NONZONE TIMER D-159823 AND ASSOCIATED NO. 51A DRIVE REQUIREMENTS AND ADJUSTING PROCEDURES

1. GENERAL

1.01 This section covers the D-159823 nonzone timer and associated No. 51A drive.

1.02 This section is reissued to revise the requirements for lubricating the motor and the recommended lubrication intervals, and to add contact alignment requirement for timers equipped with heavy contacts. Detailed reasons for reissue will be found at the end of the section.

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 One discharge of WECo. 57997 petrolatum for the purpose of this section is the amount of petrolatum discharged from the No. 353C grease gun when the piston is fully depressed once.

1.06 One discharge of KS-6438 oil for the purpose of this section is the amount of KS-6438 oil discharged from the No. 552A oil gun when the piston is fully depressed once.

1.07 One dip of KS-8496 No. 3 lubricating compound for the purpose of this section is the amount of lubricant retained on the KS-14164 brush after being dipped in the lubricant to a depth of approximately 3/8 inch and scraped once against the side of the container as the brush is removed. There shall not be sufficient lubricant adhering to the brush to form a drop on the end of the bristles.

1.08 Normal Position of Timer Gear and Cams: The timer gear and associated cams are in their normal position when the end of the gear stop is resting against the end of the gear stop pawl and with the armature resting against the head of the armature adjusting screw.

1.09 The term contact spring when used in this section includes, unless otherwise specified, both contact bars welded to the end of the spring. The front end of the spring may or may not be split. A pair of contacts as referred to in this section consists of a single contact bar of one contact spring and the corresponding contact bar on the opposing contact spring.

1.10 Armature travel is the gap between the stop plate on the armature and the nearest point on the pole piece when the armature is resting against the head of the adjusting screw.

1.11 Unless otherwise specified in the individual requirements, the driving shaft may be either rotating or stopped when checking that a requirement is met.

1.12 Before checking or readjusting to meet the requirements, take the equipment out of service in accordance with the procedures outlined in the section covering methods of taking equipment out of service. When necessary to stop the motor of the driving shaft, make sure that the circuits associated with all timers operated by the driving shaft are made busy.

2. REQUIREMENTS

2.01 Cleaning

(a) Contacts shall be cleaned, when necessary, in accordance with the section on cleaning 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 2.21(c).

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

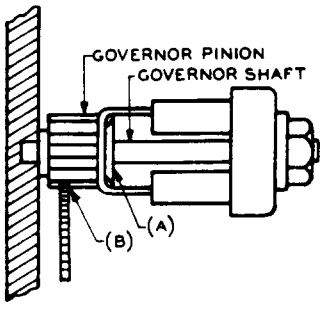

Fig. 1 - Lubricating Governor Pinion

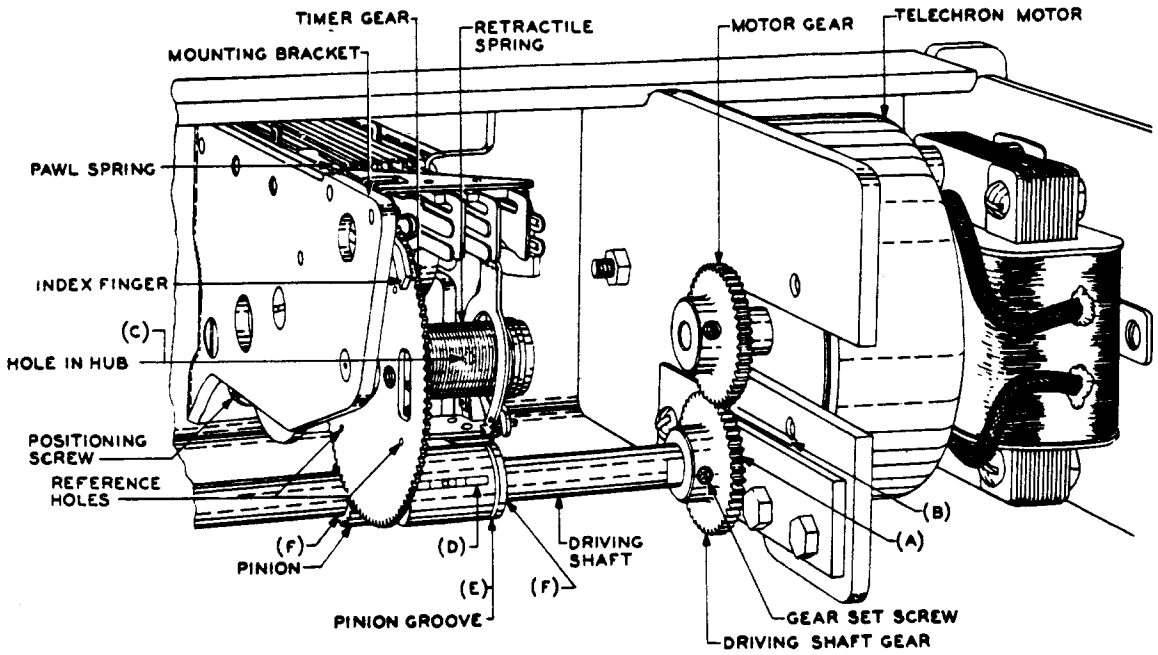

Fig. 2 - Timer and Associated Drive Assembly

2.02 Lubrication

(a) The following parts shall be adequately lubricated with WECo. 57997 petrolatum. When lubrication is necessary, the lubricant shall be applied with the No. 353C grease gun equipped with a No. 570A straight nozzle as follows:

(1) Two discharges distributed evenly around the circumference of the driving shaft at each support bearing (one discharge on each side of the support) and two discharges at the left and right thrust bearings.

(2) Fig. 2(D) - One discharge to the slot in the pinion.

(3) Fig. 2(E) - One discharge to the groove in the pinion.

(4) Fig. 2(F) - Two discharges distributed evenly around the circumference of the driving shaft at each end of the pinion.

(5) Fig. 2(C) - Three discharges to the hole in the hub of the gear shaft.

(6) Fig. 1(A) - One discharge at the right-hand face of the governor pinion.

(b) Fig. 5(A) - The friction washer shall be adequately lubricated with KS-6438 oil. When lubrication is necessary, one discharge of the lubricant shall be applied with the No. 552A oil gun to each of the two holes in the damping disc.

(c) Fig. 5(H) - The "C" cam shall be adequately lubricated with KS-8496 lubricating compound. When lubrication is necessary one dip shall be distributed over the face of the cam, which actuates the operating finger on the "C" cam spring and the surface of the cam which rubs against the armature, with the KS-14164 brush.

(d) Fig. 5(G) - The surface of the timer gear where it is engaged by the pinion prior to meshing shall be adequately lubricated with KS-8496 lubricating compound. When lubrication is necessary, one dip shall be applied to the face of the timer gear at the point of pinion engagement.

(e) Where the motor is a reoilable type, lubricate it as specified in the section covering lubrication of Telechron motors.

(f) Recommended Lubrication Intervals: It is recommended that all parts except the driving shaft bearings, surface of the timer gear, and the motor be lubricated at intervals of 24 months, the driving shaft bearings and the surface of the timer gear be lubricated at intervals of 12 months, and the motor at intervals as specified in Section A501.145. These intervals may be extended or reduced if periodic inspection have indicated that local conditions are such that requirements (a) to (e), inclusive, are met during the extended or reduced intervals.

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

associated drives 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.

2.04 End Play of Driving Shaft: Fig. 2(A) - With the driving shaft motor stopped, the end play of the shaft shall be

Min Perceptible
Max 0.010 inch

To check this requirement, gauge the minimum by feel and the maximum by inserting the No. 74D gauge between the shoulder of the gear and the plate.

2.05 Engagement of Motor and Driving Shaft Gears: The following requirements shall be met with the driving shaft motor stopped.

(a) With the driving shaft gear in the position of rotation where the head of the setscrew is nearest the motor shaft and with the bearing play of both shafts taken up so as to make the distance between them a maximum, the following requirements shall be met.

(1) The backlash between the driving shaft gear and the motor gear shall be

Min 0.005 inch

Gauge by feel.

(2) Fig. 3(A) - The teeth of the motor and driving shaft gears shall engage vertically for

Min 1/2 their depth

Gauge by eye.

(b) Fig. 2(B) - The teeth of the motor and driving shaft gears shall engage for their full width, at one point in the position of the gears, when they are moved back and forth in opposite directions to the extreme limits of motor and driving shaft end play. In no case, however, shall the engagement be less than 1/2 the width of the gear.

Gauge by eye and feel.

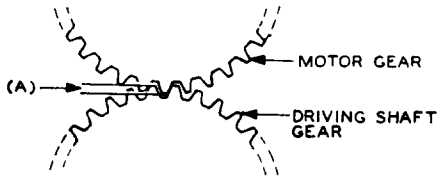

Fig. 3 - Engagement of Motor and Driving Shaft Gears

2.06 Mounting of Timers

(a) Timers shall be fastened securely to the mounting plate and shall be so mounted that the side of the mounting bracket is approximately perpendicular to the driving shaft.

Gauge by eye and feel.

(b) The locknut on the positioning screw at the rear of the timer shall be tight.

Gauge by feel.

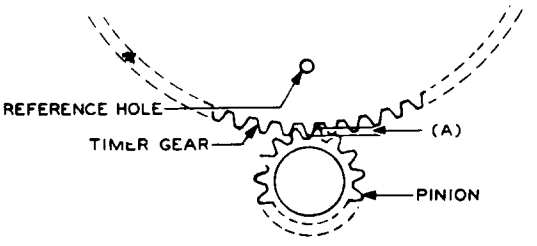

Fig. 4 - Engagement of Timer Gear and Pinion

(c) Fig. 4(A) - With the driving shaft motor stopped and with the timer electrically operated, the teeth of the timer gear shall engage with the pinion in all positions of the gear for

Min 2/3 their depth

but there shall be backlash.

Gauge by eye.

To check this requirement, rotate the gear manually so that one of the four reference holes in the gear is adjacent to the teeth in the pinion. Operate the timer electrically and check for engagement and backlash. Repeat this operation at the other three reference holes in the gear.

2.07 Engagement of Shifting Spring Tang and Pinion - Fig. 5(B)

(a) The shifting spring tang shall not touch the bottom of the pinion groove in the associated pinion but shall engage the pinion groove for

Min 1/32 inch

Gauge by eye for one complete revolution.

To check this requirement, press up on the bottom of the pinion and observe if there is a movement of the pinion before it touches the bottom of the shifting spring tang.

(b) With the shifting spring tang touching one side of the pinion groove, there shall be a clearance between the shifting spring tang and the other side of the pinion groove.

Gauge by eye and feel.

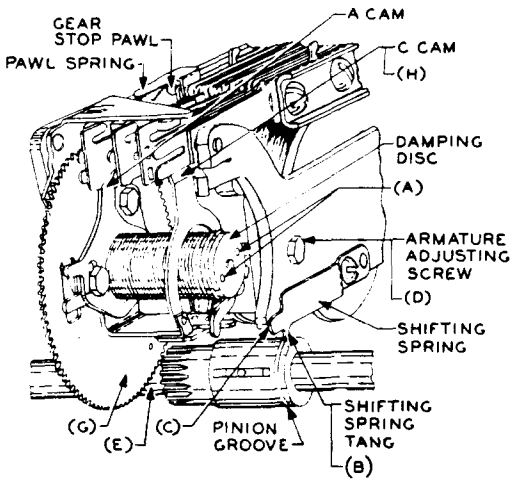

Fig. 5 - Engagement of Shifting Spring Tang and Pinion

*2.08 Freedom of Shaft Movement: With the driving shaft motor stopped, with the motor gear disengaged, and with the shifting spring tangs of all timers on the plate engaged in the pinion grooves, the shaft shall rotate freely. This requirement is met if the shaft turns with the force specified below for the number of timers involved, applied to a tooth of the driving shaft gear.

Timers	Tension
None	50 grams
1 to 10	75 grams
11 to 20	100 grams

Use the No. 79C gauge applied to the gear as shown in Fig. 6 and check at four points approximately 90 degrees apart.

2.09 Tripping Cam Clearance

(a) With the tripping cam in the position where it is just about to trip the retractile spring, the retractile spring shall not be tripped until the motion of the timer gear from the normal position has been

Min two teeth

Gauge by eye.

(b) Fig. 7(A) - With the timer gear restored to normal, immediately after the retractile spring has been tripped, and with the play in the tripping cam taken up to insure the maximum clearance between the trailing tang of the tripping cam and the tripping finger attached to the timer gear, the clearance between the trailing tang of the tripping cam and the tripping finger attached to the timer gear, shall be

Min 1/32 inch

Gauge by eye.

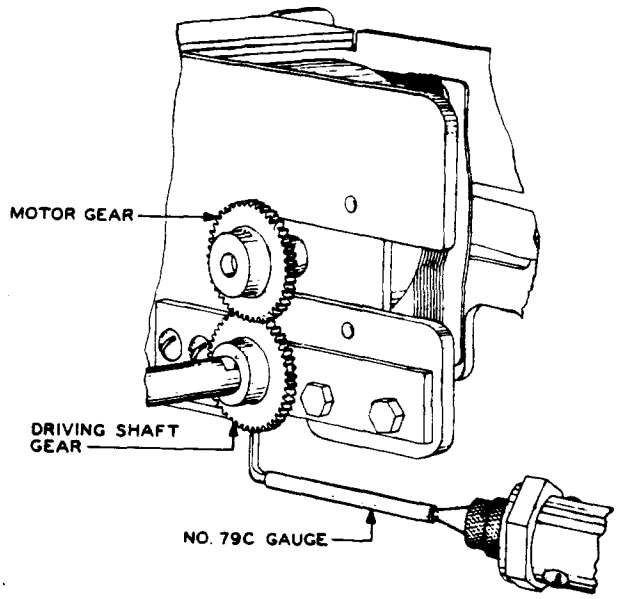

Fig. 6 - Method of Checking Freedom of Shaft Movement

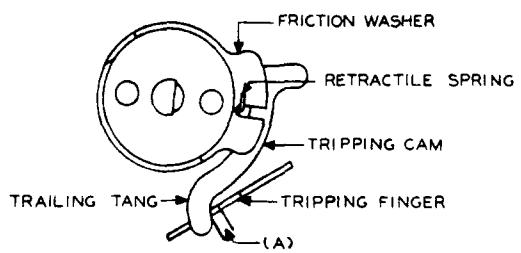

Fig. 7 - Tripping Cam Clearance

2.10 Freedom of Pinion Movement and Shifting Spring Tension: Fig. 5(C) - With the driving shaft motor stopped and with the end play in the pinion taken up to the left, the shifting spring shall leave the armature and the pinion shall move with a force applied to the tip of the shifting spring of

Max 100 grams

and with the end play in the pinion taken up to the right, the shifting spring shall restore against the armature when this force is reduced to

Test - Min 15 grams
Readjust - Min 20 grams

Use the No. 70J gauge.

When checking the tension of the shifting spring where the No. 70J gauge cannot be applied due to mounting conditions, the require-

ment is met if the tension, as determined by lifting the spring with a KS-6320 orange stick, is approximately the same as the tension of another shifting spring which meets this requirement when checked by the No. 70J gauge.

2.11 Armature Travel: The armature travel shall be

Min 0.053 inch
Max 0.060 inch

Use the No. 142A gauge.

*2.12 Armature Adjusting Screw Clearance: Fig. 5(D) - The armature adjusting screw shall not touch the sides of the hole in the armature during the operation of the armature.

Gauge by eye and feel.

2.13 Index Finger Position: Fig. 12(A) - The clearance between the index finger and the timer gear, in all positions of the gear, shall be

Min 0.005 inch

Gauge by eye.

2.14 Pinion Position

(a) Fig. 5(E) - With the timer unoperated and the end play in the pinion taken up to make the clearance between the gear and pinion as small as possible, the gear shall not touch the pinion at the positions of the four reference holes of the gear.

Gauge by eye.

To check this requirement, rotate the gear manually until one of the four reference holes in the gear is adjacent to the pinion and observe the clearance between the pinion and the gear. Repeat this operation at the other three reference holes in the gear.

(b) Fig. 8(A) - With the timer electrically operated and the end play in the pinion taken up to make the meshing as small as possible, the teeth of the gear shall mesh for at least their full width with the pinion at the positions of the four reference holes of the gear.

Gauge by eye.

To check this requirement, operate the timer electrically and note to what extent the pinion meshes with the gear, horizontally. Repeat this operation at the other three reference holes in the gear.

2.15 Gear Stop Pawl Position

(a) With the end play of the timer gear taken up toward the mounting bracket, the pawl shall drop freely off the gear stop and against the pawl stop when the timer gear is rotated one revolution.

Gauge by eye.

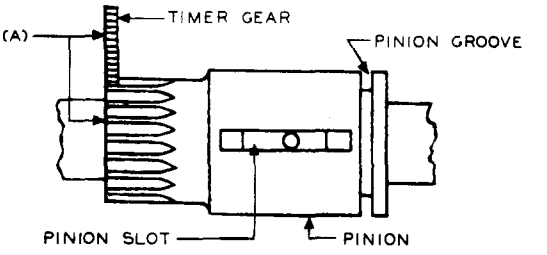

Fig. 8 - Engagement of Pinion with Associated Gear

(b) With the end play of the timer gear taken up toward the mounting bracket, the pawl shall not bind against the gear during the rotation of the gear.

Gauge by eye.

This requirement is met, if the gear restores to normal under the conditions covered in requirement 2.26(a).

(c) Fig. 9(A) - With the timer gear moved slightly from its normal position and with the pawl resting against the pawl stop, the pawl spring shall touch the pawl.

Gauge by eye.

*(d) Readjust Only: Fig. 9(B) - The tension of the pawl spring shall be

Max 5 grams

Use the No. 70H gauge.

To check this requirement, apply the No. 70H gauge at the end of the pawl.

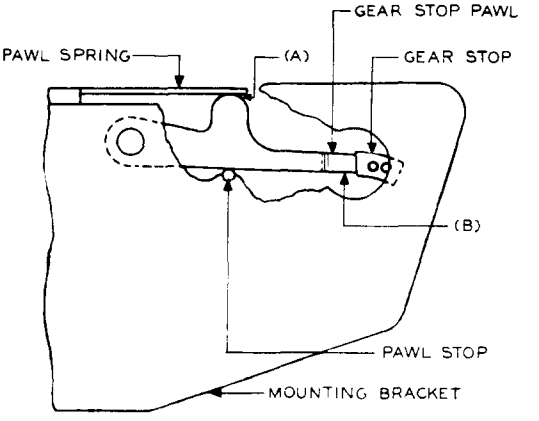

Fig. 9 - Gear Stop Pawl Position

2.16 Engagement of Timer Gear and Governor Pinion: Fig. 1(B) - The teeth of the governor pinion shall mesh with the teeth of the timer gear sufficiently to provide a good,

free-running fit, with backlash, for one complete revolution of the timer gear.

Gauge by eye and feel.

To check this requirement, move the timer gear off-normal with the fingers. Rotate the gear backward and forward several times, a distance equal to about one gear tooth, and note by feel and observing the pinion whether there is play between the gear and pinion or whether they tend to bind. Repeat this operation at the positions of the four reference holes of the gear.

2.17 Contact Alignment

(a) Fig. 10(A) - On all timers equipped with standard contacts, the contacts shall line up so that the width on the contact surface of each contact bar falls wholly within the length of its mating bar.

Gauge by eye.

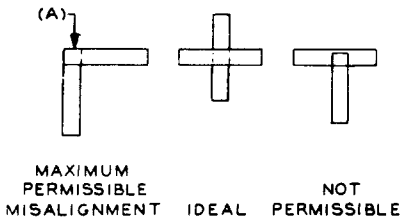

Fig. 10 - Alignment of Standard Contacts

(b) Fig. 11(A) - On timers equipped with heavy contacts, the contact alignment shall be within the limits indicated in Fig. 11.

Gauge by eye.

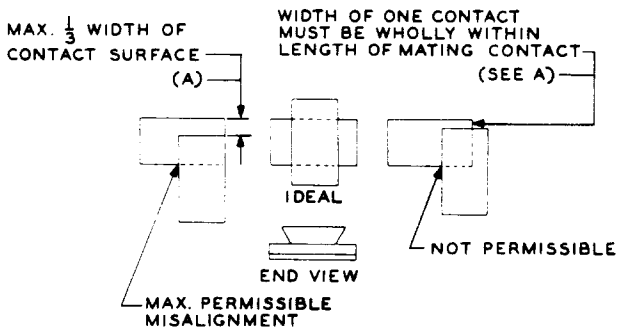

Fig. 11 - Alignment of Heavy Contacts

2.18 Spring Tension

(a) "A" Cam Bifurcated Spring: With the timer gear off-normal, the bifurcated contact spring shall rest against the head of the stud in the associated spacer assembly but the tension of this spring shall be

Max 5 grams

Use the No. 70H gauge applied in front of the contacts.

(b) "A" Cam Springs: With the timer gear rotated so that the stud on the bifurcated spring does not rest on the "A" cam, the combined tension of the solid and bifurcated contact springs just as the tang of the solid spring leaves its stop, shall be

Test - Min 20 grams
Readjust - Min 25 grams

Use the No. 70H gauge applied in front of the contacts on the solid spring.

(c) "C" Cam Springs: With the bifurcated spring moved away, the tension of the solid "C" cam spring against its stop shall be

Min 40 grams

Use the No. 70D gauge applied in front of the contact.

(d) Locking Contact Springs: The tension of the solid contact spring against its stop shall be

Min 25 grams

Use the No. 70H gauge applied in front of the contact.

*(e) Armature Spring Tension: Fig. 12(D) - The tension of the armature spring shall be such that the force required to move the armature away from the armature adjusting screw shall be

Min 45 grams

Use the No. 70D gauge.

To check this requirement, measure the tension with the timer disengaged from the pinion and with the gauge applied directly in front of the armature stud.

2.19 Contact Pressure of "C" Cam Contacts: With the armature unoperated and the timer gear normal, the contact pressure as it leaves the solid spring shall be

Test - Min 15 grams, Max 35 grams
Readj - Min 20 grams, Max 35 grams

Use the No. 70D gauge applied at the tip of the bifurcated spring.

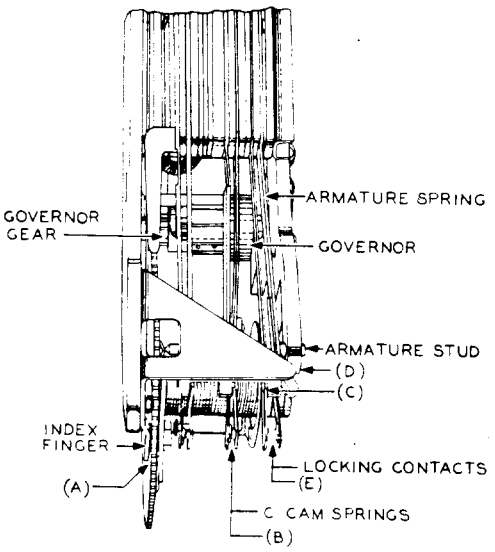

Fig. 12 - Engagement of Governor Gear and Pinion

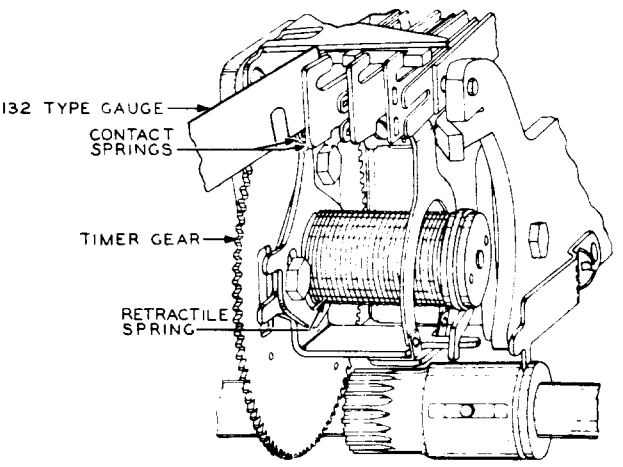

Fig. 13 - Method of Gauging Contact Separation

2.20 Contact Separation

(a) "A" Cam Contacts: Fig. 15(A) - With the timer gear rotated so that the "A" cam does not touch the stud, the contact separation shall be

Min 0.010 inch

Gauge by eye.

Use the No. 132B gauge as a reference.

(b) "C" Cam Contacts: Fig. 12(B) - With the armature electrically operated and the timer gear rotated so that the C spring finger rests on the flat of the "C" cam, the contact separation shall be

Test - Min 0.008 inch, Max 0.018 inch
Readj - Min 0.008 inch, Max 0.015 inch

Use the Nos. 132A, D, and AE gauges. See (c).

(c) Locking Contacts: Fig. 12(E) - With the armature unoperated, the contact separation shall be

Test - Min 0.035 inch
Readj - Min 0.038 inch

Use the Nos. 132L and M gauges.

Check this requirement by placing the proper 132-type gauge in the contact gap as indicated in Fig. 13. If the minimum gauge passes between the contacts due to its weight alone, the minimum requirement is met. If the maximum gauge fails to pass between the contacts without moving the flexible contact spring, the maximum requirement is met.

2.21 Spring Gauging

(a) Both contacts of the bifurcated contact springs shall make with their associated contacts in the fully operated or nonoperated position of the springs, whichever position represents the closed position for the contacts.

Gauge by eye and feel.

(b) With the timer in the normal position and with a gauge of the value indicated below inserted between the tang of the solid spring and its stop, the "A" cam contacts shall meet the following conditions.

Use the No. 74D and 132-type gauges.

Contacts Shall Not Make (Inches)	At Least One Pair of Contacts Shall Make (Inches)
Test 0.015	Test 0.007
Readj 0.015	Readj 0.010

To check this requirement, insert the gauge of the specified thickness between the spring tang and its stop and parallel to either the stop or spring tang whichever will insure the minimum separation between the tang and the stop, as shown in Fig. 14. The contacts shall be checked with the end play of the timer gear taken up toward the mounting bracket. Check whether a contact makes, by applying the KS-6320 orange stick to the tip of the bifurcated spring and attempt to move the contact toward its associated spring. A movement of the bifurcated spring indicates that the contact is not closed.

(c) Readjust Only: After a particular contact is cleaned, build-up is removed, or adjustments are made on a contact spring, both contacts on the bifurcated spring shall

make approximately simultaneously with their associated contacts if it is a make contact or shall break approximately simultaneously with their associated contacts if it is a break contact. Operate the timer manually and gauge by eye.

2.22 Contact Follow: Fig. 12(C) - With the armature electrically operated and the timer gear normal, the clearance between the tang on the solid locking contact spring and its stop shall be

Min 0.015 inch

Gauge by eye.

Use the No. 132D gauge as a reference.

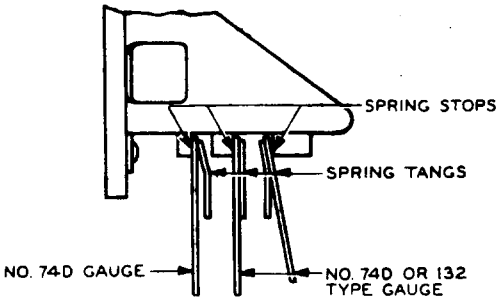

Fig. 14 - Method of Gauging Contact Springs

2.23 "A" Cam Position: Fig. 15(B) - With the timer gear in its normal position, the center line of the "A" cam shall be centrally located with respect to the center line of the stud on the A contact spring assembly. This requirement is met, if with one end of the gauge applied as shown in Fig. 16, the near end of the gauge takes a position to either side of a line passing through the end of the stud and parallel to the timer gear and with the gauge reversed, the near end of the gauge takes a position with respect to the line opposite to that taken before the gauge was reversed.

Use the No. 143A gauge.

2.24 "C" Cam Position

(a) Fig. 17(A) - With the armature electrically operated and the timer gear normal, the trailing edge of the "C" cam shall clear the C spring finger.

Gauge by eye.

(b) Fig. 17(B) - The top edge of the C spring finger shall be 1/32 inch (±1/32 inch) above the top edge of the "C" cam.

Gauge by eye.

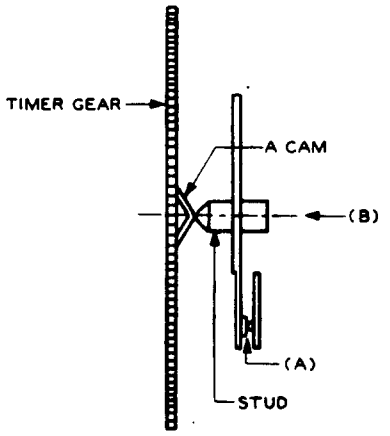

Fig. 15 - "A" Cam Position

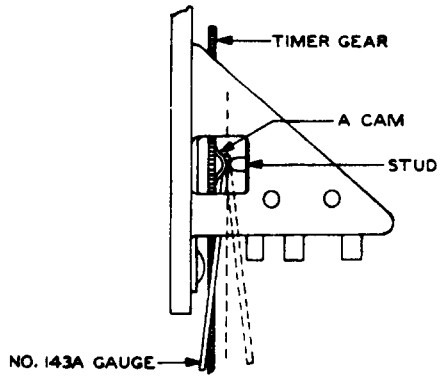

Fig. 16 - Checking "A" Cam Position

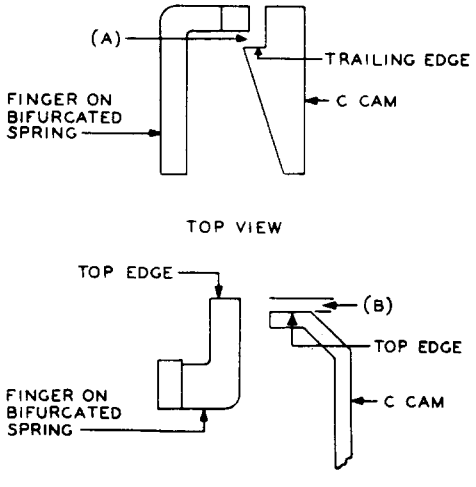

Fig. 17 - "C" Cam Position

(c) With the armature unoperated, the clearances between the "C" cam and the armature and between the "C" cam and the C spring finger on the bifurcated spring shall be approximately equal.

Gauge by eye.

(d) With the "A" cam set as covered in requirement 2.23, with the armature electrically operated, and the play in the timer gear taken up toward the mounting bracket, the "C" cam shall be positioned so that the following conditions are met.

(1) The "C" cam contacts shall break at least 1/3 tooth movement before the "A" cam contacts make.

(2) The "C" cam contacts shall remake not more than 1/2 tooth movement after the "A" cam contacts make. The "C" cam contacts may, however, make before the "A" cam contacts make.

(3) The interval between the remake of the "C" cam contacts and the break of the "A" cam contacts shall be

Max two tooth movements

A tooth movement is the movement of the timer gear equal to the distance from any point on one gear tooth to the corresponding point on the next gear tooth. To check the "C" cam position, rotate the timer gear manually until the "C" cam is in position where it is about to engage the C spring finger. Operate the timer electrically and note when the "C" cam contacts break. Using the index finger as a reference, check that the gear moves a minimum of 1/3 tooth movement before the "A" cam contacts make. With the timer still operating, check that the "C" cam contacts remake within 1/2 tooth movement after the "A" cam contacts make and that the break of the "A" cam contacts takes place within two tooth movements after the remake of the "C" cam contacts. The use of two flashlights connected across the "A" and "C" cam contacts will aid in determining when the contacts make and break.

2.25 Timer Gear Retractile Spring Clearance: With the coil of the retractile spring nearest the timer gear pushed as near the gear as possible, the clearance between the tip of the spring which projects through the gear and the mounting bracket shall be

Min 0.010 inch

Gauge by eye.

2.26 Timer Gear Retractile Spring Tension:

(a) With a force of 50 grams applied to a tooth in a direction to cause the timer gear to rotate away from the normal position, the gear shall move away from the normal position and shall restore to normal when this pressure is reduced to

Test - 5 grams
Readjust - 10 grams

Use the No. 79C gauge.

To check this requirement, proceed as follows. Rotate the gear approximately one quarter of a revolution to operate the tripping mechanism, thus insuring that the spring tension is at a minimum. Allow the gear to restore against its stop. Then apply the gauge to the bottom of the gear as indicated in Fig. 18. Hold the gauge horizontally and apply pressure gradually toward the rear of the timer until the gear moves from its normal position. Continue exerting pressure until the gear has moved from four to six teeth away from the normal position. Note that the pressure required to move the gear is not in excess of the specified 50 grams. Gradually reduce the pressure until the gear restores to its normal position and note that the gauge reading does not go below the value specified until the gear has restored fully against its stop.

(b) With the timer gear turned so that the pawl is resting on the top of the pawl stop and with the front end of the pawl approximately in the center of the stop, the

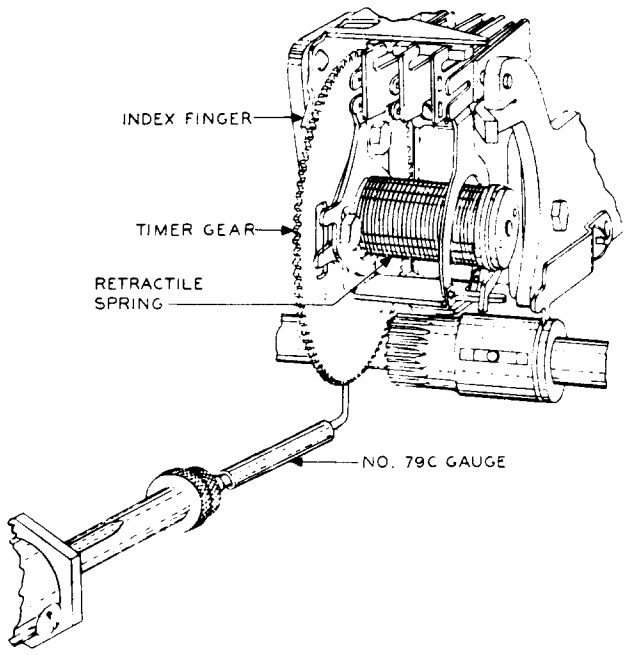

Fig. 18 - Checking Retractile Spring Tension

gear shall restore to normal against a pressure of

5 grams

Use the No. 79C gauge.

To check this requirement, proceed as follows. Rotate the gear one quarter of a revolution to operate the tripping mechanism, thus insuring that the spring tension is at a minimum. Allow the gear to restore against its stop. Then manually rotate the gear to the point where the front end of the pawl rests on the top of the pawl stop at approximately its center. Hold the gear in this position and apply the gauge to the gear as shown in Fig. 18, applying sufficient pressure to prevent the gear from restoring to normal. Gradually reduce the pressure until the gear starts to move toward the normal position. Check that the gauge reading, as the gear starts to move, is not less than the specified value.

2.27 Straightness of Springs: Fig. 19(A) - All springs shall be free of sharp bends or kinks due to adjustment, but 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.

2.28 Separation Between Springs: Fig. 19(B) - The clearance between adjacent springs, whether in their operated or unoperated position, shall be

Min 0.015 inch

Gauge by eye.

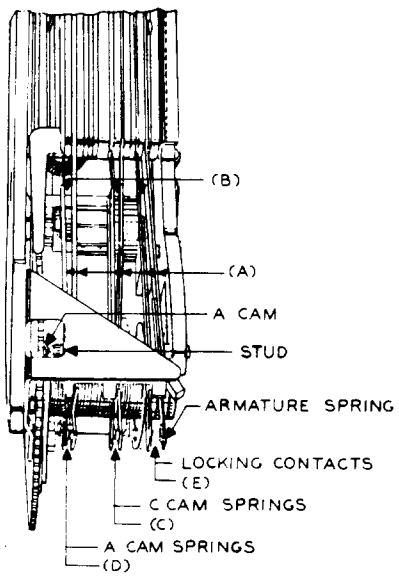

Fig. 19 - Timer - Top View

2.29 Electrical Requirements

(a) Operate: When the timer is assembled on a drive, with the driving shaft motor stopped and the gear in a position to prevent the pinion from meshing, the magnet shall operate the armature so that the stop plate on the armature touches the pole piece on the operate current specified on the circuit requirement table.

(b) Release: With the motor operating the driving shaft, the pinion shall disengage promptly from the timer gear and the gear restore to normal when the timer is released. This requirement shall be met, when the loop in the end of the gear retractile spring is just at the point of slipping over its stop and with a force of 15 grams applied just in front of the armature stud in a direction tending to operate the armature.

Use the No. 70H gauge.

To check this requirement, rotate the timer gear until the tripping cam begins to lift the loop in the end of the gear retractile spring. Operate the timer electrically. When the gear has been rotated approximately one-half tooth further, but before the spring has slipped over its stop and with the No. 70H gauge applying the specified tension to the armature, release the timer.

2.30 Timing Requirements: With the motor operating the driving shaft and the armature operated, the timing interval, as measured from the break of the "A" cam contacts [Fig. 19(D)] until the reclosure of the "C" cam contacts [Fig. 19(C)] shall be

Min 5 mins

Use the KS-3008 stop watch.

(a) Checking Timing Requirements

(1) Preparation: Connect one end of each of the 1W13B cords equipped with the 360-type tool to the terminals of the bottom cap of the KS-14250, L1 flashlight. Use the flashlights as specified below in making the tests. Closure of contacts will be indicated by lighting the flashlight and opening of contacts by extinguishing the flashlight.

(2) Initial Registration - Minimum Timing Interval: Connect the flashlights to the proper spring terminals at the rear of the timer, as shown in Fig. 20. Both flashlights should light. Operate the timer magnet by connecting ground to the right winding terminal connection at the top of the timer. Begin timing with the KS-3008 stop watch when the "A" cam contacts break. After an interval of a few seconds less than 5 minutes, the "C" cam contacts will break and then release. Cease timing at the reclosure of the "C" cam contacts.

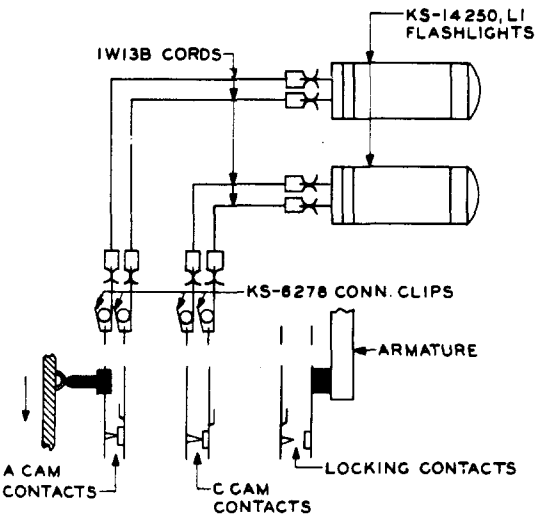

Fig. 20 - Connections for Checking Timing Interval

3. ADJUSTING PROCEDURES

3.001 List of Tools, Gauges, Materials, and Test Apparatus

Code or Spec No.	Description
Tools	
46	3/8-inch Hex. Single-end Socket Wrench
353C	Grease Gun (part of No. 1003A Tool Kit) (must be equipped with a No. 570A straight nozzle)
363	Spring Adjuster
417A	1/4- and 3/8-inch Hex. Open Double-end Flat Wrench
485A	Smooth-jaw Pliers
505A	Spring Adjuster (for 0.013-inch springs)
506A	Spring Adjuster (for 0.023-inch springs)
507A	Spring Adjuster (for 0.030-inch springs)
510C	Test Lamp (must be equipped with a No. 561A straight tip and a W2CB (24V) or a W2BL (48V) cord)
551A	Combination Wrench
552A	Oil Gun
563A	90-degree Offset Screwdriver
564A	45-degree Offset Screwdriver
KS-6320	Orange Stick
KS-6854	Screwdriver
KS-14164	No. 4 Artist's Show Card Brush
KS-14220 List 1 List 7 List 14	Wrench Consisting of Sliding T-handle 6-inch Extension Bar 7/16-inch Socket
KS-14250,L1 (or replaced flashlight equipped with KS-7742 bottom cap) (2 reqd)	Flashlight
P-220366	Dental Mirror
R-2653	No. 5 Bristo Setscrew Wrench
-	5-inch Diagonal Pliers
-	4-inch Regular Screwdriver
-	5-inch Regular Screwdriver
-	6-inch Cabinet Screwdriver
Gauges	
70D	50-0-50 Gram Gauge
70H	0-30 Gram Gauge
70J	0-150 Gram Gauge
74D	Thickness Gauge Nest
79C	0-200 Gram Push-pull Tension Gauge
131A	Thickness Gauge Nest (consists of a nest of 132-type gauges)
142A	0.053- and 0.060-inch Thickness Gauge
143A	Off-normal Cam Location Gauge
KS-3008 (or equivalent)	Stop Watch
Material	
KS-6438	Alaska Cylinder Oil
KS-7860	Petroleum Spirits
KS-8496	No. 3 Lubricating Compound
KS-14666 (or replaced D-98063)	Cloth
WECo. 57997	Petrolatum (unmedicated white vaseline may be used)
-	Hardwood Toothpick, flat on one end, pointed on the other
Test Apparatus	
35 Type	Test Set
1W13B (4 reqd)	Cord (each equipped with a KS-6278 connecting clip in one end)

3.002 While readjusting to meet some of the requirements specified herein, as for example, requirement 2.04, it will be necessary to open the motor circuit by removing the fuse. Checking and adjusting will also be facilitated if the setscrew in the motor gear is loosened to permit the driving shaft to be turned manually. After tests, tighten the setscrews and check that requirement 2.05(b) is met.

3.003 Due to mounting conditions, it may not be possible to make some of the adjustments unless the drive mounting is removed from the frame or the timer is removed from the mounting plate. To remove the drive mounting plate from the frame, remove the locknuts (if provided) from the screws which attach the mounting plate to the frame using the KS-14220 wrench. Remove the mounting screws using the 5-inch regular screwdriver. This will permit the mounting plate to be moved forward far enough to give access to some of the parts for adjusting. Take care in moving the plate forward not to put any strain on the wires connecting to the timer terminals. To remove a timer from the mounting plate, first unsolder all leads from the terminals. Remove the positioning screw locknut with the No. 46 wrench and the positioning screw with the 6-inch cabinet screwdriver. Remove the two mounting screws with the 4-inch regular screwdriver, which will free the timer. Whenever the timer is removed for any reason, inspect for all requirements and make all adjustments that appear necessary at this time. After the timer has been properly tested and adjusted, remount it making sure requirements 2.06, 2.07, 2.10, 2.14, and 2.29(b) are met, and resolder the wires that were removed.

3.01 Cleaning (Rq 2.01)

(1) Clean the contacts in accordance with the section on cleaning relay contacts. Clean other parts in accordance with approved procedures.

3.02 Lubrication (Rq 2.02)

(1) After lubricating any part of the timer or driving shaft, wipe off excess lubricant with the KS-14666 cloth.

(2) Driving Shaft: To lubricate the shaft at the left and right thrust bearings, remove the bearing mounting screws at the left thrust bearing with the No. 417A wrench. Remove the end plate and move the driving shaft to the left sufficiently so that the No. 570A nozzle of the No. 353C grease gun will fit between the shaft gear and the right thrust bearing. Rotate the shaft until the flat on the shaft at the right thrust bearing is accessible and lubricate the shaft at that point. Lubricate the shaft at the left thrust bearing. Reposition the shaft so that the gears mesh. Remount the end plate and hold the end plate and left thrust bearing as tightly as possible against the locating plate and tighten the bearing mounting screws securely. Check that requirement 2.08 is met. Lubricate the shaft at each support bearing with the No. 570A nozzle of the No. 353C grease gun held to the shaft on each side of the bearing.

(3) Pinion: Drive the shaft around until the slot in the pinion is accessible. Apply the lubricant to the groove with the No. 570A nozzle of the No. 353C grease gun held approximately perpendicular to the pinion. To lubricate the shaft at the right end of the pinion, first move the pinion to the left so that the pinion will engage with the gear. To lubricate the shaft at the left end of the pinion, first move the pinion to the right as far as possible.

(4) Shaft of Timer Gear: To lubricate the shaft of the timer gear, separate the turns of the retractile spring near the middle of the spring with a toothpick in order to insert the No. 570A nozzle of the No. 353C grease gun.

(5) Governor Shaft: To lubricate the governor shaft, use the No. 353C grease gun. Rotate the associated large gear sufficiently to permit the No. 570A nozzle entering between the governor arms. Hold the end of the nozzle against the shaft as close to the right end of the governor gear as possible and apply the lubricant.

(6) Friction Washer: To lubricate the friction washer, insert the curved end of the nozzle of the No. 552A oil gun in the hole in the damping disc and depress the plunger once. Repeat this operation in the other hole in the damping disc. Rotate the gear three or four revolutions, manually, to work in the oil. Wipe off surplus oil with the KS-14666 cloth, using a toothpick or the KS-6320 orange stick to insert the cloth between the frame of adjacent timer and the damping disc.

(7) "C" Cam: Use the KS-14164 brush to apply the lubricant. Rotate the gear forward to obtain access to the rear of the cam when applying the lubricant. After the lubricant has been applied, allow the gear to restore slowly to normal to prevent the lubricant reaching other surfaces where its presence might be objectionable.

(8) Point of Engagement of Timer Gear and Pinion: Rotate the timer gear manually so that the point of pinion engagement is at the front. The reference hole opposite the point of pinion engagement should be used as a guide to determine how far the gear should be turned. Remove any old lubricant from the gear surface with the KS-14666 cloth. Using the KS-14164 brush, apply the lubricant to the face of the gear at the point of pinion engagement. Allow the gear to restore slowly to normal to prevent the lubricant from reaching other surfaces where its presence might be objectionable.

(9) Motor: Where the motor is nonreoilable type and it appears that lubrication is necessary, remove the motor as follows and substitute a new motor. On reoilable type, remove the motor. To do this, unsolder the leads to the motor field coil terminals at the front of the motor. Loosen the locknut at the rear of the motor with the No. 417A wrench. Remove the two motor mounting screws with the Nos. 563A and 564A offset screwdrivers. Lift the motor so that the teeth of the motor gear do not engage the teeth of the driving shaft gear and draw the motor forward from the drive. Lubricate the motor in accordance with the procedures given in the section covering lubrication of Telechron motors. Remount the motor by placing the slot in the motor plate over the mounting screw at the rear of the plate and sliding the motor toward the rear. Take care that the spacer is properly located between the motor and the mounting plate. Insert the two motor mounting screws loosely and position the motor so that there is the proper amount of backlash between the motor and driving shaft gears. Tighten the motor mounting screws securely and tighten the locknut on the motor mounting screw at the rear of the motor. Reconnect the leads to the motor field coil terminals.

3.03 Record of Lubrication (Rq 2.03)
(No Procedure)

3.04 End Play of Driving Shaft (Rq 2.04)

(1) To adjust the end play of the driving shaft, loosen the setscrew in the driving shaft gear with the R-2653 Bristo setscrew wrench and move the gear to the right or left, as required. Insert the 0.004-inch blade of the No. 74D gauge between the gear and end plate to insure a clearance and position the gear so that the setscrew is above the flat section of the shaft. Be sure in inserting the gauge that the end of the gauge rests against the surface of the driving shaft. With the end play of the shaft taken up to the left and the gear held firmly against the gauge tighten the gear setscrew securely. Remove the gauge. Check the horizontal position of the gears and if necessary shift the motor gear as outlined in 3.05(2).

3.05 Engagement of Motor and Driving Shaft Gears (Rq 2.05)

(1) To adjust the depth of engagement of the motor and driving shaft gears, loosen the screws and nut which hold the motor with the Nos. 563A and 564A offset screwdrivers and the No. 417A wrench. Position the motor so that the gears mesh properly and tighten the screws and nut securely.

(2) To adjust the alignment of the faces of the teeth of the motor and driving shaft gears, loosen the motor gear setscrews with the R-2653 Bristo setscrew wrench and move the gear to the right or left, as required. Tighten the setscrews securely.

3.06 Mounting of Timers (Rq 2.06)
3.07 Engagement of Shifting Spring Tang and Pinion (Rq 2.07)

(1) To tighten loose mounting screws use the 4-inch regular screwdriver. To adjust the positioning screw use the 6-inch cabinet screwdriver. To tighten the positioning screw locknut use the No. 46 wrench.

(2) To adjust the engagement of the timer gear and shifting spring with the pinion, first loosen the positioning screw locknut at the rear of the frame with the No. 46 wrench. Turn the positioning screw with the 6-inch cabinet screwdriver until the shifting spring and timer gear are properly positioned with respect to the associated pinion. If the shifting spring and gear cannot be adjusted simultaneously with respect to the pinion, loosen the timer mounting screws with the 4-inch regular screwdriver and turn the timer slightly to the left or right, as required, to give satisfactory adjustment but not enough to prevent the mounting bracket being approximately perpendicular to the drive shaft. If the gear and shifting spring still do not mesh properly with the pinion, remove the timer and loosen the shifting spring mounting screw with the KS-6854 screwdriver. Position the shifting spring up or down, as required, to insure its satisfactory engagement with the pinion. Tighten the shifting spring mounting screw securely and remount the timer.

(3) If there is no clearance between the shifting spring tang and the sides of the pinion groove, it may be due to a bent tang or accumulation of dirt in the groove. Use a toothpick to clean out any dirt in the pinion groove. To adjust a bent tang, disengage the shifting spring tang from the pinion groove by loosening the positioning screw locknut with the No. 46 wrench and turning the timer positioning screw with the 6-inch cabinet screwdriver. Straighten the tang with the No. 485A pliers. Readjust the positioning screw until requirements 2.06, 2.07, 2.10, 2.14, and 2.29(b) are met.

3.08 Freedom of Shaft Movement (Rq 2.08)

(1) Before adjusting a shaft which is tight in its bearings, first disengage the motor gear as covered in 3.002.

(2) To correct a tight shaft first check that the shifting spring tangs are properly located as covered in requirement 2.07 and determine if any shifting spring tang binds at the pinion. If necessary, adjust the position of the shifting springs as outlined in 3.07.

(3) If the shaft still binds, lubricate in accordance with requirement 2.02(a).

(4) If, after lubricating, the shaft does not turn freely, loosen the bearing mounting screws of the two middle support bearings with the No. 417A wrench and permit the shaft to assume a free position at the bearings. Tighten the bearing mounting screws securely. If the shaft moves freely, check requirements 2.06, 2.07, and 2.29(b) and insure that the timer gears and shifting springs engage properly with the pinions.

(5) If the shaft still binds, remove the shaft as outlined in (6) and wipe the shaft off with the KS-14666 cloth. Check for burrs at the bearing positions and for a bent shaft. If the shaft is bent or if the bind is not removed after cleaning the shaft and removing all burrs, replace the shaft with a new one.

(6) To remove the driving shaft remove the bearing bracket mounting screws, except for the bracket adjacent to the driving shaft gear, with the No. 417A wrench. After cleaning, position the driving shaft and bearing, holding the bearings as tightly as possible against the locating plate. Tighten the bracket mounting screws securely. Lubricate the shaft as covered in 3.02 and make sure that requirements 2.06, 2.07, 2.10, and 2.29(b) are met.

(7) After adjusting or replacing the driving shaft, check the engagement of the motor and driving shaft gears and, if necessary, adjust as outlined in 3.05.

3.09 Tripping Cam Clearance (Rq 2.09)

(1) If the retractile spring is tripped too soon or there is insufficient clearance between the tripping cam and tripping finger, report the trouble to the supervisor.

3.10 Freedom of Pinion Movement and Shifting Spring Tension (Rq 2.10)

(1) To adjust for pinion movement, first disengage the associated timer gear and shifting spring from the pinion by loosening the timer positioning screw locknut with the No. 46 wrench and turning the positioning screw with the 6-inch cabinet screwdriver. With the timer disengaged and using the No. 70H gauge, check to see that the pinion will move freely with a force of 25 grams applied to either end of the pinion. If the pinion does not move freely, lubricate the shaft and pinion as outlined in 3.02

(2) With the timer disengaged, check the tension of the shifting spring. The tension of the shifting spring against the armature should be between 40 and 80 grams. If the tension is not satisfactory, remove the timer and adjust the shifting spring with the No. 507A spring adjuster, applying the spring adjuster near the crook in the spring. If sufficient tension cannot be obtained in this manner, remove the shifting spring mounting screw with the KS-6854 screwdriver and remove the shifting spring. Grasp the spring just back of the crook in the spring and form the spring slightly so that when it is remounted the tension will be within the specified limits. Remount the shifting spring and tighten the mounting screw securely. Check the tension and, if necessary, readjust using the No. 507A spring adjuster. Remount the timer, making sure requirements 2.06, 2.07, 2.10, 2.14, and 2.29(b) are met.

3.11 Armature Travel (Rq 2.11)

(1) To adjust the armature travel, turn the armature adjusting nut with the No. 551A wrench until the 0.053-inch end of the No. 142A gauge can be inserted loosely between the armature stop plate and pole piece as shown in Fig. 21 and the 0.060-inch end of the gauge, if it can be inserted without forcing, does so with a snug fit.

3.12 Armature Adjusting Screw Clearance (Rq 2.12)

(1) Before adjusting for clearance between the armature and armature adjusting screw, dismount the timer as covered in 3.003. Loosen the armature mounting screws with the KS-6854 screwdriver and move the armature until there is a clearance between the armature and the adjusting screw. Tighten the armature mounting screws securely. Remount the timer, making sure requirements 2.06, 2.07, 2.10, 2.14, and 2.29(b) are met.

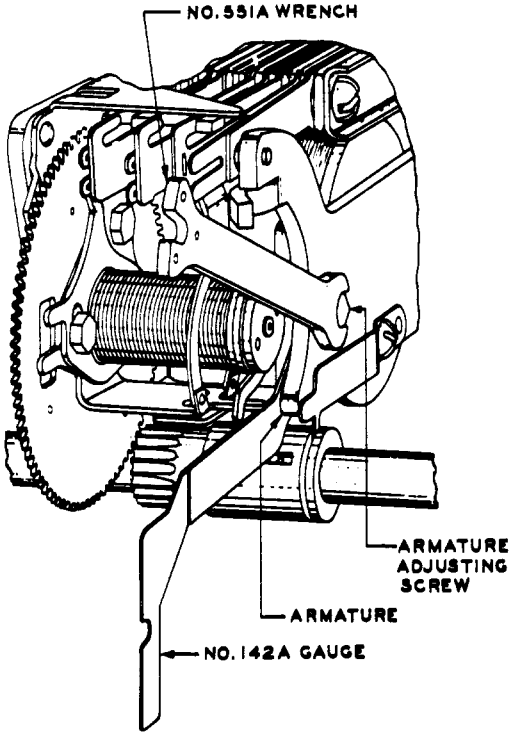

Fig. 21 - Method of Adjusting Armature Travel

3.13 Index Finger Position (Rq 2.13)

(1) Use the No. 485A pliers to adjust the position of the index finger.

3.14 Pinion Position (Rq 2.14)

(1) If it is necessary to change the position of a pinion with respect to its gear, adjust the tip of the shifting spring (Fig. 22) away from the armature with the No. 485A pliers to position the pinion nearer the gear or adjust the tip of the shifting spring toward the armature to position the pinion farther from the gear. After adjusting the tip of the shifting spring, check requirement 2.10 and, if necessary, readjust the shifting spring tension as outlined in 3.10(2). Check that requirements 2.07, 2.10, and 2.29(b) are met.

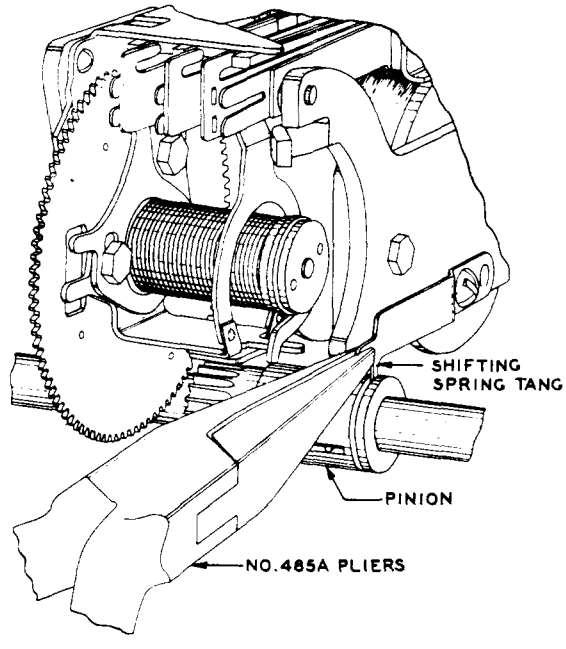

Fig. 22 - Method of Adjusting Shifting Spring

3.15 Gear Stop Pawl Position (Rq 2.15)

(1) Remove the timer in order to check or adjust the pawl spring tension. Use the No. 485A pliers to change the tension in the pawl spring. If the pawl does not drop freely from the gear stop, increase the tension but not to exceed the tension specified in requirement 2.15(d). If after increasing the tension of the pawl spring, as specified above, requirement 2.15(a) and (b) are not met, clean the pawl by applying a few drops of petroleum spirits at the pawl bearing, between the pawl and the gear, and between the pawl and the mounting bracket. Use a toothpick in applying the petroleum spirits. If these requirements are still not met, refer the matter to the supervisor. After checking or adjusting, remount the timer and check that requirements 2.06, 2.07, 2.10, 2.14, 2.26, and 2.29(b) are met.

3.16 Engagement of Timer Gear and Governor Pinion (Rq 2.16)

(1) If there is no backlash between the gear and governor pinion, refer the matter to the supervisor.

3.17 Contact Alignment (Rq 2.17)

(1) If the contacts do not line up properly or the spacers on the solid spring rubs on the bifurcated springs, it is an indication that the springs are twisted or have shifted in the assembly. Straighten twisted springs as outlined in (2). If springs are straight or if after straightening twisted springs 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.

(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 spring or misalignment of the two prongs of the bifurcated spring. Correct for a twisted spring by using the No. 505A or No. 506A spring adjuster applied near the point where the spring leaves the insulators. To correct misalignment of the prongs of the bifurcated spring, use the No. 505A or No. 506A spring adjuster and adjust the upper or lower prong of the bifurcated spring. It is recommended that in adjusting as covered above, the two prongs of the bifurcated springs be adjusted to make contact with the opposing contacts as near simultaneously as possible.

3.18 Spring Tension (Rq 2.18)
3.19 Contact Pressure of "C" Cam Contacts (Rq 2.19)

(1) Use the No. 505A, No. 506A, or No. 507A spring adjuster to adjust the springs. Place the adjuster on the spring near the middle and slide it back along the spring to the point where the spring leaves the clamping plate and insulators, as shown in Fig. 23. Adjust the spring to the right or left, as required. Check that requirements 2.17, 2.20, 2.21, 2.22, 2.23, 2.24, and 2.26(a) are met.

3.20 Contact Separation (Rq 2.20)

(1) The spring studs and washers so space the bifurcated contact springs with respect to the solid contact springs that no adjustment for contact separation should be necessary, if the springs are straight in accordance with requirement 2.27 and the contacts on the bifurcated contact springs are in approximately the same vertical line.

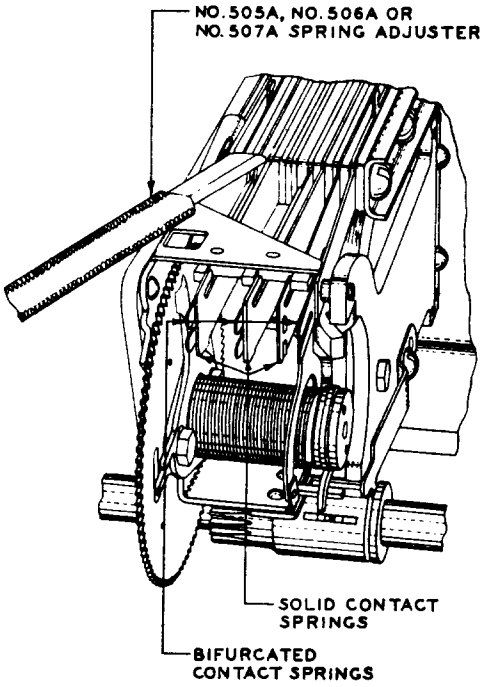

Fig. 23 - Method of Adjusting Spring Tension

3.21 Spring Gauging (Rq 2.21)
3.22 Contact Follow (Rq 2.22)

(1) To adjust for spring gauging, contact follow, or locking contact spring position, adjust the spring tang to the right or left, as required, using the No. 507A spring adjuster. Check that requirements 2.20, 2.21, 2.23, 2.24(b), and 2.26(a) are met.

3.23 "A" Cam Position (Rq 2.23)
3.24 "C" Cam Position (Rq 2.24)

(1) To adjust the position of the "A" cam, loosen the "A" and "C" cam clamping screws with the No. 551A wrench. Rotate the gear, as required, to obtain access to the setscrews. With the gear rotated from the normal position, insert one end of the No. 143A gauge between the "A" cam and the stud of the A contact spring assemblies. Allow the gear to return to its normal position. Then without moving the gear, insert the KS-6854 screwdriver into the slot at the front of the gear. Move the adjusting lever of the "A" cam up or down, as required, with the screwdriver. Remove the screwdriver. Check the adjustment as follows. Insert first one end of the No. 143A gauge and then the other end between the "A" cam and the stud. The cam is correctly located, if regardless of the end inserted, the near end of the gauge lies approximately the same distance from but on opposite sides of a line, which passes through the end of the stud on the A contact spring assembly and parallel to the gear wheel as shown in Fig. 24. Tighten the "C" cam clamping screw, located just back of the slot in the gear. Rotate the gear and tighten the "A" cam clamping screw. Adjust the "C" cam as outlined in (2).

(2) To adjust the "C" cam after adjusting the "A" cam, loosen the clamping screw just back of the gear slot, or if only the "C" cam is being adjusted, loosen both "C" cam clamping screws with the No. 551A wrench. Adjust the position of the "C" cam with the KS-6854 screwdriver inserted in the slot in the front of the gear. Tighten the clamping screw just back of the slot in the gear securely. Check the adjustment of the cam with the armature operated and using the P-220366 dental mirror to view the engagement of the "C" cam and C spring finger from the top of the timer. The No. 510C test lamp may aid in observing the cam position. If necessary, again adjust the cam to obtain the proper position. Tighten both "C" cam clamping screws securely.

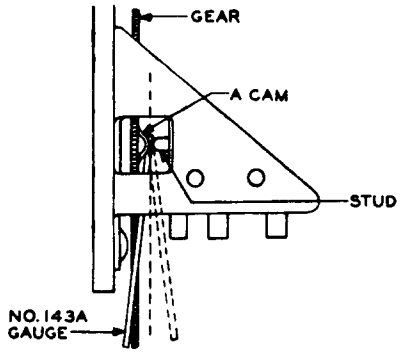

Fig. 24 - Method of Adjusting "A" Cam

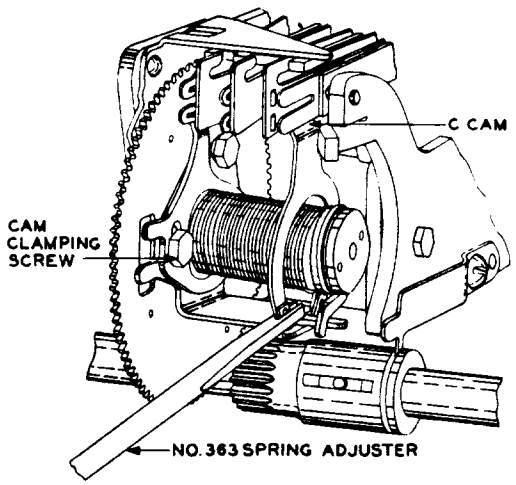

Fig. 25 - Method of Adjusting "C" Cam

(3) Adjust the position of the "C" cam with respect to the armature and C spring finger with the No. 363 spring adjuster, as shown in Fig. 25. Apply the adjuster near the point where the cam spring joins its base. With the cam adjusted, the face of the cam should be approximately parallel to the gear.

(4) If the top edge of the "C" cam is not properly located with respect to the C spring finger, check that the legs supporting the "C" cam are not kinked or bowed. If necessary, straighten them using the No. 485A pliers taking care to maintain the adjustment made in (3). If the condition is not corrected by adjusting in this manner, replace the timer.

3.25 Timer Gear Retractile Spring Clearance (Rq 2.25)

(1) If there is insufficient clearance between the end of the retractile spring which protrudes through the timer gear and the timer frame, rotate the gear until the end of the spring is accessible and cut the end off as close to the gear as possible with the 5-inch diagonal pliers.

3.26 Timer Gear Retractile Spring Tension (Rq 2.26)

(1) If the gear fails to restore to normal against the specified tension when moved from four to six teeth from the normal position, lubricate the shaft of the timer gear as covered in 3.02(4). If after the shaft has been lubricated, the gear still fails to return to normal, it is an indication that the tension of the retractile spring is too low, in which case refer the question to the supervisor.

(2) If the gear fails to return to the normal position as the pawl passes over the gear stop, it is an indication that the tension of the pawl spring is excessive. Remove the timer from its mounting as covered in 3.003 and check the tension of the pawl spring as the gear stop is passing under the end of the pawl. To do this, use the No. 70D gauge applied to the front end of the pawl when the pawl is lifted to its highest point by the gear stop. Reduce the tension of the pawl spring toward the minimum specified using the No. 485A pliers. Remount the timer as covered in 3.003.

3.27 Straightness of Springs (Rq 2.27)
3.28 Separation Between Springs (Rq 2.28)

(1) 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 No. 505A, No. 506A, or No. 507A spring adjuster. If necessary, dismount the timer in order to obtain access to the part of a spring needing adjustment. Check that requirements 2.18, 2.19, 2.20, 2.21, 2.22, 2.24(b), and 2.26(b) are met.

(2) 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.

3.29 Electrical Requirements (Rq 2.29)

(1) If the timer does not operate on the specified operate current, adjust as follows, checking for timer operation after each adjustment.

(a) Decrease the tension of the armature tension spring toward a minimum.

(b) Decrease the tension of the shifting spring toward a minimum.

If the timer still does not operate, refer the matter to the supervisor.

(2) If the release requirement is not met, increase the tension of the armature spring but not sufficiently to prevent the operation of the timer. If the timer still does not release check that requirements 2.06 and 2.07 are met and, if necessary, reposition the timer and adjust the engagement of the shifting spring with the pinion. If the timer still does not release, refer the matter to the supervisor.

3.30 Timing Requirements (Rq 2.30)

(1) 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 requires lubrication or is defective. In this case, relubricate the motor as covered in 3.02(9). If the requirement is still not met, replace the motor.