits and wipe off the parts. To clean the parts normally inaccessible operate and release the key and hold the cloth on the wheel as the key releases.

#### 3.02 Lubrication (Rq.2.02)

(1) When lubricating the key, apply one drop of oil on the worm and the main shaft, worm shaft and pinion shaft bearings. Excessive lubricant shall not be

## 3.02 (Continued)

allowed to remain on any of these points. Take care in applying the oil that none is applied or spattered onto the teeth of the gears or pinions.

3.03 Record of Lubrication (Rq.2.03)  
No procedure.

- 3.04 Contact Separation (Rq.2.04)
- 3.05 Inner Contact Spring Position (Rq.2.05)
- 3.06 Spring Clearance (Rq.2.06)
- 3.07 Contact Alignment (Rq.2.07)
- 3.08 Stud Gap (Rq.2.08)
- 3.09 Contact Follow (Rq.2.09)
- 3.10 Contact Sequence (Rq.2.10)
- 3.11 Impulse Spring Pressure (Rq.2.11)
- 3.12 Lower Contact Spring Pressure (Rq.2.12)
- 3.13 Contact Pressure (Rq.2.13)

(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.

(2) Unless otherwise specified, adjust the springs close to the point where the spring leaves the spring assembly clamping plates and insulators with the No. 105, 303 or 371 spring adjuster as shown in Fig. 11. Use the Nos. 105 and 303 spring adjuster on the light springs and the No. 371 spring adjuster on the heavy springs. In adjusting the springs take care not to kink them. Kinked springs should not be straightened unless the kink interferes with the proper adjustment of the key. Removing kinks tends to weaken the spring and shorten the life of the key.

(3) Contact Alignment: At the time the other spring adjustments are being made, see that the contact points lie wholly within the boundary of the opposing contacts. If necessary, loosen the spring assembly screws with the 3" cabinet screwdriver and shift the springs until each contact point lies wholly within the corresponding contact disc preferably as near the center as possible. Then tighten the screws securely.

(4) If the flexible contact springs do not rest on their stop springs adjust as follows: Insert a piece of No. 22 bare tinned copper wire between the flexible spring and stop spring. Place the No. 485A pliers over the stop spring and flexible spring and compress the pliers. When the contacts are fully made, the flexible contact springs should be held slightly away from the stop springs. This indicates that the contacts have a follow which insures sufficient contact pressure.

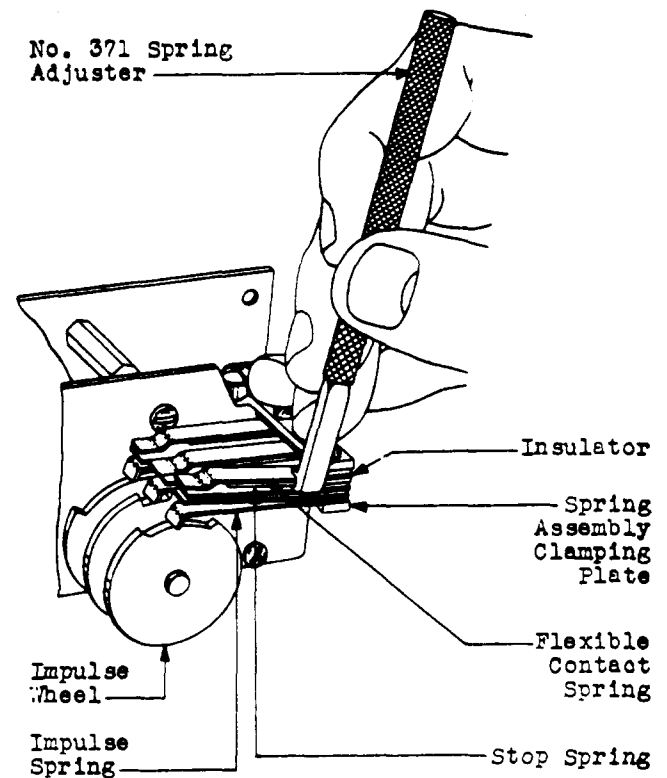


Fig. 11 - Method of Adjusting Contact Springs

(5) Spring Clearance: Trouble due to springs touching each other which are designed never to make contact is caused either by springs being kinked or bowed or by excessive follow. Straighten the springs or reduce the excessive follow as required with the No. 485A pliers.

(6) Foreign matter wedged between the contact springs may prevent springs from making contact when the key is operated. Remove the foreign matter with a toothpick which has been dipped in petroleum spirits. Do not use the same toothpick for more than one operation.

(7) Contact Follow: If the follow requirement cannot be met by adjusting the springs close to the point where they leave the clamping plates and insulators, the part of the spring close to the contact may be given a slight bend toward the moving spring with the No. 485A pliers. This bend should not be enough however, to make a visible kink in the spring.

(8) Contact Sequence: When adjusting for contact sequence increase or decrease the contact separation, contact pressure or contact follow as outlined in (2).

3.04-3.13 (Continued)

(9) In adjusting the impulse spring exercise care not to kink the spring as it is made of steel and does not readily yield to adjustment in this manner. In extreme cases it will be necessary to loosen the assembly screws with the 3" cabinet screwdriver and remove the impulse spring (the three impulse springs are a unit) and then bend the particular spring in the desired direction with the thumb and fingers. In tensioning the spring, take care not to alter the angle at which the spring meets the impulse wheel. Remount the spring in the assembly and tighten the assembly screws. Recheck the pressure of the spring and readjust as necessary.

3.14 Setting of Impulse wheels - No. 491A Key (Rq.2.14)

(1) If the setting of the impulse wheels is not within the requirements proceed as follows:

(2) Middle and Rear Impulse Wheel: See that the switch mechanism is normal and with the 3" cabinet screwdriver, loosen the screws which hold the middle and rear impulse wheels to the shaft, and set the middle impulse wheel so that the spring centers in the recess. Hold the middle impulse wheel firmly with the left hand, tighten the screw securely, and then move the rear impulse wheel until its spring is centered in the recess. The center of the recess in the rear impulse wheel should then be approximately in line with the center of the middle wheel recess. Tighten the set screw holding the wheel to the shaft securely.

(3) Front Impulse Wheel: Loosen the screws holding the front impulse wheel to the shaft with the 3" cabinet screwdriver and shift the wheel until the front edge of its recess is the same angular distance ahead of the front edge of the recess of the rear wheel as the front edge of the recess of the rear wheel is ahead of the front edge of the recess in the middle wheel.

3.15 Setting of Impulse wheels - No. 491E Key (Rq.2.15)

(1) To adjust for this requirement, loosen the impulse wheel set screws with the 3" cabinet screwdriver and shift the wheel until the guide line and the tip of the associated impulse spring are in alignment. Tighten the set screws.

3.16 Setting of Impulse Wheel - No. 60B Selector Key (Rq.2.16)

(1) To adjust the position of the impulse wheel, loosen the two impulse wheel set screws with the 3" cabinet screwdriver and position the impulse wheel on the shaft. Tighten the set screws securely.

3.17 Pressure of Brush on Commutator (Rq.2.17)

(1) If the requirement is not met, correct by adjusting the brush at the base with the No. 485A pliers until the desired tension is obtained.

(2) Inasmuch as altering the commutator brush tension may vary the speed of the key it will be necessary to check requirement 2.17.

3.18 Speed of Key (Rq.2.18)

(1) To increase the speed, adjust the two wings of the governor approximately equal amounts toward the governor shaft, with the No. 485A pliers applied as shown in Fig. 12.

(2) To decrease the speed apply the No. 485A pliers to the wings in the manner outlined in (1) above and adjust the two wings of the governor approximately equal amounts away from the governor shaft.

3.19 Per Cent Make and Break - 60B Selector Key (Rq.2.19)

(1) To adjust the percentage make and break of the contacts adjust the contact separation. Adjust the contact separation as outlined in 3.04, increasing the separation to increase the per cent break and decreasing the separation to decrease the per cent break.

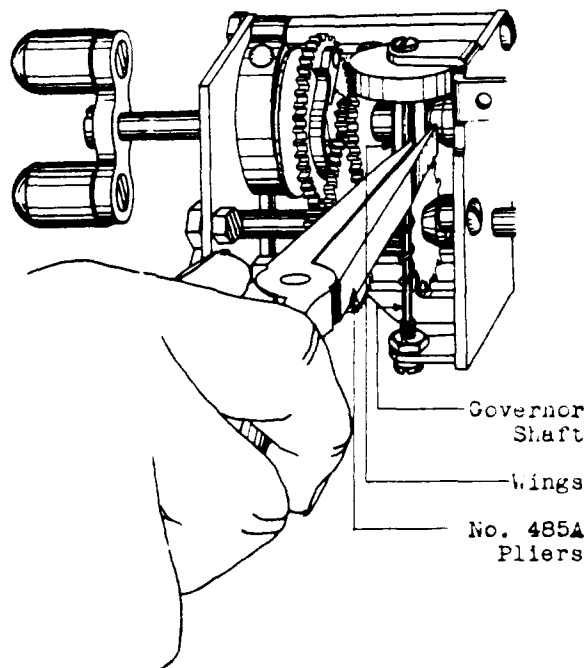


Fig. 12 - Adjusting for Speed with No. 485-A Pliers



3.19 (Continued)

(2) Adjust the position of the outer contact spring first and then, if necessary, adjust the inner contact spring. After adjustment make sure requirements 2.05, 2.06, 2.11 and 2.13 are met.

3.20 Tension of Pawl Spring (Rq.2.20)

(1) To adjust the tension of the pawl spring use the No. 371 spring ad-

juster applied as shown in Fig. 13.

3.21 Setting of Code Segments - No. 60B Selector Key (Rq.2.21)

(1) To adjust the setting of the code segments on the impulse wheel, loosen the segment set screw with the 3" cabinet screwdriver and position the segments as required. Tighten the set screw securely.

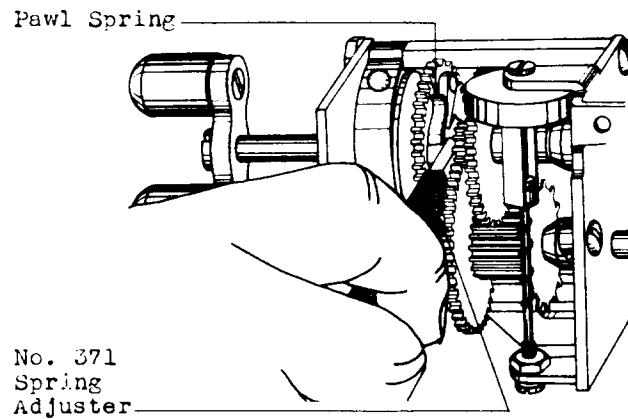


Fig. 13 - Method of Adjusting  
Pawl Spring