

**TIMERS**  
**2-TYPE, 4A, 4B (MFR DISC.) 4E, AND D-171689**  
**REQUIREMENTS AND ADJUSTING PROCEDURES**

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**1. GENERAL**

**1.01** This section covers the requirements and adjusting procedures for the 2-type, 4A, 4B (Mfr Disc.), 4E, and D-171689 timers.

**1.02** The reasons for reissuing this section are listed below. Since this reissue is a general revision, no revision arrows have been used to denote significant changes. The Equipment Test List is not affected.

- (1) To add the 4E timer
- (2) To rate the 4B timer manufacture discontinued (Mfr Disc.)
- (3) To add paragraph 1.04.

**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** The 4E timer is a solid-state electronic timer and is an exact wire-for-wire replacement of the electromechanical 4B (Mfr Disc.). The 4E timer provides the 0.25 second pulse each second and the 2.8 second pulse each 6 seconds as required by the master timing frame SD-25633-01 for the timing of long distance calls.

**1.05 Preparation of KS-16832 L2**

**Lubrication:** This lubricant is provided in 2-ounce and 1-pint containers. A small, wide-mouth container, such as the 2-ounce jar in which the lubricant is available, should be used as a receptacle from which to dispense the lubricant. If allowed to stand more than 1 day without agitation, the lubricant ingredients tend to separate; therefore, before each day's use, shake the container of lubricant for approximately 30 seconds to insure mixing of the ingredients. The proper method of shaking the lubricant consists of repeated, rapid turning of the container to an upside down position and back to the upright position. If the lubricant from a 1-pint container is to be used, the lubricant must be mixed as just described before it is poured into the smaller container. Under storage conditions, the cover should be tight on the container.

**1.06 One dip of KS-16832 L2 lubricating compound**

for the purpose of this section is the amount of lubricant retained on the KS-14164 brush after being dipped into the lubricant to a depth of approximately 3/8 inch and scraped once against the side of the container as the brush is removed.

**1.07** Before checking or readjusting to meet requirements, take the equipment out of service in accordance with local procedures.

**2. APPARATUS**

**2.01 List of Tools, Gauges, Materials, and Test Equipment**

CODE OR SPEC NO.	DESCRIPTION
<b>TOOLS</b>	
206	30-degree offset screwdriver

**NOTICE**

Not for use or disclosure outside the  
Bell System except under written agreement

**SECTION 030-141-701**

**TOOLS**

207	90-degree offset screwdriver
363	Spring adjuster
417A	1/4- and 3/8-inch open double-end flat wrench
505A	Spring adjuster (for 0.013-inch springs)
506A	Spring adjuster (for 0.023-inch springs)
510C	Test lamp
KS-6320 L1	Orange stick (wood)
KS-6320 L2	Orange stick (plastic)
KS-14164	No. 4 Artist's show card brush
R-2653	No. 5 Bristo setscrew wrench
R-2959	1/16-inch Allen wrench
—	4-inch E screwdriver

**GAUGES**

66D	Thickness gauge nest
70H	0-30 gram gauge
74D	Thickness gauge nest
92D	0.018-inch thickness gauge
92E	0.015-inch thickness gauge
92H	0.025-inch thickness gauge

KS-3008 Stopwatch

**MATERIALS**

KS-16832 L2	Lubricating compound
—	Hardwood toothpick (flat on one end, pointed on the other)

**TEST EQUIPMENT**

— Brush Recorder Mark II or Mark 220 or equivalent strip chart recorder

**3. REQUIREMENTS**

**3.01 Cleaning**

(a) Contacts shall be cleaned, when necessary, in accordance with the 069 Division which covers cleaning of relay contacts. After cleaning any contact, a check shall be made to see that both contacts on the bifurcated spring involved close as specified in requirement 3.07(c).

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

**3.02 Lubrication**

(a) **Fig. 1, (A) and (B); Fig. 2, (A) and (B): The face of the cam and the button** shall be adequately lubricated with KS-16832 L2 lubricating compound. When lubrication is necessary, one dip of the lubricant shall be applied with the KS-14164 brush to the face of the cam and the top of the button.

(b) No attempt shall be made to lubricate the motors of timers equipped with Haydon motors.

**(c) Recommended Lubrication Interval:**

It is recommended that the specified parts of 2-type, 4A, and D-171689 timers be lubricated at intervals of 24 months and of 4B timers (Mfr Disc.) at intervals of 12 months. Under ordinary circumstances, these intervals will be satisfactory. There may, however, be local conditions such as high temperature which will necessitate lubrication at more frequent intervals. The interval may be extended if periodic inspection indicates that the requirements will be met during the extended interval.

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

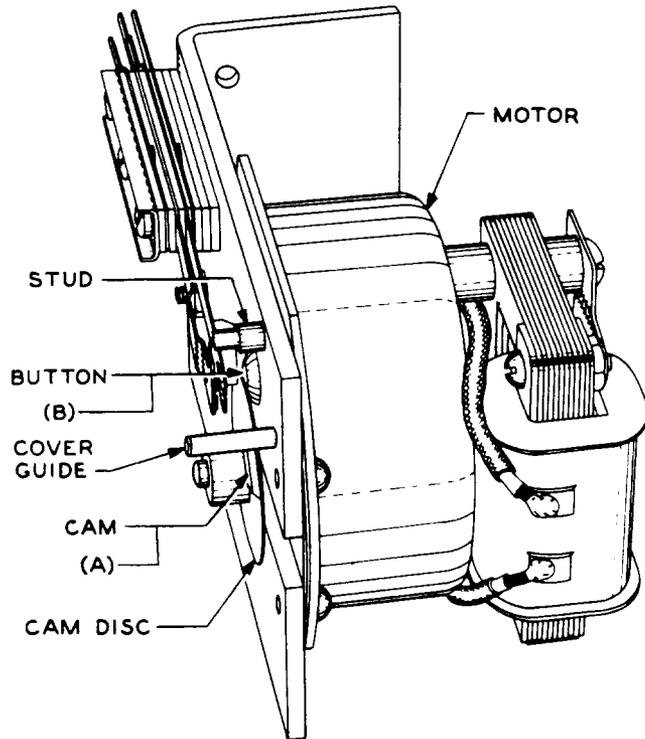


Fig. 1—2A Timer With Telechron Motor

### 3.04 Cam Position

(a) **Fig. 3, (A):** With the motor endplay taken up toward the left, the cam disc shall exert a pressure against the button, measured just in front of the button of

Max 30 grams

Use the 70H gauge.

**Warning:** When it is necessary to manually rotate the motor shaft to check requirements or make adjustments, rotate it in the normal direction only to avoid possible damage to the motor bearings or gearing.

(1) **2-Type Timers:** To check this requirement, manually operate the timer in the normal direction of rotation until the cam is over the button and then stop the timer. Lift the operating finger off the cam, and with the motor endplay taken up toward the left, measure the tension required to lift the cam disc from the button.

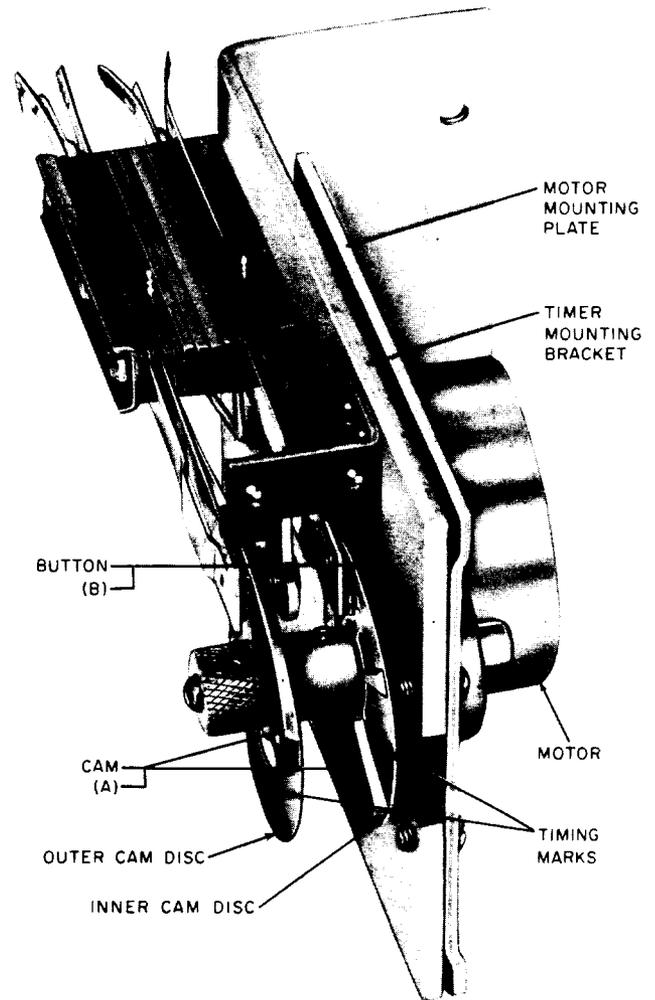


Fig. 2—4A, 4B (Mfr Disc.), and D-171689 Timers With Haydon Motor (4B Illustrated)

(2) **4A, 4B (Mfr Disc.), and D-171689**

**Timers:** To check the requirement for either the inner or outer cams, manually operate the timer in the normal direction of rotation until the cam is over the button and then stop the timer. Lift the associated operating finger off the cam, and with the motor endplay taken up toward the left, measure the tension required to lift the cam disc from its associated button.

(b) **Fig. 3, (B):** With the cam positioned so the contacts are operated, the bottom of the operating finger shall extend 1/8 inch below the upper edge of the associated cam.

Gauge by eye.

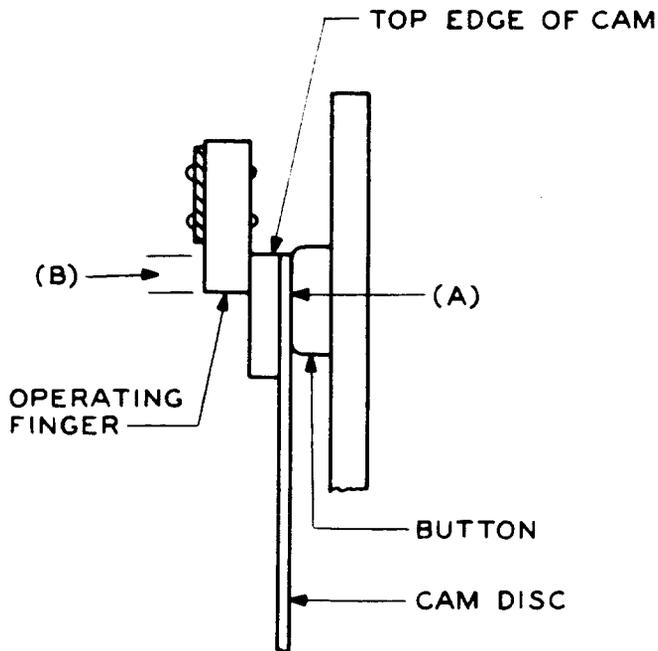


Fig. 3—Vertical Position of Cam

(c) **4B Timer (Mfr Disc):** The timing mark on the outer cam assembly shall be directly over and in line with the timing mark on the inner cam assembly.

**3.05 Contact Alignment:** Fig. 4, (A)—The contact alignment shall be within the limits indicated in Fig. 4.

Gauge by eye.

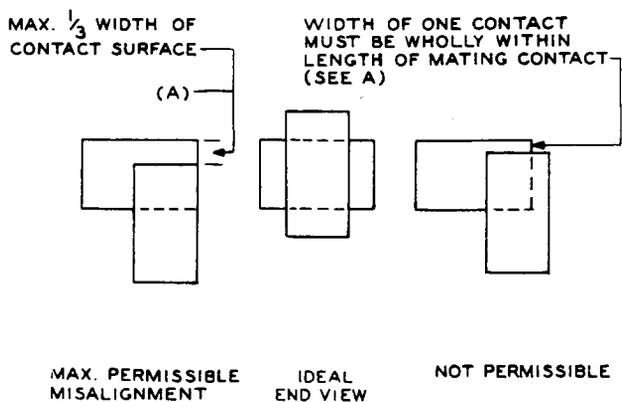


Fig. 4—Alignment of Heavy Contacts—Plan View of Contact Surfaces

**3.06 Contact Separation:** With the bifurcated spring resting against the washer in its associated spacer assembly, the contact separation shall be

Min 0.010 inch

Gauge by eye.

Use the 0.010-inch blade of the 74D gauge as a reference.

**3.07 Contact Make**

(a) Both contacts of the bifurcated contact springs shall make with their associated contacts in the fully operated position of the springs.

Gauge by eye and feel.

(b) With the operating finger resting on the flat of the cam and with a gauge of the value indicated below, inserted between the tang of the solid spring and its stop, the make contact shall meet the following conditions:

	CONTACTS SHALL NOT MAKE	AT LEAST ONE CONTACT SHALL MAKE
Test	0.025 inch	0.015 inch
Readjust	0.025 inch	0.018 inch

Use the 92D, 92E, and 92H gauges.

To check whether a contact makes, use the KS-6320 orange stick applied to the tip of the bifurcated spring and attempt to move the contact toward its associated spring. A perceptible movement of the bifurcated spring indicates the contact is not closed.

(c) **Readjust Only:** After a particular contact is cleaned, buildup is removed or adjustments are made on a contact spring. Both contacts on the bifurcated spring shall make approximately simultaneously with their associated contacts.

Gauge by eye.

**3.08 Operating Finger Clearance:** Fig. 5, (A)—With the cam disc between the button and operating finger so the operating finger clears

the cam, the clearance between the operating finger and associated disc when the endplay of the shaft is taken up to the left shall be

Min 0.010 inch

Use the 74D gauge.

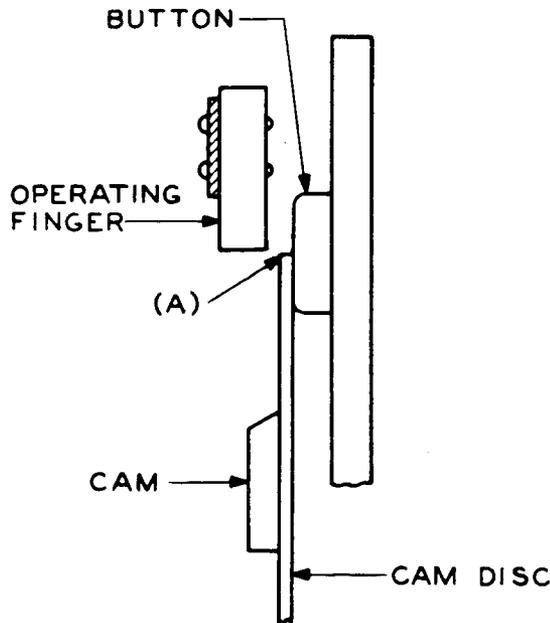


Fig. 5—Operating Finger Clearance

### 3.09 Spring Tension

(a) **Bifurcated Spring Tension:** With the cam disc rotated so the operating finger is not touching the cam, the tension of the bifurcated spring against the washer in the associated spacer assembly, measured in front of the contacts, shall be

**Test:** Min 5 grams, max 20 grams

**Readjust:** Min 10 grams, max 20 grams

Use the 70H gauge.

(b) **Solid Spring Tension:** With the cam disc rotated so the operating finger is not touching the cam and with the bifurcated spring lifted from the washer of the associated spacer assembly, the tension of the solid spring against its stop, measured in front of the contacts, shall be

**Test:** Min 20 grams

**Readjust:** Min 25 grams

Use the 70H gauge.

When checking the tension of the solid spring against its stop, rotate the cam disc so the operating finger is not resting on the cam. Insert a toothpick between the finger and button sufficiently to lift the bifurcated spring from the head of the spacer assembly but not sufficiently to close the contacts.

**3.10 Straightness of Springs:** All springs from the point where they leave the assembly clamping plates and insulators to the ends of the springs, shall be free of sharp bends or kinks due to adjustment. A gradual bow in the springs is permissible provided the bow is not sufficient to reduce the separation between springs below the specified minimum.

Gauge by eye.

**3.11 Separation Between Springs:** There shall be a clearance between adjacent springs whether in their operated or unoperated position of

Min 0.015 inch

Gauge by eye.

The thickness of the thinner spring is 0.013 inch.

### 3.12 Timing Requirements

(a) **2A, 2B, 2E, and 2F Timers**

(1) The timing interval, as measured from the closure of the timer contacts until the reclosure of the contacts on the next cycle, shall be

Min 15 seconds

Use the KS-3008 stopwatch.

To check the timing interval, close the circuit to the motor and check the operation of the timer contacts by observing successive operations of the relays or other apparatus which operate through the timer contacts. It may be necessary to block relays to obtain a satisfactory check.

(2) The timing interval, as measured from the opening of the timer contacts until the reclosure of the contacts, shall be

<u>TIMER</u>	<u>SECONDS</u>	
	<u>MIN</u>	<u>MAX</u>
No. 2A and 2B	13	14
No. 2E and 2F	14.2	14.6

Use the KS-3008 stopwatch.

To check the timing interval, close the circuit to the motor and check the operation of the timer contacts by observing successive operations of the relays or other apparatus which operate through the timer contacts. It may be necessary to block relays to obtain a satisfactory check.

(b) **2C and 2D Timers:** The timing interval, as measured from the closure of the timer contacts until the reclosure of the contacts on the next cycle, shall be

Max 6 minutes 1 second

Use the KS-3008 stopwatch.

To check the timing interval, check the period between two operations of the associated T1 or T2 relay. Begin timing with the KS-3008 stopwatch when the T1 or T2 relay operates. Stop timing when the T1 or T2 relay reoperates on the next reclosure of the cam contacts.

(c) **4A and D-171689 Timers**

(1) **Outer Cam:** The timing interval, as measured from the break of the contacts until the break of the contacts on the next cycle, shall be

6 seconds

Use the KS-3008 stopwatch.

To check the timing interval, operate the CKL key and check the period between the lighting of two successive U lamps. Begin timing with the KS-3008 stopwatch when a U lamp lights. Stop timing when the next U lamp lights.

(2) The timing interval, as measured from the opening of the contacts until the closure of the contacts, shall be

Min 5.5 seconds  
Max 5.7 seconds

Use the KS-3008 stopwatch.

To check the timing interval, check the period between the release of the PO or PE relay associated with the outer cam and the reoperate of the relay. Start timing when the relay releases. Stop timing when the relay reoperates.

(3) **Inner Cam:** The contacts which are operated by the inner cam shall be closed during each revolution of the cam

approximately 3.6 seconds

Use the KS-3008 stopwatch and the 510C test lamp.

To check the timing interval, connect one end of the cord of the 510C test lamp to the No. 4 spring of the timer and connect the other end to battery. Start timing when the lamp in the 510C test lamp is lighted. Stop timing when the lamp is extinguished.

(4) **Timing Interval Between Inner and Outer Cams:** The timing interval between the opening of the contacts which are operated by the inner cam and the closure of the contacts which are operated by the outer cam, shall be

Min 0.8 seconds

Use the KS-3008 stopwatch and the 510C test lamp.

To check the timing interval, connect one end of the cord of the 510C test lamp to the No. 4 spring of the timer and connect the other end to battery. Start timing when the lamp in the 510C test lamp is extinguished. Stop timing when the PO or PE relay which is operated by the outer cam operates.

(5) **Timing Interval Between Outer and Inner Cams:** The timing interval between the opening of the contacts which

are operated by the outer cam and the closure of the contacts which are operated by the inner cam shall be

Min 0.8 seconds

Use the KS-3008 stopwatch and the 510C test lamp.

To check the timing interval, connect one end of the cord of the 510C test lamp to the No. 4 spring and connect the other end to battery. Start timing when the PO or PE relay, which is operated by the outer cam, releases. Stop timing when the lamp of the 510C test lamp lights.

(d) **4B Timer (Mfr Disc.)**

(1) The timing interval and cam overlap measurements for the 4B timer (Mfr Disc.) can best be made with a strip chart recorder. A recorder with at least two pens is needed. It should have sufficient chart speed to give the required precision. The output of the timer, as recorded, can be compared to the times shown in Fig. 6.

Use a Brush Recorder Mark II per Section 100-131-100 or a Brush Recorder Mark 220 per Section 100-131-120 or an equivalent strip chart recorder. Connect one pen to contact 1 of

the 4B timer (Mfr Disc.) and connect another pen to contact 4 of the 4B timer (Mfr Disc.).

When in the circuit, contacts 2 and 5 are connected to ground and contacts 1 and 4 are connected through relay windings to battery (-48V). The strip chart recorder must be connected per its associated BSP to read these potentials. For bench tests, the proper conditions must be set up to get the usable results.

(e) **4E Timer:** The 4E electronic timer operates from the same 22-volt 60-Hz supply which feeds the 4B timer (Mfr Disc.). This 22-volt ac supply is used as both power source and timing reference, and requires only about 1/10th the power required by the 4B timer (Mfr Disc.). The 4E timer output provides TP contact closure for 0.25 seconds each second and provides CH contact closure for 2.80 seconds each 6 seconds as required by the master timing circuit SD-25633-01. Since the timing function within the 4E timer is achieved through counting the 60-Hz pulses feeding the counter, the accuracy of the 4E timer is a function of the internal circuitry and the available 60-Hz source and not of any mechanical adjustment, as on the 4B (Mfr Disc.) timer.

(f) **Accuracy of All Timers:** The timer shall not gain or lose time over a period of 48 hours when connected to a power supply

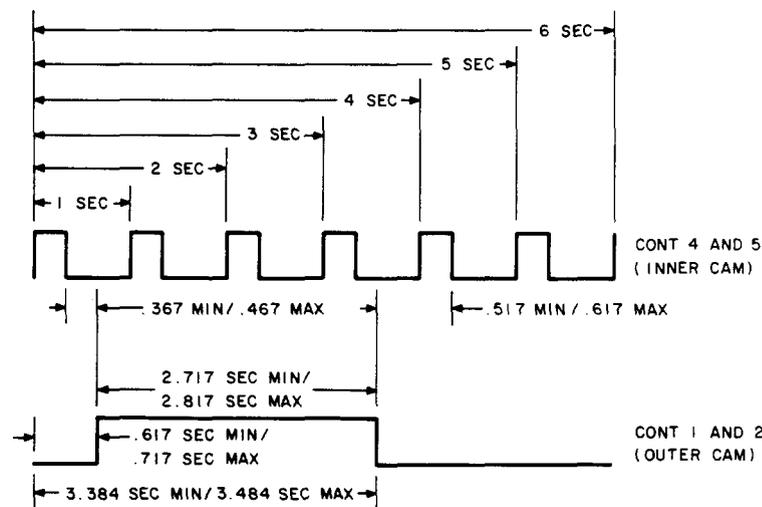


Fig. 6—4B Timer (Mfr. Disc.) —One Cycle

regulated for time service. Check by comparing with a reliable time source controlled by the same power supply.

**3.14** If it is necessary to remove the timer from the mounting plate, unsolder the leads from the terminals and remove the timer mounting screws with the 4-inch E screwdriver.

**Warning:** *When replacing the cover on timers without a cover guide, care should be taken to replace the cover by inserting cover lips between the motor mounting plate and the timer mounting bracket. Incorrect installation may cause the rotating cam shaft to grind against the metal cover. Also there is a chance the cover might short out the contact springs.*

#### 4. ADJUSTING PROCEDURES

**4.01 Cleaning:** (Reqt 3.01)—Clean the contacts in accordance with the section covering cleaning of relay contacts. Clean other parts in accordance with approved procedures.

**4.02 Lubrication:** (Reqt 3.02)—To lubricate the cam and button, rotate the cam disc until the cam is accessible. Apply the specified quantity of lubricant to the top of the button and the face of the cam.

**4.03 Record of Lubrication:** (Reqt 3.03)—(No Procedure)

**4.04 Cam Position:** (Reqt 3.04)

(1) To adjust the position of the cam horizontally on the motor shaft, loosen the cam setscrews with the R-2653 wrench or a 1/16-inch Allen wrench (R-2959 wrench) and move the cam on the motor shaft as required. If it is necessary to position both cams, position the inner cam first. Recheck the timing intervals between the cams. Tighten the setscrews securely.

(2) To adjust the overlap of the operating finger, loosen the motor mounting screws and nut with the 206 and 207 offset screwdrivers and the 417A wrench. Move the motor up or down as required. Tighten the screws and nut securely.

**4.05 Contact Alignment:** (Reqt 3.05)—If the contacts do not line up properly, it is an indication that the springs are twisted or have shifted in the assembly. Straighten twisted springs as outlined in 4.10. If springs are straight or if after straightening twisted springs and contacts do not line up properly, it is an indication the springs have shifted in the assembly. In this case refer the matter to the supervisor.

**4.06 Contact Separation:** (Reqt 3.06)

**4.07 Contact Make:** (Reqt 3.07)

**4.08 Operating Finger Clearance:** (Reqt 3.08)

**4.09 Spring Tension:** (Reqt 3.09)

**4.10 Straightness of Springs:** (Reqt 3.10)

**4.11 Separation Between Springs:** (Reqt 3.11)

(1) Use the 505A or 506A spring adjuster to adjust the springs for contact separation, spring gauging, operating finger clearance, or spring tension. Adjust each prong of the bifurcated spring, as required, for contact separation. Adjust for spring gauging and operating finger clearance by adjusting the tang of the solid spring to the right or left, as required, with the 506A spring adjuster. When adjusting for spring tension, apply the adjuster at the rear of the spring to be adjusted where the spring leaves the clamping plate and insulators.

(2) If both contacts on the bifurcated springs do not make contact in the closed position of the contacts, it may be due to a twist in the springs or misalignment of the two prongs of the bifurcated spring. Correct for a twisted spring by using the 505A spring adjuster applied near the point where the spring leaves the insulator. To correct misalignment of the prongs of the bifurcated spring, use the 363 spring adjuster and adjust the upper or lower prong of the bifurcated spring. In adjusting, as covered above, adjust the two prongs of the bifurcated springs to make contact with the opposing contacts as nearly simultaneously as possible.

(3) If the springs are not straight or there is insufficient clearance between the springs,

correct by adjusting the springs where they are bent or where the clearance is insufficient with the 505A or 506A spring adjuster. If necessary dismount the timer in order to obtain access to the part of a spring needing adjustment.

- (4) ***Kinked Springs:*** 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 the life of the spring assembly. Normally straight springs that have been adjusted should have no sharp bends due to adjustment. A gradual bow, however, is permissible.

#### 4.12 **Timing Requirements:** (Reqt 3.12)

##### 4A and D-171689 Timers

- (1) If the inner and outer cams are not in their proper positions to meet the timing requirements, manually operate the timer in the normal direction of rotation until the outer cam is approximately 180 degrees away from the operating finger. Then stop the timer and loosen the cam setscrews on the outer cam disc with the R-2653 wrench or 1/16-inch Allen wrench (R-2959 wrench) and position the outer cam with respect to the inner cam. In the final adjusted position, the cam on the outer disc should be located so it is approximately centered with respect to the cutout portion of the cam on the inner disc. Tighten the cam setscrews securely.

##### 4B Timers (Mfr Disc.)

- (2) If the outer and inner cams are not in their proper positions to meet the timing

requirements, manually operate the timer in the normal direction of rotation until the timing mark on the inner cam is to the front and approximately 90 degrees away from the operating finger. Loosen the cam setscrews on the outer cam disc with the R-2653 wrench or a 1/16-inch Allen wrench, and position the outer cam with respect to the inner cam. In the final adjusted position, the timing mark on the outer cam should be located approximately in line with the timing mark on the inner cam.

- (3) Recheck to determine that requirement 3.04 is met.

#### All Electromechanical Timers

- (4) If the timing requirements are not met, recheck all mechanical requirements and make adjustments as required. If the timing requirements are still not met, it is an indication that the motor is defective. In this case replace the motor as covered in Section 030-141-801.

#### 4E Timer

- (5) The 4E Timer is a solid-state electronic timer. Application of 22-volt ac to the timer causes the timer to start counting 60-Hz pulses from a predetermined starting point. This point corresponds to the "bench mark" on the electromechanical 4B timer (Mfr Disc.). The 4E being a solid-state electronic timer eliminates the need for periodic lubrication and cam adjustment as is now required of the 4B timer (Mfr Disc.).