DIALS
SHOP PROCEDURE

CONTENTS PAGE

1. GENERAL

1.01 This section provides the shop procedures for the maintenance of the GTE Automatic Electric (GTE AE) line of rotary dials. These shop procedures cover disassembly, reassembly, lubrication, adjustments, and parts lists.

1.02 This section is reissued to update information on the Type 154A dial. Due to extensive changes involved, marginal arrows are omitted. Remove the previous issue of this section from the binder or microfiche file and replace it with this issue.

2. DESCRIPTION

2.01 Rotary dials may be placed into two categories: those with single-contact springs and those with double-contact springs. The Type 24, 24A36, and 51 dials have single-contact springs, while the Type 51A, 52, 53A, 53B, 54A, 54B, and 154A dials (Figure 1) have bifurcated contact springs. The manufacture-discontinued dials are included in this description only to show the fundamental differences between them and the present dials. The associated tables and figures referenced also provide a parts breakdown as well as parts compatibility information where applicable.

Type 24 Dial

2.02 The Type 24 dial, introduced in 1924, is a non-quieted-pawl type dial that can be readily distinguished from the others during dial windup since the pawl produces a series of clicks as it passes over the ratchet teeth. The dial housing is not of the die-cast type, the spring banks (impulse and shunt) are mounted separately to the rear of the housing, and the fingerstop is an integral part of the bearing and stop bracket. The Type 24 dial is no longer manufactured.

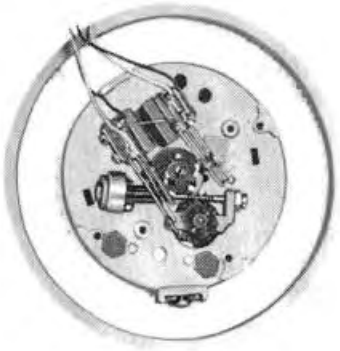
Type 24A36 Dial

2.03 The Type 24A36 dial, introduced in 1936, provides pawl quieting by placing a flat spring over the pawl tip, that cushions its impact against the teeth of the ratchet gear. (The Type 24A36 dial also contained pawls that were silenced by a piano-wire-type spring.) Other characteristics of the Type 24A36 dial are the same as those mentioned for the Type 24 dial. During dial windup, a definite series of clicks is heard, but the clicks are not as pronounced as those during windup of the Type 24 dial. The Type 24A36 dial is no longer manufactured.

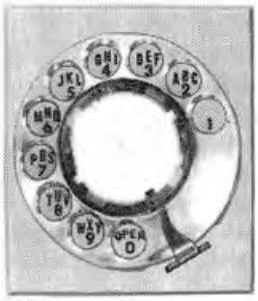
Type 51 Dial

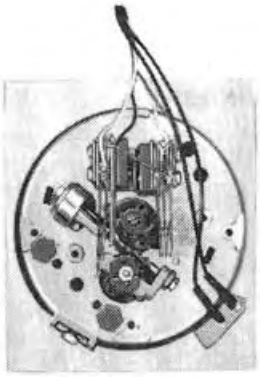
2.04 The Type 51 dial, introduced in 1951, provides silencing through the use of a friction-type pawl lever (lo-

TYPE 51A

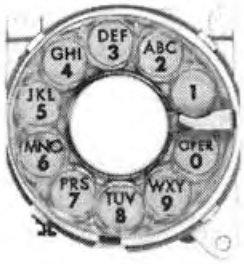


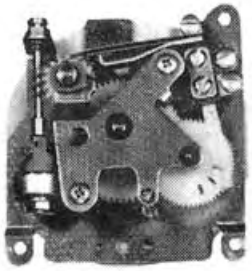
TYPE 52F





TYPE 54





TYPE 154A

Figure 1. Dial Types 51 Through 154A.

cated between the ratchet gear and the spider) that is pushed ahead by the pawl and by the contour of its contact edge, thereby keeping the pawl from engaging the teeth during dial windup. The three types of dials just mentioned have a diameter of 3 inches, use single-contact springs, and are equipped with D-78540 fingerwheels. The Type 51 dial base is made of die-cast aluminum. The spring mountings and bearing bridge are integral parts of the base. The Type 51 dial is no longer manufactured.

Type 51A Dial

2.05 The Type 51A dial, introduced in 1954, is similar to the Type 51 dial except that it has double-contact impulse and shunt springs. Tapped bosses in the base provide for mounting an acrylic (plastic) dust cover. Later models of the Type 51A dial were provided with two 7/32-inch slots for mounting the dust cover. A variety of fingerwheels have been used with this dial. The Type 51A dial is no longer manufactured.

Type 52, 52F, 53A, 53AF, 53B, and 53BF Dials

2.06 The Type 52, 53A, and 53B dials have a mechanism similar to that of the Type 51A dial. They differ in that an external number plate with a diameter of 4-1/4 inches is used. The Type 53A dial is equipped with an additional cam and spring assembly that is used for party identification of Type A SATT installations. The Type A can is an acetal (plastic) cam that has three removable (or adjustable) pulse pins that provide for programming the pulse pin arrangement on the job according to the party identification requirement of the individual station. The Type 53B dial is similarly equipped except that the additional cam provides a single identification pulse for use in Type B SATT offices. Party identification depends upon placement of the one-lobe cam. Type 52, 53A, and 53B dials have screw-type terminals to accommodate leads with spade lugs. Type 52F, 53AF, and 53BF dials have terminals of the wire-wrapping variety, denoted by the suffix letter F in the type number.

Type 54F, 54AF, and 54BF Dials

2.07 The Type 54, 54AF, and 54BF dials (Type 54 was introduced in 1960 on the Type 182 STARLITE Telephone Set) are nominal 3-inch-diameter dials similar to the Type 51A dial, but are equipped with a rectangular number plate and integral electroluminescent lamp. The die-cast base is not interchangeable with those of other types of dials because the flange height is reduced to accommodate the lamp. Terminals of the wire-wrapping variety are used.

2.08 In 1974 the Type 51 through 54 dials were redesigned. The worm wheel and pinion are plastic and accept a new impulse cam. The bearing and stop bracket accommodate the new worm wheel and pinion, and assembles to the revised dial base. The pawl is now plastic with an integral pawl spring. The pawl is fastened to the pawl plate by a modified pawl pinion. The pawl plate is staked to the main shaft. The shunt cam and hub are made of aluminum. These changes are effective with dial assemblies manufactured after January 1974. Figure 2 shows an exploded view of the components and mechanisms associated with Type 52 through 54 dials. Figure 3 provides the part numbers for the components and a compatibility list.

Type 154A Dial

2.09 The Type 154A dial (introduced in 1968 on the Type 980 Dial-in-Handset) is a smaller dial, distinctly different from the older Type 52 dial. In this miniature dial, both the pawl stop and the fingerstop are movable. A set of reducing gears provide unique shunting, and most of the component parts are mounted between two plates. Four plastic gears and three shafts run in plastic bearings. An optional electroluminescent lamp can be provided to light the dial.

2.10 The Type 154A miniature dial has also been changed. The baseplate now has a molded plastic center section. A tab has been added to the finger stop to prevent overriding. The bushing is plastic and combined with the disc. The gear shunt cam is plastic and does not require an inserted metal shaft. The worm of the governor assembly is made of nickel-silver, and the hub is integrated with the worm. The governor cup is acetal and has an integral snap for mounting. The impulse spring-stop is now part of the bearing plate. The bearing screw is acetal, and the bearing nut is aluminum. Figure 4 shows an exploded view of components and mechanisms associated with the Type 154A dial. Table 1 provides a description and part number for each circled item shown in the figure. Certain items in Table 1 are optional; therefore, determine if the option is required before selecting or ordering specific items. These changes are effective with dial assemblies manufactured after January 1975.

Other Dials

2.11 All dials covered in this section are of the delayed-impulse type; however, other dial variations exist (nondelayed impulse, normally open, etc), but these are primarily for industrial use and consequently will not be covered. Table 2 lists the different characteristics of dials manufactured by GTE AE.

3. INSPECTION

3.01 Dials returned for maintenance should first be thoroughly inspected to determine whether any faults exist that can be readily detected prior to performing any adjustments or replacements on the dial. An overall visual inspection should include checking the dial for dirt and grime, bent impulse springs, bent fingerwheel, loose wire terminals, misaligned govenor wings, and proper functioning of the main spring and shaft assembly. The fingerwheel should be rotated several times while inspecting operation of the

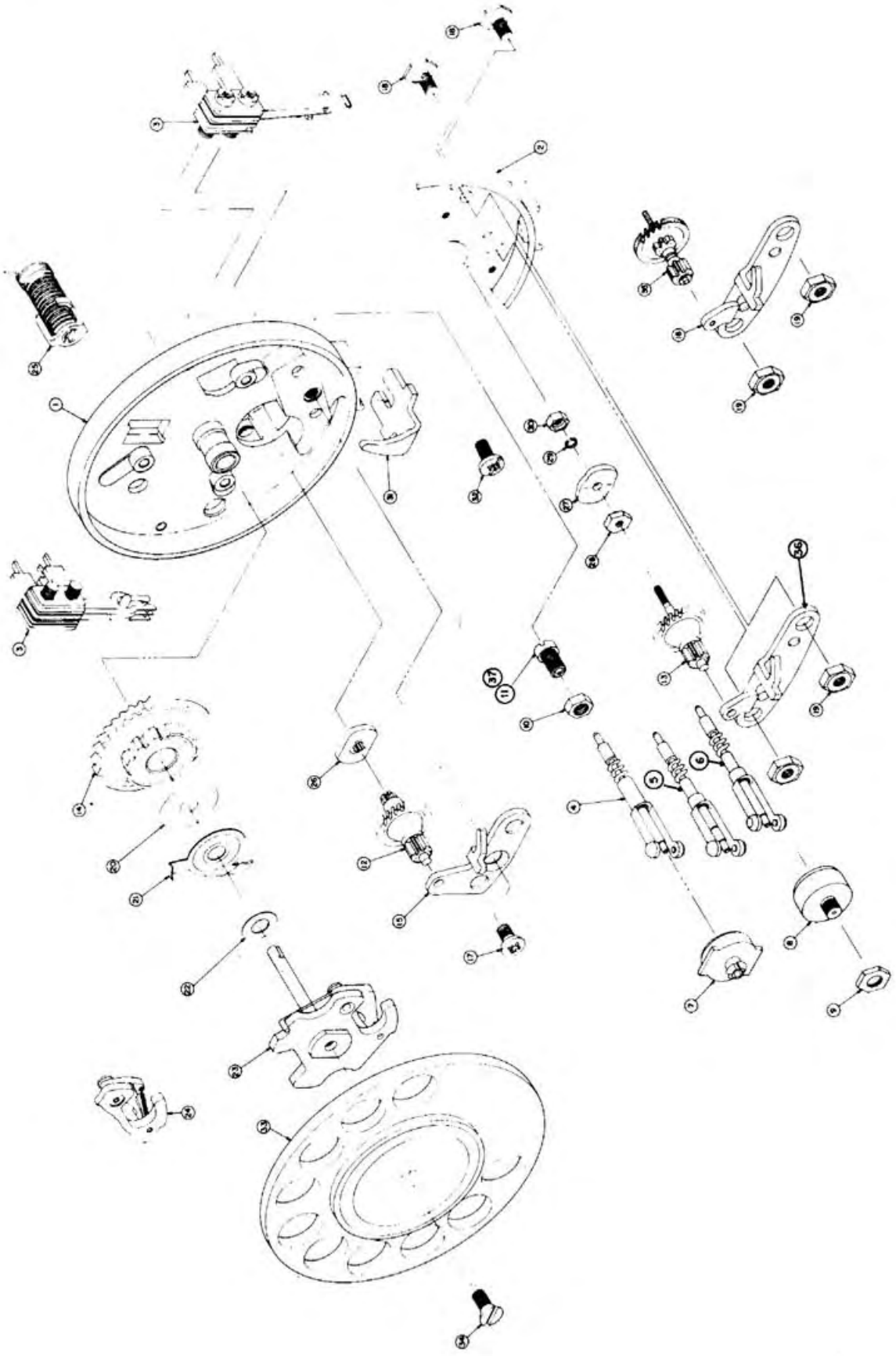


Figure 2. Exploded View of Dial Types 52 Through 54.

	Item	A	Item	7	8	5	4	6	13	35	12	11	37	16	36	15	1	2	26	27
				D-27095-A	D-2791-A	D-64061-A	D-64061-B	D-64057-A	HD-430003-A	D-43042-A	HD-430004-A	D-76313-B	D-76313-A	HD-731049-A	D-731513-A	HD-731051-A	HD-780063-A	HD-780900-A	HD-830005-A	D-83004-A
Phase I	7	D-27095-A				R	R	X	C	C	C	C	C	C	C	C	C	C	C	C
	8	D-2791-A				X	X	R	C	C	X	C	C	C	C	C	C	C	C	C
	5	D-64061-A	R	X					C	C	C	C	C	C	C	C	C	C	C	C
Phase I	4	D-64061-B	R	X					C	X	C	C	X	C	X	C	C	C	C	C
	6	D-64057-A	X	R					C	C	X	C	C	C	C	C	C	C	C	C
Phase I	13	HD-430003-A	C	C	C	C	C					C	C	C	X	C	X	X	X	X
	35	D-43042-A	C	C	C	X	C					C	C	X	X	X	X	X	X	X
Phase II	12	HD-430004-A	C	X	C	C	X					C	C	X	X	X	X	X	X	X
Phase I	11	D-76313-B	C	C	C	C	C	C	C	C				C	C	C	C	C	C	C
	37	D-76313-A	C	C	C	X	C	C	C	C				C	C	C	C	C	C	C
Phase I	16	HD-731049-A	C	C	C	C	C	C	X	X	C	C					X	X	X	C
	36	D-731513-A	C	C	C	X	C	X	X	X	C	C					X	C	X	C
Phase II	15	HD-731051-A	C	C	C	C	C	C	X	X	C	C					X	X	X	X
Phase II	1	HD-780063-A	C	C	C	C	C	X	X	X	C	C	X	X	X				X	X
	2	HD-780900-A	C	C	C	C	C	X	X	X	C	C	X	C	X				X	X
Phase II	26	HD-830005-A	C	C	C	C	C	X	X	X	C	C	X	X	X	X	X	X		
	27	D-83004-A	C	C	C	C	C	X	X	X	C	C	C	C	X	X	X			
	38	D-76313-C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C

LEGEND:

C - COMPATIBLE (MAY BE USED IN CONJUNCTION WITH CORRES. PARTS IF ALL OTHER "REQUIRED" (R) PARTS ARE ALSO USED).

R - REQUIRED— IF PART IN COLUMN "A" IS USED, CORRESPONDING PART MUST ALSO BE USED.

X - THESE TWO PARTS CANNOT BE USED TOGETHER.

MANUFACTURING NOTES:

1-EITHER D-63061-A OR D-62061-B MAY BE USED.

Amount	Part No.	Description	Item
1	HD-780063-A D-780900-A	Base Assembly Base Assembly	1 2
1	NP-25-A4	Spring Combination	3
1	D-64061-B D-64061-A D-64057-A	Governor Assembly Governor Assembly Governor Assembly	4 5 6
1	D-27095-A D-2791-A	Governor Cup Governor Cup	7 8
1	D-77041-A	Nut (Brass Governor Cup)	9
1	D-77041-C	Hex Nut	10
1	D-76313-B	Bearing Screw **(PLASTIC)**	11
1	HD-430004-A HD-430003-A	Pinion and Worm Gear Pinion and Worm Gear	12 13
1	D-43045-A	Ratchet Gear	14
1	D-731051-A D-731049-A	Bearing and Stop Bracket Bearing and Stop Bracket	15 16
1	HD-765640-FT04	Screw-Bearing and Stop Bracket	17
2	D-760878-A	Screw-Bearing and Stop Bracket	18
2	D-77408-A	Nut-Bearing and Stop Bracket	19
1	D-440279-A	Fiber Washer - Silencer	20
1	D-16356-A	Pawl Lever (Silencer)	21
1	D-17592-A	Washer-Silencer	22
1	D-46192-H D-46192-A,B,C,D,F, or G	Shaft Assembly Shaft Assembly	23 24
1	D-109112-A or B	Main Spring Assembly	25
1	HD-830005-A D-83004-A	Impulse Cam Impulse Cam	26 27
1	D-82102-A	Hub-Impulse Cam	28
1	D-17530-A	Lockwasher - Impulse Cam	29
1	D-77333-A	Locknut - Impulse Cam	30
1	D-33128-A	Finger Stop	31
1	HD-764006-A	Screw - Fingerstop	32
1	HD-780059-A	Fingerwheel	33
1	D-762000-D	Screw - Fingerwheel	34
1	D-43042-A	Pinion and Worm Gear Assy.	35
1	D-731513-A	Chrome Plated Bearing & Stop Bracket	36
1	**D-731513-A**	**BEARING SCREW (BRASS)**	**37**
1	**D-76313-C**	**BEARING SCREW SELF-LOCKING**	**38**

NOTE: D-109112-A & B MAIN SPRING ASSY'S ARE INTERCHANGEABLE.
D-46192-A-H SHAFT ASSY'S ARE INTERCHANGEABLE.
HD-731052-A & D-732124-A DIAL MOUNTING BRACKETS ARE INTERCHANGEABLE.
HD-530031-A-M AND D-530190-A-M DIAL NUMBER PLATES ARE INTERCHANGEABLE.
D-77041-A-C GOVERNOR BEARING SCREW NUTS ARE INTERCHANGEABLE.
ITEM 15 BEARING AND STOP BRACKET - HD-731051-A REQUIRES ITEM 17 THREAD FORMING SCREW HD-765640-FT04. ITEM 16 BEARING AND STOP BRACKET - HD-731049-A - REQUIRES TWO ITEM 18 D-760878-A SCREWS AND TWO ITEM 19 D-77408-A NUTS.
THE FOLLOWING PARTS ARE NOT AFFECTED BY PHASE I AND PHASE II CHANGES:
ITEM 14 D-43045-A
20 D-440279-A
21 D-16356-A
22 D-17592-A
3 NP-25-A4

Figure 3. Dial Part Matrix.

Table 1. Type 154A Dial Parts List.

ITEM NO.	PART NO.	QUANTITY	DESCRIPTION	INTER-CHANGEABLE
1	D 490202 D	1	Fingerwheel cover	Yes
2	D 781050 A	1	Fingerwheel	Yes
3	D 17695 A	1	Spring washer	Yes
4	D 33131 A	1	Finger stop	No
5	HD 530054 A	1	Number plate	
6	D 94161 A	1	Electroluminescent lamp	Yes
7	D 65511 F	2	Retaining ring	Yes
8	D 17693 A	1	Washer spring	Yes
9	D 65599 A	1	Molded disc	Yes
10	D 110042 B	1	Main spring	Yes
11	D 750355 A	1	Sintered bushing	Yes
12	D 76313 C	1	Bearing screw	Yes
13	D 46743 A	1	Pinion and wormwheel assembly	Yes
14	D 64061 B	1	Governor worm assembly	Yes
15	D 27095 A	1	Governor cup	Yes
16	D 17696 A	1	Neoprene washer	No
17	HD 765400PB05	2	4-24 x 5/16 standard screw	
18	HD 765256PM04	1	2-56 x 1/4 standard screw	
19	D 781020 A	1	Bearing-plate assembly	No
20	D 77459 A	1	Nut 0.073 to 0.075 inch	Yes
21	D 17698 A	1	Lock washer 0.147 x 0.18 inch	Yes
22	D 83167 A	1	Impulse cam	Yes
23	D 82169 A	1	Hub-hex 0.250 inch	Yes
24	HD 430005 A	1	Shunt gear	Yes
25	D 43046 A	1	Molded ratchet and gear	
26	D 34021 A	1	Pawl-shaft assembly (shown in Figure 4 with split shaft)	Yes
27	D 17700 A	2	Flat washer	
28	D 735572 A	1	Base and spring pileup assembly	No

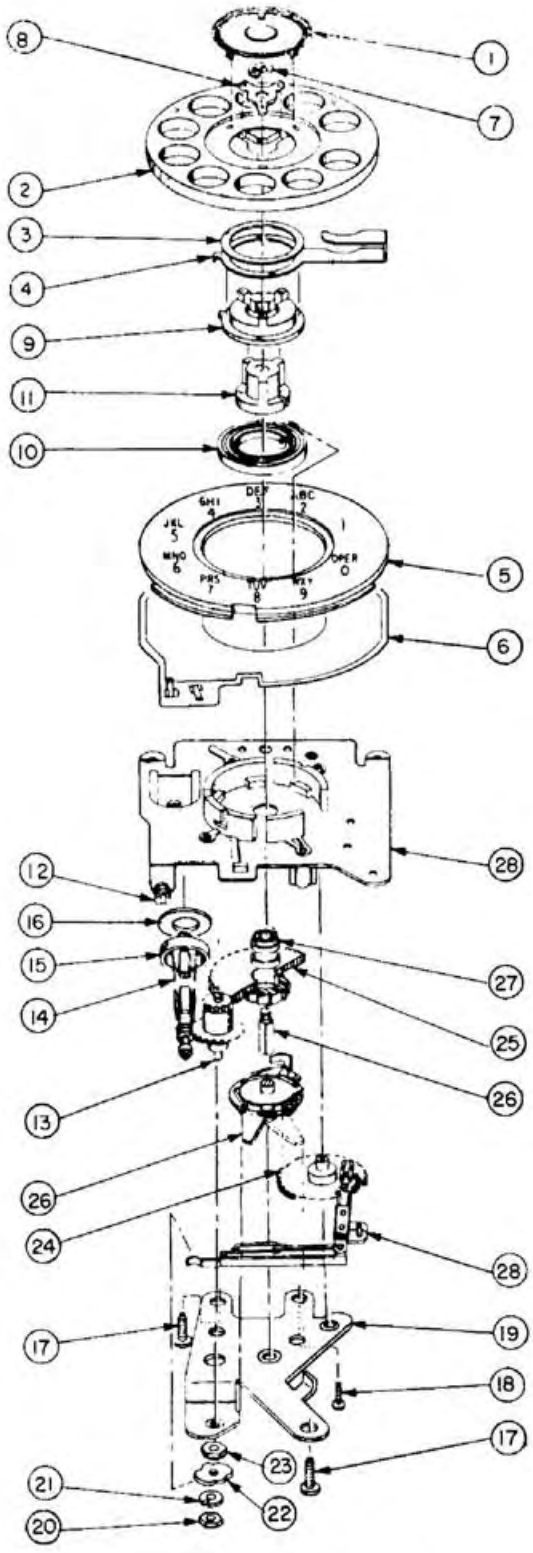


Figure 4. Exploded View of Type 154A Miniature Dial.

governor, pulse cam, and pulse and shunt springs. Check for any out-of-round condition of the main shaft assembly. Remove the escutcheon assembly, fingerwheel, and dial plate, and examine the pawl lever silencer (when used), pawl ratchet, pawl spring, and ratchet and worm gear assembly on the front of the dial. Check and replace the number plate if faded or chipped. Rotate the shaft assembly and check for slippage between the pulse cam and worm gear assembly. Verify that the fiber or plastic buffers are in place and secure on the middle impulse spring and operating shunt spring.

4. DIAL TOOLS AND MATERIALS

4.01 The following tools and materials are required for maintaining dials:

(a) Medium-sized thin-bladed screwdriver (577732).
(b) Escutcheon tool (578885).
(c) Dial wrench (part No. H-25937).
(d) Cam nut wrench (part No. H-16480).
(e) Spring adjustment pliers (586205).
(f) Small Phillips screwdriver (577741).
(g) Thickness gauge (part No. H-26795-50).
(h) Gram gauge 50-0-50 (582135).
(i) Artist's brush (sable 580453).
(j) Flat paint brush (1 inch or smaller, 571482).
(k) Fingerwheel removal tool (578922).
(l) Several clean lint-free cloths.
(m) Mild soap.
(n) Trichloroethylene (for cleaning).
(o) Standard dial lubricant (specification 5920, H-78612-79, 2 oz).
(p) Replacement parts.

5. FINGERWHEEL DISASSEMBLY AND INSTALLATION

Metal Fingerwheels

5.01 To remove a metal fingerwheel from a dial, the escutcheon assembly must be removed first. Using the standard escutcheon tool or a small pocket screwdriver, perform the following:

(a) Insert the tip, holding the tool parallel to the fingerwheel, between the escutcheon ring and the acetate disc which covers the number card. Pass under the edge of the ring at a point even with the 5/JKL hole (Figure 5).
(b) Taking care not to scratch the acetate disc, press the tip of the tool downward slightly and move it counterclockwise toward the 6/MNO hole. It should engage the tab of the escutcheon lock.
(c) Further movement of the tool toward the 7/PRS hole will then force the escutcheon lock counterclockwise so that it no longer holds down the tab of the escutcheon ring.

Table 2. Characteristics of GTE AE Dials.

CHARACTERISTIC	TYPE								
	24	24A36	51	51A	52	53A	53B	54	154A
Spring Contacts	Single	Single	Single	Bifurcated	Bifurcated	Bifurcated	Bifurcated	Bifurcated	Bifurcated
Pawl Quieting Provision	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Adjustable Spotter Cam (Screw Type)	No	No	No	No	No	No	No	Can Be Adapted	No
Pulse Cam with Scribe Mark (16° or 12°)	No	No	16°	16°	16°	12°	12°	No	12°
Die-Cast Zinc Base	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No
Twin Contact SATT Springs	N/A	N/A	N/A	No	No	Yes	Yes	Yes	No
Separate Bracket Mounting for Impulse and Shunt Springs	Yes	Yes	No	No	No	No	No	No	No
Removable Separate Fingerstop	No	No	No	No	Yes	Yes	Yes	Yes	Yes
Types of Telephones	Type 1A and 34A3	Type 1A, Type 40 and 600 Series	Type 40, 50 and 600 Series 890	Type 40, 50, 83, 183, 95 600, 700, 860A, 880, 881, 882 and 863	Type 80, 85, 86, 87, 80T. 90, 90M 100 and 700 186, 187 102A, 80E, 85EB, and 85ED	Used in SATT A Systems with Type 80, 90, 90M and 100 Series, and 80E	Used in SATT B Systems with Type 80, 90, 90M and 100 Series, and 80E	Type 182, 182A, 192 and SATT Systems	Type 980

d) Lifting the tip of the tool when it reaches the 7/PRS hole should raise the entire escutcheon assembly out of the depression in the center of the fingerwheel.

5.02 Once the escutcheon assembly is removed, the metal fingerwheel is removable by performing the following:

(a) Using a screwdriver with a wide, thin blade, remove the screw and the escutcheon lock.
(b) Lift the fingerwheel off the hub of the shaft.

NOTE: For a short period, Type 24A36 dials were assembled by using a D-17574 zinc retaining washer and a 5-40 flathead machine screw to hold the fingerwheel and escutcheon lock. This requires a narrow-bladed screwdriver for removal. If a broad-head screw is available, set it aside for use in reassembly of the dial, and return the zinc washer to the storeroom for use on dial blanks.

5.03 To disassemble the metal escutcheon assembly, perform the following:

(a) Hold the assembly rear side up with the fingers of both hands and press on the clamping plate with the thumbs adjacent to the semicircular indentations on its edge (Figure 6).
(b) Rotate the plate counterclockwise until the indentations clear the ridges formed in the edge of the escutcheon ring, at which time the locking tongue will also clear the channel similarly formed for it to engage.
(c) Push against the acetate disc with a finger to force the disc, number card, and clamping plate out of the escutcheon ring, and slide these parts out from under the locking lug.

5.04 To install a new number card in a metal escutcheon assembly, perform the following:

(a) Wipe the acetate disc to remove dirt and finger marks. Replacements should be made for a scratched or discolored disc.
(b) Hold the escutcheon ring with its rear side up and insert the edge of the acetate disc under the locking lug of the ring at the point where the edge of the disc has a long indentation. Lay the narrow indentation or slot in the opposite edge of the disc over the channel formed inside the edge of the ring.
(c) With a blunt-ended object, such as an eraser end of a pencil, snap the disc over the two ridges formed in the edge of the ring so the disc seats.
(d) Insert the number card in the same manner. Its edge has two semicircular indentations which allow it to clear the ridges in the ring.
(e) Insert the clamping plate with its concave side up, and push down its edges with a thumb to flatten it.
(f) Once flat, rotate the plate clockwise until its edges are caught beneath the ridges in the wall of the escutcheon ring, and its locking tongue is seated in the channel formed inside the wall.

5.05 To install a metal fingerwheel on the dial shaft, perform the following:

(a) Position the center hole of the fingerwheel over the shaft hub, aligning the finger holes with the designations on the number plate.
(b) Lay the escutcheon lock over the hub so that it sits between the two detents located at the 5/JKL and 7/PRS positions.
(c) Insert the screw in the hole in the hub and drive it part way.
(d) Center the circular portion of the escutcheon lock so that it rides free of the lip on the under surface of the screw head.
(e) Tighten the screw.

5.06 To install the escutcheon assembly on the metal fingerwheel, perform the following:

(a) Move the escutcheon lock counterclockwise until it strikes the detent.
(b) Insert the tab on the escutcheon ring into the slot in the wall of the depression in the fingerwheel at a point just above the finger stop.
(c) Press the opposite edge of the escutcheon ring into the depression and insert a blade such as that described in paragraph 5.01 between the ring and the acetate disc.
(d) Keeping the tool parallel with the fingerwheel and taking care not to scratch the disc, insert the tip under the edge of the ring at a point even with the 7/PRS hole.
(e) Press the tip of the tool downward slightly and move it clockwise toward the 6/MNO hole. It should engage the tab of the escutcheon lock, and further movement of the tool toward the 5/JKL hole will then force the escutcheon lock clockwise so that it holds down the tab of the escutcheon ring.

Acrylic and Polycarbonate Fingerwheels

5.07 To remove the chrome escutcheon assembly from a D-780697-A acrylic fingerwheel, perform the following:

(a) Using a small pocket screwdriver, hold the blade parallel to the fingerwheel and insert the tip of the screwdriver between the escutcheon ring and the acetate disc that covers the number card.
(b) Pass the screwdriver tip under the edge of the ring at a point midway between the 5/JKL and 6/MNO holes (Figure 7).
(c) With the tip of the blade seated against the outer wall of the escutcheon ring, gently apply force upward and outward until the latch releases with a click. Lift the escutcheon assembly clear of the fingerwheel.

5.08 To remove the D-780697-A acrylic fingerwheel, perform the following:

(a) Select a screwdriver with a blade that is both wide and thin.
(b) Remove the screw and washer and lift off the fingerwheel toward the upper left, away from the finger stop.

5.09 To disassemble the chrome escutcheon assembly from a D-780697-A acrylic fingerwheel, follow the same procedure as specified in paragraph 5.03. This is simplified somewhat, since the escutcheon locking lug is not in the way on the escutcheon ring, but protrudes from the clamping plate and makes the latter easier to rotate.

5.10 To install a new number card in the chrome escutcheon assembly from a D-780697-A acrylic fingerwheel, follow the same procedure as specified in paragraph 5.04. The escutcheon ring has no locking lug, and the long indentation in the edge of the acetate disc and number card serves no purpose in this assembly.

5.11 To install a D-780697-A acrylic fingerwheel on the dial shaft, perform the following:

(a) Insert the escutcheon locking plate into the openings in the rear of the fingerwheel.
(b) Holding the locking plate and fingerwheel togehter, slide the assembly over the pawl plate and under the finger stop.
(c) Align the finger hole with the designations on the number plate and position the center opening in the locking plate over the hub of the dial shaft.
(d) Install the washer (with the stamped circle, denoting the slightly convex surface, away from the fingerwheel) and screw into the hub of the dial shaft. Care should be taken so as not to crack the fingerwheel.

5.12 To install the chrome escutcheon assembly on a D-780697-A acrylic fingerwheel, perform the following:

(a) Insert the index tab on the escutcheon ring into the slot in the formed ear of the locking plate which protrudes through the fingerwheel adjacent to the finger stop.
(b) Press down firmly, with a thumb, between the 5/JKL and 6/MNO finger holes against the acetate disc and number card. Listen for a click for proper engagement. (It may be necessary to use a small screwdriver to apply the proper force to engage the latch.)
(c) Wipe the acetate disc free of finger marks.

5.13 To remove a D-780896-A acrylic or polycarbonate fingerwheel from the dial shaft, perform the following:

(a) Using a standard fingerplate removal tool, H-886316-1, insert the end into the small hole located in the ribbed area of the fingerwheel surrounding the number card just adjacent to the 6/MNO fingerhole.
(b) The end of the tool must enter at a slight angle aimed toward the 6/MNO finger hole. Once the end is seated against the latching lug (Figure 8), push gently downward on the tool until the lug is down and out of its latching detent (Figure 8).
(c) Rotate the dial clockwise past zero until the clamping disc releases.
(d) Release the fingerwheel and allow it to return to rest (zero hole between 8/TUV and 9/WXY on the number plate).
(e) Lift the fingerwheel toward the upper left away from the finger stop.

NOTE: If the latching lug on the clamping disc fails to spring out of its detent when pushed down by the escutcheon tool, the zero finger hole will not pass beyond the finger stop when the dial is wound. In this case, hold the fingerwheel in the fully wound position, insert the tool, and press against lug, while turning the fingerwheel further in clockwise direction.

5.14 To remove the clamping disc from an older dial that has been equipped with a D-780896-A acrylic or polycarbonate fingerwheel, use a screwdriver with a blade that is both wide and thin to loosen the broad-head screw that fastens the clamping disc to the hub on the dial shaft. On some dials manufactured after May 1964, the clamping disc is spot welded in place to accommodate the acrylic or polycarbonate fingerwheel. This type does not have a tapped hole in the hub. If such a disc has been damaged, the entire pawl plate assembly must be replaced. There is no way to replace the defective clamping disc for a removable disc or a metal fingerwheel. The later model dials are equipped with a clamping disc that is also spot welded on the hub but these types of dials also have a tapped hole in the hub for mounting a removable disc. The damaged clamping disc must be pried off the hub with a screwdriver. Then, the clamping disc can be replaced by the dial fingerwheel kit (H-885503-1) which contains a clamping disc, broad-head screw and an acrylic or polycarbonate fingerwheel. The clamping disc can then be replaced on the hub and secured to the hub by means of the broad-head screw.

5.15 Before installing a new number card in a D-780896-A acrylic or polycarbonate fingerwheel, wipe the window area in the center to remove dirt and fingermarks. If this area has been scratched or defaced, the entire fingerwheel must be replaced.

5.16 To install a clamping disc on an older dial to adapt the D-780896-A acrylic or polycarbonate fingerwheel, perform the following:

(a) Position the center hole of the disc over the hub of the dial shaft so the latching tab lies in the upper

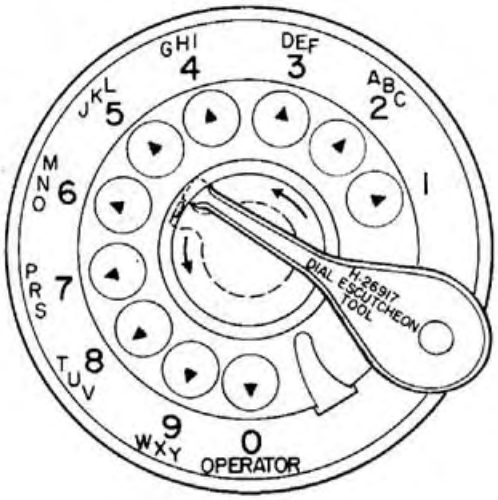


Figure 5a. Removal.

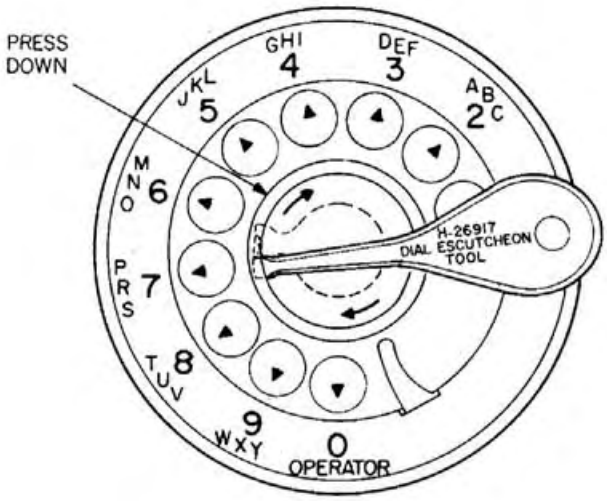


Figure 5b. Installation.

Figure 5. Escutcheon Removal and Installation for the Metal Fingerwheel.

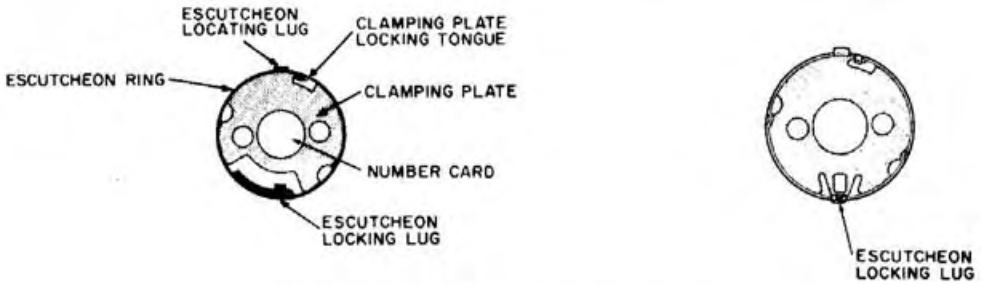


Figure 6. Escutcheon Disassembly.

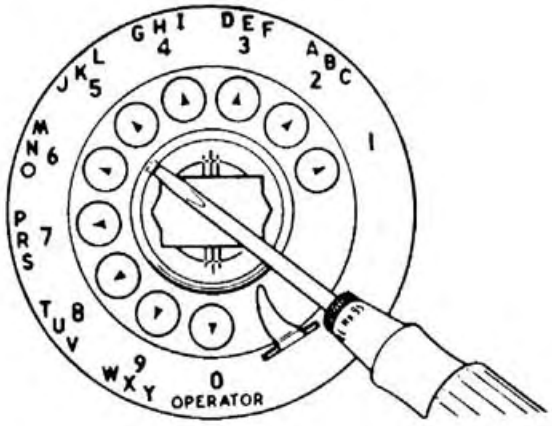


Figure 7. Escutcheon Removal for the D-780697-A Acrylic Fingerwheel.

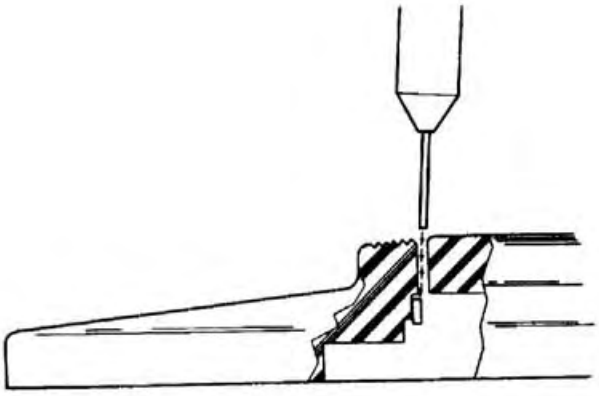


Figure 8a. Insertion. End of Standard Escutcheon Tool Engages Edge of Latching Tab and Forces it Downward.

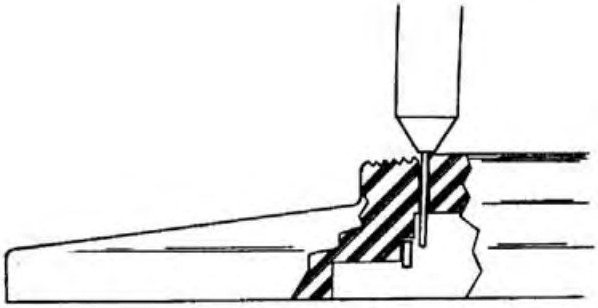


Figure 8b. Withdrawal. Latching Tab Has Snapped into Recess Molded in Fingerwheel Out of Reach of Tool.

Figure 8. Use of Standard Escutcheon Tool, H-886316-1, to Unlatch the D-780896-A Acrylic or Polycarbonate Fingerwheel.

left quadrant adjacent to the 5/JKL and 6/MNO designations on the number plate (Figure 9).

(b) Use a broad-bladed screwdriver with a thin edge to fasten the D-76312-A screw through the clamping plate and into the shaft.

5.17 To install a D-780896-A acrylic or polycarbonate fingerwheel on a dial equipped with the accompanying clamping disc, perform the following:

(a) Hold the fingerwheel parallel to the number plate. The zero hole should be positioned between the 8/TUV and 9/WXY designations.
(b) Move the fingerwheel to the upper left, then lower the lower right side under the finger stop.
(c) Center the dial on the clamping disc and rotate the fingerwheel counterclockwise. As the zero passes the 9/WXY position, the latching lug should engage with a click.

Dial Clamping Plate Adapter

5.18 The dial clamping plate adapter PP-1108 (Figure 10) is used to prevent the D-780896-A acrylic or polycarbonate fingerwheel from unintentionally snapping off the dial clamping plate due to sprung or ill-fitting clamps. The adapter reinforces the clamping plate and prevents the removal of the fingerwheel without the use of fingerplate removal tool H-886316-1 or equivalent.

5.19 To install the dial clamping plate adapter on the dials equipped with an acrylic or polycarbonate fingerwheel, remove the fingerwheel from the dial assembly in accordance with the instructions in paragraph 5.13. Place the adapter within the dial clamping plate as shown in Figure 10. Replace the fingerwheel in accordance with the instructions given in paragraph 5.17.

Miniature Polycarbonate Fingerwheel

5.20 To remove the polycarbonate fingerwheel from the Type 154A miniature dial, perform the following:

(a) Remove the white fingerwheel cover from the center of the dial assembly with a small pocket screwdriver.
(b) Holding the screwdriver in your right hand, parallel to the fingerwheel, insert the screwdriver tip into the small slot across from the finger stop and carefully pry the fingerwheel cover up (Figure 11).
(c) Using the same pocket screwdriver, being careful not to scratch the fingerwheel or handset housing, push against the top right hand leg of the three-point retainer in a counterclockwise direction until it lines up with the slots in the fingerwheel (Figure 11).
(d) Depress the left side of the fingerwheel gently with your left thumb.
(e) With your right hand thumb and forefinger, remove the fingerwheel, spring washer, and finger stop together.

5.21 The Type 154A miniature dial does not contain a number card in the fingerwheel. The telephone number is to be located on a designation strip, beneath the designation strip cover, directly above the dial in the front housing of the handset. To remove the designation strip cover to install a number card, perform the following:

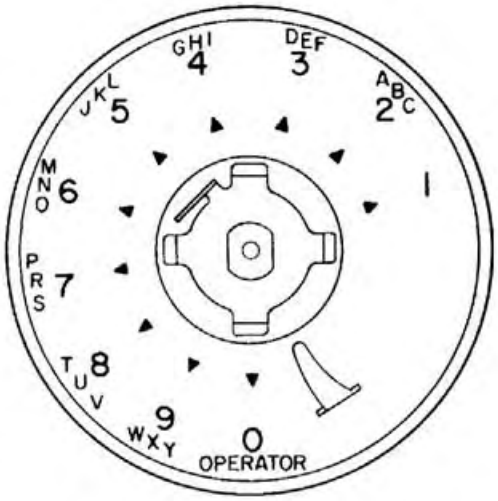


Figure 9. Proper Position of Clamping Disc When Installing the D-780896-A Fingerwheel.

(a) Insert the tip of the fingerplate removal tool (H-886316-1) or equivalent into the right hole in the designation strip cover.
(b) Bow the cover upward as little as necessary by applying pressure toward the center.
(c) Pull the cover up and out.
(d) Remove the designation strip.

5.22 To install a polycarbonate fingerwheel on the Type 154A miniature dial, perform the following:

(a) Replace the finger stop with the projection of the finger stop between the 1 and 0/OPER position.
(b) Replace the spring washer over the finger stop.
(c) Hold the fingerwheel between the thumb and forefinger of your left hand with the AE Trademark reading backward in the upper right-hand corner.
(d) Insert the right side of the fingerwheel under the finger stop and position the fingerwheel down over the three-point retainer so that the three legs of the retainer fit into their respective slots in the fingerwheel.
(e) Depress the fingerwheel down with slight pressure and check the movement of the finger stop to be sure it is located securely between its stops.
(f) Keep holding the fingerwheel with slight pressure. Using a small pocket screwdriver, push against one leg of the retainer clockwise one-sixth of a turn so that all three legs rest in their locating depressions in the fingerwheel.
(g) Replace the white fingerwheel cover with the small slot even with the finger stop. Press down until the cover snaps into the locked position in the fingerwheel.

5.23 To install the designation strip cover over the designation strip, perform the following:

(a) Insert the left end into the housing.
(b) Bow the cover upward as little as necessary by applying pressure toward the center.
(c) Insert the right end into the housing.

6. DIAL DISASSEMBLY

6.01 To remove the dial from the telephone, loosen the base mounting screws securing the baseplate assembly to the telephone housing. Remove the screws securing the dial mounting bracket to the dial and disconnect the wires running from the transmission network to the dial spring terminals.

6.02 Prior to further disassembly of the dial assembly, it will be necessary to remove the escutcheons, dial number cards, and fingerwheel from the dial as instructed in part 5. The dials are grouped into compatible categories for ease in performing the disassembly and assembly procedures.

6.03 Recently manufactured dials incorporate plastic parts that eliminate the use of some hex nuts and washers. In those instances, disregard the instruction to remove these small parts.

Type 24, 24A36, 51, 51A, 52, 53A, 53B, 54A, and 54B Dials

6.04 To disassemble a standard dial, proceed with step (a), steps (c) through (f), and paragraphs 6.05 through 6.07. To disassemble a SATT dial, start with step (b) and then proceed the same as for a standard dial.

(a) Remove the main spring assembly. The main spring assembly includes the main spring and the one-piece

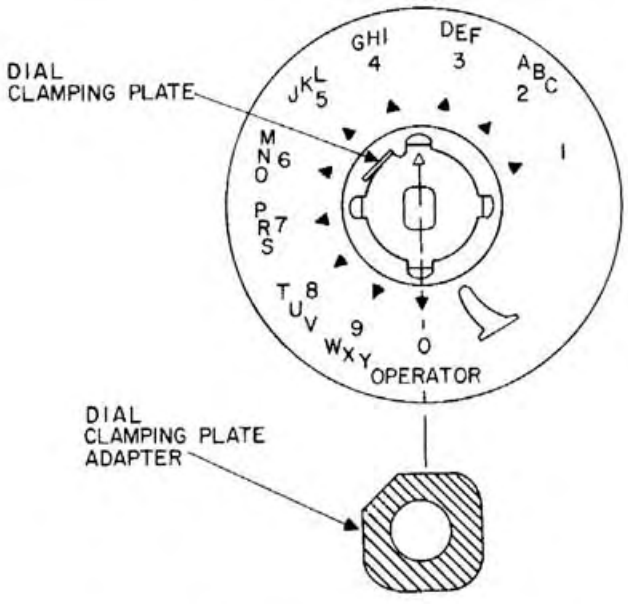


Figure 10. Dial Clamping Plate Adapter Location on the Dial.

shunt cam and impulse shorting arm. Remove the spring as follows:

(1) Hold the dial face down (front side down) in the palm of one hand. Press the shaft assembly against the palm to prevent the main shaft from rotating under twisting action.

(2) Grasp the shunt cam armpiece with the other hand and turn it slightly in the counterclockwise direction until the shunt cam arm locking key (consisting of a part of main spring passed through the tubular portion of the shunt cam armpiece) disengages from a slot in the main shaft.

NOTE: Hold the shunt cam armpiece while releasing the key, because the main spring unwinds suddenly and may fly off.

(3) Lift the main spring assembly off the shaft.

(b) Remove the spotter cam and main spring assemblies (SATT dial only). The main spring assembly of a SATT dial includes a hex nut (Type 53 dial) spotter cam, spotter cam indicator, and one-piece shunt cam and pulse shorting arm. Repeat step (a)(1), then remove the hex nut holding the spotter cam to the main shaft; lift off the spotter cam indicator plate and the spotter cam. Remove the main spring assembly from the shaft.

(c) Remove the main shaft assembly. The main shaft assembly is comprised of the shaft assembly plate (to which is attached the ratchet pawl and pawl spring), metal washer, pawl lever silencer (not used on Type 24 and 24A36 dials) and a fiber washer. Remove the shaft assembly as follows:

(1) Remove the main shaft assembly by grasping it with the fingers and pulling it out.

(2) Remove the parts from the shaft one by one; clean, but do not lubricate. Place all disassembled parts on a clean, dry surface.

NOTE: Do not attempt to disassemble the pawl or pawl spring.

(d) Remove the screw that attaches the bearing and stop bracket to the dial base and remove the bearing and stop bracket.

(e) Remove the main gear wheel by gently pulling it off the main bearing. Lift the lower thrust washer off the main bearing.

(f) Detach the impulse cam from the worm wheel and pinion, and remove the worm wheel and pinion.

6.05 Use the following procedure to remove the pinion gear shaft and impulse cam:

(a) Remove the lock nut. Hold the hub nut with a wrench while loosening the locknut (this precaution will prevent damage to the governor worm gear).

(b) Lift the lock washer off the threaded shaft.

(c) Remove the pulse cam.

(d) Unscrew the hub nut. Do not damage the threads on the top side.

(e) Remove, but do not force the pinion and pulse cam shaft.

(f) Slip the spacing washer off the bottom side of the bearing in the bearing bridge if it does not come off with the shaft.

(g) Clean all parts just removed.

6.06 Remove the spring assemblies. The pulse, shunt, and spotter spring assemblies should be removed only if they are to be replaced completely. If complete replacement is undertaken, proceed as follows:

(a) Remove the two screws holding the link connecting the pulse and shunt spring assemblies. Remove the link or jumper wire joining the two pileups. (On some dials this will require unsoldering the leads.)

(b) Complete the disassembly by removing the two screws holding the spring pileups.

6.07 Use the following procedure to remove the governor assembly and governor cup:

(a) Remove the governor bearing screw lock nut and governor bearing screw from the bearing bridge.

(b) Pull the governor shaft out of the governor cup bearing hole.

(c) Unscrew the hex nut securing the governor cup and remove the nut and cup.

6.08 The disassembly of a dial is now completed. Thoroughly clean and inspect all parts at this time to ensure that a dial malfunction will not occur because of a defective part. Lubrication of the dial may be performed now, or later, after the dial is reassembled. For cleaning information, refer to part 7.

Type 154A Dial

6.09 To disassemble and clean the Type 154A dial, it is necessary to remove the dial assembly from the Type 980 Dial-in-Handset. Use the following procedure to remove the dial assembly from the handset:

(a) Remove the clear plastic number card cover by inserting a fingerwheel removal tool into the hole located on the right-hand side of the cover. Push the cover to the left, bowing the plate as little as possible until the cover releases from its position.

(b) Remove the number card to expose the two screws.

(c) Use a screwdriver to loosen the two screws. These are captive screws that will not come out completely.

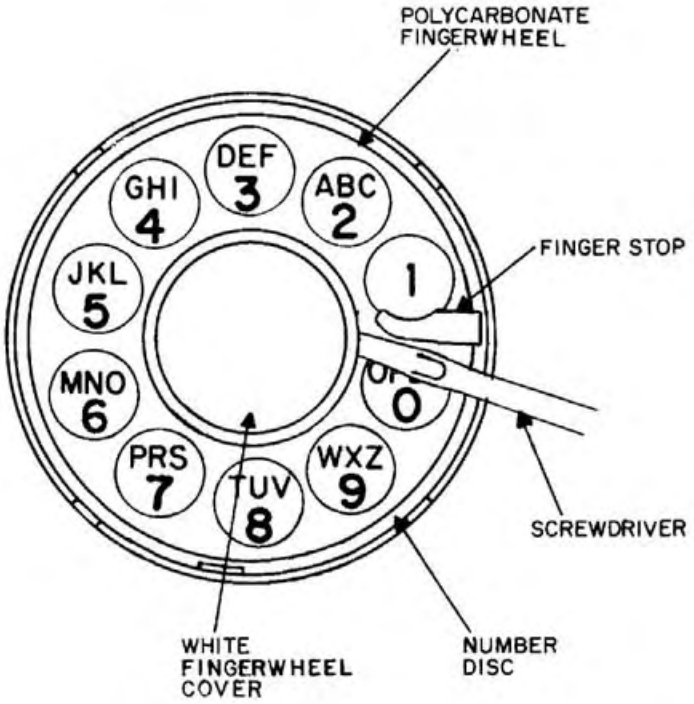


Figure 11a. Fingerwheel Cover Removal.

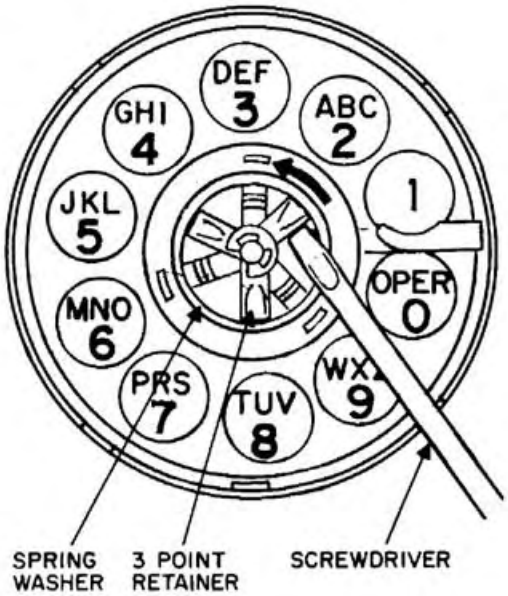


Figure 11b. Fingerwheel Removal.

Figure 11. Fingerwheel Cover and Fingerwheel Removal for the Miniature Dial.

(d) Pull the back cover gently outward to remove it from the handset.
(e) Place the handset on the table, dial face down.
(f) Loosen the three terminal screws that secure the transmitter and receiver leads to the shunt and pulsing spring contact terminals and remove the leads.

NOTE: The 0.33 μF capacitor C2 and 100-ohm resistor R5 that are interconnected between the yellow and brown leads are released and will fall out if the handset is turned over. It is suggested that these items and their interconnecting leads be removed at this time and set aside.

(g) If the dial is lit, disconnect the white and black leads from the two terminals protruding upward from the electroluminescent lamp located at the base of the dial.
(h) Remove the three dial plate mounting screws located on each of the three projections of the dial plate.
(i) Carefully lift the dial from the telephone.

6.10 The procedure for removing the fingerwheel cover, fingerwheel, spring washer, and finger stop is described in part 5. The balance of the disassembly procedure, i.e., removal of the locking ring, number plate, and insulator or electroluminescent lamp (unlit or lit dial) is as follows (Figure 4):

(a) Insert the tip of a thin-bladed screwdriver into the small notch in the locking ring located on the upper right-hand portion of the locking ring.
(b) Push the locking ring downward in a counterclockwise direction until the tab on the locking ring is pushed out of its locking channel.
(c) Lift the locking ring, number plate, and insulator (or electroluminescent lamp) off the dial plate.

6.11 To disassemble the top end of the Type 154A miniature dial, refer to Table 1 and Figure 4, and proceed as follows:

(a) Remove the plastic cover (item 1) from the center of the fingerwheel (item 2) by carefully prying up at the slot near the finger stop (item 4).
(b) Rotate the washer spring (item 8) so that it aligns with the three slots in the fingerwheel.
(c) Remove the fingerwheel (item 2), the bowed washer (item 3), and the finger stop (item 4).
(d) Rotate the washer spring 60 degrees so as to be off the three projections of the molded disc (item 9).
(e) Remove the retaining ring (item 7) by using a small screwdriver and the washer spring while holding the molded disc down.
(f) Use a small screwdriver to pry up the molded disc a distance of one-sixteenth inch while holding the pawl-shaft assembly (item 26).
(g) Insert the tip of a thin-bladed screwdriver between the molded disc and the main spring (item 10) to hold the main spring down while sliding off the disc.
(h) Continue to hold the main spring down and remove the tip of the screwdriver inserted in (g).
(i) Place the dial on a low-friction surface and, with a screwdriver, lift the outer end of the main spring off the plastic hook. Let the dial spin on the low-friction surface while holding down the main spring as it unwinds.
(j) Remove the center hub and mainspring.

NOTE: Because of the complexity of reassembly, the Type 154A dial should not be disassembled any further.

7. CLEANING

7.01 After extended use, dials accumulate a certain amount of dirt and grime that adheres to the lubricated areas within the dial. This foreign matter will hamper operation of the dial and should be removed at periodic intervals. The cleaning interval depends upon atmospheric conditions. In a dusty atmosphere, the dial assemblies require cleaning more often than in a comparatively dust-free atmosphere.

7.02 Two acceptable methods are used for cleaning dials; the complete disassembly method and the ultrasonic method. The complete disassembly method is used when the dial has been disassembled or if ultrasonic cleaning facilities are not available. The ultrasonic method (if such facilities are available) requires less time because only the fingerwheel, escutcheon, and dial number cards are removed. The Type 154A dials do not have dial number cards.

NOTE: Some of the components, particularly the main shaft, must be lubricated while the dial is still in the partially disassembled state even when ultrasonic cleaning is employed. This lubrication is important to ensure proper dial performance and long term reliability.

Disassembly Method

7.03 When using this method, disassemble the dial according to the procedure described in part 6. Clean the dial components with an approved solvent. If the components have accumulated deposits of rust, use an appropriate rust remover on the area affected. Special attention should be given to removing corrosion on terminals to minimize electrical problems, such as open circuits and high-resistance connections.

Ultrasonic Method

7.04 If an ultrasonic cleaning tank is available, use the ultrasonic method of cleaning the dial assembly.

WARNING: Observe the following precautions when using the ultrasonic equipment:

(1) There should be adequate forced ventilation to carry off the fumes from the solution. The fumes are toxic.
(2) Rubber gloves and a rubber apron should be worn during the cleaning operation.
(3) If the solution comes in contact with the operator's eyes, wash the eyes thoroughly with tap water.
(4) At close range, the frequency of the ultrasonic cleaning tank can permanently impair hearing. Leave the area during the cleaning operation.

Perform the following when using the ultrasonic method of cleaning:

(a) Fill the tank with a water-base solution containing 2 ounces per gallon of Dirl-Lum 603 (572395), 0.125 ounce per gallon of sodium cyanide, and 0.0125 ounce per gallon of mercaptobenzothiazole.
(b) Remove the escutcheons, fingerwheels, and number cards from the dials to be cleaned.
(c) Place the dials, less the parts removed in (b), into the ultrasonic tank.
(d) Set the tank to operate for 3 minutes. It will turn off by itself.
(e) Spray-rinse the dials in tap water at approximately 140°F.
(f) Dry the dials by blowing moisture off with compressed air.

8. REASSEMBLY

8.01 If the dial was completely disassembled for cleaning and/or repair, use the procedure that follows to reassemble the dial assembly. Use only the applicable steps if the dial assembly was partially disassembled.

Type 24, 24A36, 51, 51A, 52, 53A, 53B, 54A, and 54B Dials

8.02 The governor worm assembly in the newer 51 through 54 dials is reassembled as follows:

(a) Insert the worm end of the governor shaft into the governor bearing screw hole until the buffer end of the shaft is approximately one-fourth inch from the governor cup tab.
(b) Attach the governor cup to the governor cup tab.
(c) Insert the buffer end of the shaft into the governor cup bearing, and assemble the self-locking bearing screw and tighten.

8.03 Assemble each spring pileup as follows:

(a) Arrange the springs and insulators in proper sequence and fasten to the proper mounting bracket with the screws removed during disassembly.
(b) Align the springs for proper contact and buffer position before tightening screws.
(c) Replace the metal link or jumper wire.

NOTE: On some dials, this link is placed under the terminal screws: dials with solder terminals have a jumper wire soldered to the terminals.

8.04 Use the following procedure to reassemble the governor worm assembly in older-design dials:

(a) Insert the worm end of the governor shaft into the governor bearing screw hole until the buffer end of the shaft is approximately one-fourth inch from the governor cup bracket.
(b) Insert the threaded projection of the governor cup through the hole in the governor cup bracket and fasten the cup to the bracket with a locknut.
(c) Insert the buffer end of the governor shaft into the bearing hole of the governor cup.

8.05 Use the following procedure to reassemble the worm wheel and pinion, and the impulse cam in newer-design dials:

NOTE: Attach the impulse cam after the pinion, main gear, bearing and stop bracket are assembled to the dial base.

(a) Attach the impulse cam to the worm wheel and pinion.
(b) Fit the other end into the bearing and stop bracket.

NOTE: Do not assemble the main bearing at this time.

8.06 Place the main gear over the main bearing assembly with the larger diameter toward the dial base and engage the teeth with the pinion gear.

8.07 Reassemble the bearing and stop bracket as follows:

(a) Position the bearing and stop bracket to the dial base interior, placing the protruding end of the pinion and worm gear shaft into the bearing hole.
(b) Fasten the bearing and stop bracket bolts and nuts.

8.08 Use the following procedure to reassemble the worm gear and pulse cam assembly in older-design dials:

(a) Slip the metal spacing washer over the threaded portion of the pinion and worm gear shaft.
(b) Insert the threaded end of the shaft into the bearing hole.
(c) Screw the hub nut (hub side up) on the threaded end of the shaft completely up to the end of the threads.
(d) Place the impulse cam on the shaft with the long axis of the cam parallel to the main axis of the pulse springs.

(e) Slip the lock washer and the locknut over the shaft and tighten the locknut, holding the hub nut with a wrench while tightening the locknut to prevent damage to the worm gear.

NOTE: Do not assemble the bearing and stop bracket at this time.

8.09 In older-design dials reassemble the main bearing assembly as follows:

(a) Place the lower thrust washer over the main bearing.
(b) Place the main gear over the main bearing with the large diameter toward the dial base and engage the teeth with the pinion gear.

8.10 In older-design dials, the bearing and stop bracket is reassembled as follows:

(a) Position the bearing and stop bracket in the dial base interior, placing the protruding end of the pinion and worm gear shaft into the bearing hole.
(b) Fasten the bearing and stop bracket to the dial base with the stop bracket nuts and bolts (Type 51, 51A, 52, 53A, 53B, 54A, and 54B dials only).

8.11 Reassemble the main spring assembly in the following manner:

(a) Rotate the main shaft assembly counterclockwise until the ratchet pawl rests against the pawl stop. Check the main bearing for loose staking by applying pressure alternately to one side of the finger plate and then to the other side while observing the bearing movement.
(b) With the dial held in the hand and the thumb pressing the main shaft assembly against the pawl stop, place the main spring assembly over the shaft and position the assembly so the pulse arm and shunt cam arm are directly over their respective buffers.
(c) Rotate the main spring assembly about one-third revolution clockwise, placing the hooked end of the main spring over the nearest of the three spring hooks on the base.
(d) As a final assembly adjustment for both standard and SATT dials, twist the main spring assembly approximately 1-1/2 turns counterclockwise. The cam arms bypass the spring buffers once at the end of the first partial revolution and must pass buffers after the next full revolution. As soon as the cam arms pass the buffers (does not apply to Type 53 and 54 dials), immediately press the main spring assembly down so that the keyed end slips into the perpendicular slot in the main shaft and catches in the horizontal slot; then release the assembly. The cam arm should turn slightly clockwise as the key catches, pushing the cam arms against the buffers. If a SATT dial (Type 53 dial only) is being reassembled, the main spring key must be pressed down into the perpendicular slot in the shaft as soon as the shunt cam arms push against the buffers (there is no catching of the key in a horizontal slot). On SATT Type 53 dials, the dial must be rotated off normal to get the cam drums past the buffers.

8.12 The reassembly of the dial assembly is completed except for the front dial parts such as the dial number card and escutcheon. For a reassembly procedure for these parts, refer to part 5. If the dial has not been lubricated during reassembly, it should be done now (refer to part 9). Refer to part 10 of this section for adjustment procedures.

SATT Dials

8.13 For SATT dials only, perform the following:

(a) Place the spotter cam over the main shaft and then follow with the spotter cam indicator plate.

NOTE: For a Type B SATT dial only, line up the cam and indicator plate so the spotter lobe appears opposite the proper indicator notch.

(b) Screw the hex nut onto the main shaft and tighten firmly.
(c) Perform paragraph 8.11(d) procedure.

Type 154A Dial

8.14 To reassemble the front end of the Type 154 dial, proceed as follows while referring to Table 1 and Figure 4:

(a) Insert the molded disc (item 9) into the mainspring (item 10).
(b) Bring the pawl-shaft assembly (item 26) to its most counterclockwise position and place the bushing with the mainspring and keeper over the pawl-shaft-assembly.
(c) Hook the outer end of the mainspring over the plastic hook near the top of the base and spring pileup assembly (item 28) and push the mainspring down (with a screwdriver) to free it from its keeper. Remove the keeper while holding the mainspring down.
(d) Replace the molded disc with its tab to the left of the washer spring (item 8).
(e) Push the pawl-shaft-assembly forward by pressing the rear end and, with longnosed pliers, slip on the retaining ring (item 7).
(f) Rotate the washer spring until it rests on the projections of the plastic disc.
(g) Replace the finger stop (item 4), the bowed washer (item 3), and the fingerwheel (item 2), in that order, and rotate the washer spring 60 degrees.
(h) Replace the cover (item 1), positioning its slot near the finger stop.

9. LUBRICATION

9.01 At the time of assembly or at any time a dial is disassembled, it should be checked and lubricated. Readjustment or partial relubrication gives only temporary improvement. Before lubrication, remove the fingerplate and mainspring assembly and wipe all exposed parts clean. The following general procedures should be followed when lubricating a dial:

(a) Variations in application techniques may be employed as long as a light coat of lubrication is placed on all points. Lubrication may be put on by sponge, syringe, or brush, or by tumbling.
(b) The term "lubricate" means to apply a thin coat of lubricant to the particular surface.
(c) If two surfaces are in contact, only one needs to be lubricated.

9.02 Use only dial lubricant Specification 5920 for all GTE AE dials. Thoroughly mix the lubricant at least once every 2 hours to prevent separation prior to application. This lubricant is available in 2-ounce or 1-gallon containers. Order No. H-78612-79 is for the 2-ounce container, and order No. H-78612-80 is for the 1-gallon container.

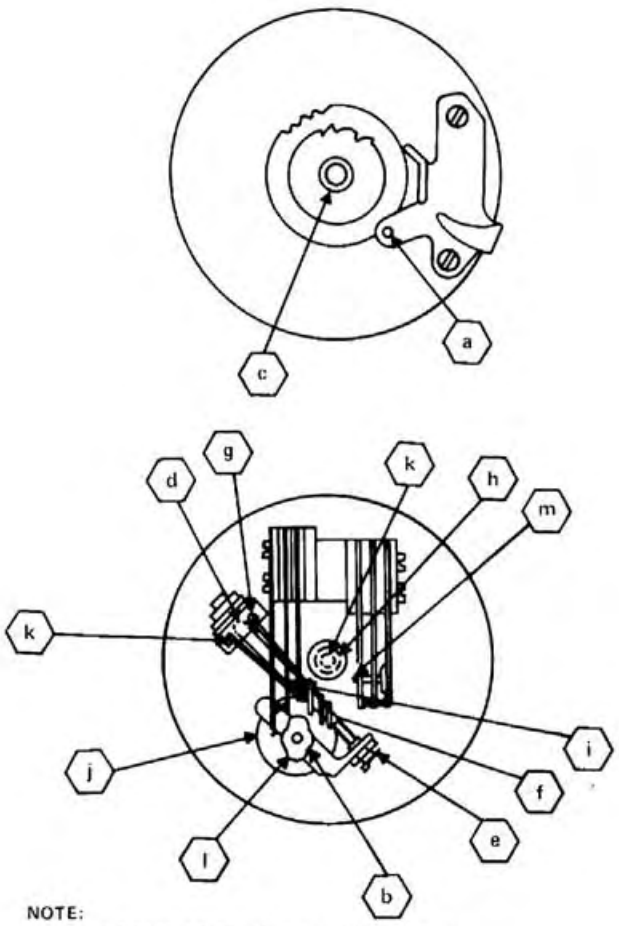
CAUTION: Specification 5920 lubricant may cause deterioration in some plastics. Do not allow this lubricant to contact any of the dial assembly's external plastic parts such as the fingerwheel.

Type 24, 24A36, 51, 51A, 52, 53A, 53B, 54A, and 54B Dials

9.03 Refer to Figure 12 and lubricate the following dial points:

(a) The end of the pinion shaft where the shaft bears on the stop and bearing bracket.
(b) The shaft journal, where it bears on the pinion shaft bearing bridge, the teeth of the pinion, the face of the pinion and bridge, and the wormwheel.
(c) Where the main bearing before the main gear is mounted.
(d) The bearing hole of the governor cup and inside governor cup.
(e) The bearing hole at the rear bearing screw.
(f) Along the length of the worm and the exposed length of the governor shaft (for rust protection).
(g) The edge of the cam.
(h) Between at least two-thirds of the worm gear teeth.
(i) The ends of the governor buffers.
(j) The impulse spring buffer.
(k) The shunt spring buffers. (Do not lubricate the hard rubber buffers.)

NOTE: Before continuing the lubrication, remove the fiber washer and the pawl silencer from the shaft assembly and wipe each piece clean.



NOTE:
LETTERS REFER TO STEPS IN PARAGRAPH 9.03.

Figure 12. Lubrication Points for Dial Types 24 through 54.

9.04 Also lubricate the following points:

(a) Around the head of the pin.
(b) Between the pawl and the pawl plate.
(c) Over the length of the shaft.
(d) On the edge of the pawl where it contacts the bearing and stop bracket.
(e) On the pawl spring anchor pin at the point of contact with the pawl spring.
(f) In the pawl spring anchor hole in the pawl.
(g) Along the coils of the pawl spring.
(h) Both sides of the pawl silencer.
(i) Both sides of the fiber washer.
(j) Both sides of the stainless steel washer (reassemble the dial).
(k) Between the coils of the main spring.

SATT Dials

9.05 For SATT-equipped telephones, lubricate the following points:

(a) Between each side of the spotter pawl, the washers mounted on the same pin, and on the pin.
(b) On the edge of the SATT cam.
(c) On the spotter pins on the SATT cam's mounting brass spotter pins.

NOTE: After lubrication is complete, wipe away lubricant from part areas not requiring lubrication.

Type 154A Dial

9.06 Because of the large quantity of plastic and nylon components used in the Type 154A dial, lubrication is minimal in comparison to other dials. The term "dip" is defined as the quantity of lubricant left on a No. 4 artist's sable rigger brush after it has been dipped into the lubricant and gently brushed against the side of the container to remove the drop at the end of the bristles. Distribute one dip of dial lubricant among the following points:

(a) Around the governor shaft at the point where it enters the governor cup bearing.
(b) Around the governor shaft at the point where it enters the rear bearing screw.
(c) Over the worm (and the inside of the governor cup bearing hole).
(d) The exposed length of the governor to provide rust protection.
(e) The ends of the governor buffers.

NOTE: Do not lubricate buffers made of hard rubber.

9.07 Sparingly distribute one dip of dial lubricant (Specification 5920) among the following points:

NOTE: If the gears have stainless steel shafts, do not perform this procedure. Check the shafts with a magnet; stainless steel is nonmagnetic. Later shunt gears have integral plastic shafts that need no lubrication.

(a) Both plastic bearings that support the pinion and gear and the shaft's ends of the gear.
(b) Both plastic bearings that support the shunt cam gear and the entire shaft for the gear.

10. ADJUSTMENTS

10.01 After a dial has been cleaned and given a thorough visual inspection and it is found to be seriously maladjusted due to tampering, replace it. If no discernible defects exist that may cause malfunction of the dial, proceed with the adjustment procedure. When test equipment is indicated, use test procedure TP7-7 and a dial adjuster's speed and percent make test set, or equivalent.

10.02 The adjustment procedure for the Type 154A dial differs from those of the other dials and, therefore, is discussed separately (refer to paragrpah 10.27).

NOTE: Deviation from nominal values is to be expected and is not cause for readjustment.

General Requirements

10.03 The dial must be checked to determine whether or not it meets the general requirements described below. Some requirements may also be found in Standard Adjustment A-100. Sequentially correct any deficiencies according to the adjustment procedures. The general adjustment requirements are as follows:

(a) All screws and nuts must be tight. Be cautious when tightening screws into plastic components because overtightening can crack the receiving plastic components and render the entire dial useless.
(b) Screws, nuts, and other components must not be marred or mutilated excessively, nor be defective in any manner.
(c) Spring assemblies must have well-aligned springs, contacts, and bushings. A pair of contacts must not be out of alignment more than on-third of their diameters at the base, as gauged visually.
(d) A gradual bow in the free length of any spring is permissible, but there must be no sharp bends or kinks in the springs due to adjustment.
(e) The dial must be free of grease, grit, or any other foreign matter that is likely to impair operation or detract from appearance.
(f) The finger stop must not override its stop post.

NOTE: Changes in dial speed do not affect the pulse ratio of the dial though the response of relays and switches to the pulses will be more critical at higher speeds. The test desk can easily measure the pulse speed of dials in service but it is not equipped to measure accurately the pulse ratio of dials at the customer's premises. It is customary to assume that the pulse ratio is satisfactory if the pulsing speed is good when the finger-wheel is allowed to run back freely with no manual interference.

(g) The number plate must be clean and must not be broken, scratched, or marred.
(h) All spring follows and clearance values are gauged visually unless specified otherwise.

Type 24, 24A36, 51, 51A, 52, 53A, 53B, 54A, and 54B Dials

10.04 The following adjustments are performed with the expectation that the dial will be brought within the allowable tolerances necessary for satisfactory operation. If it is obvious that an adjustment will not completely correct a dial fault, defer the adjustments until the mechanical deficiency in the dial is remedied. When deviations in adjustments between different types of dials appear, these deviations will be covered in the appropriate step.

10.05 Impulse Springs. Remove the dial from the telephone and adjust the impulse springs as follows:

(a) With the fingerwheel off-normal and the tip of the main impulse spring opposite a low side of the cam, adjust the main impulse spring to rest against both contacts of the middle impulse spring with a total pressure of 40 ±10 grams. The pulse cam thickness, including the resulting end play in both directions, must lie within the edges of the main impulse spring.

(b) When not engaged by the impulse shorting arm, the middle impulse spring must firmly rest against the heavy stop spring from its own tension (Figure 13).

(c) With the fingerplate off-normal and the tip of the main impulse spring opposite a low side of the cam, both contacts must be closed and both bifurcations of the middle impulse spring should preferably rest against the heavy stop spring. A perceptible gap (as gauged visually) between one of the bifurcations and the stop spring must not be cause for rejection. (A perceptible gap is defined as not more than 0.002 inch.)

(d) Both pairs of contacts must be closed, with the impulse springs opposite the low side of the cam.

(e) The heavy stop spring must be adjusted to give the proper contact separation for the impulsing springs, as determined by an electrical test with an impulse ratio meter if possible. (If this meter is not available, gauge visually.) Ratio limits are 59 to 61 percent break readjust, and 58.5 to 61.5 percent break test. Dials in service may show a higher percent break ratio but need not be readjusted if the ratio does not exceed 63 percent break. When an impulse ratio meter is not available, the contact separation must be 0.018 inch ±0.001 inch, with the fingerplate off-normal and the tip of the main impulse spring resting against the high side of the cam adjacent to the locating hole.

CAUTION: Dials adjusted to the percent break may have a contact separation slightly outside the gauging limits specified above. The gauging limits are not applicable to dials adjusted by meter. When a meter is used, the dial must be disconnected from the telephone circuit.

(f) When an impulse shorting arm is used, the highest point of the middle impulse spring buffer must engage the contacting portion of the arm.

(g) The shorting arm, when used, must cause the main impulse spring to clear the cam at the leading edge by not less than 0.015 inch nor more than 0.030 inch during the shorted pulse. The clearance at any other point on the cam during the shorted pulse must not exceed 0.045 inch (gauged visually).

(h) The impulse shorting arm must not cause the middle impulse spring to move away from the heavy stop spring until after the completion of the last pulse. Take up play in the dial gear train by restraining the impulse cam with the thumb while slowly releasing the fingerwheel.

(i) Clearance between the impulse shorting arm and the shunt spring buffer must be 0.005 inch minimum during windup as gauged visually.

10.06 Restoring Springs. The restoring springs must have 1 to 1-1/3 turns tension with the dial at the normal position.

10.07 Shunt Springs. Adjust the shunt springs as follows:

(a) Shunt springs must be adjusted so that they have a minimum of 0.015 inch follow (gauged visually) before breaking contact.

(b) Contact separation for shunt springs, when the dial is in the normal position, shall not be less than 0.015 inch to 0.030 inch.

NOTE: If the shunt spring assembly has four or more springs and includes three springs that make common contact when the dial is off-normal, contact separation for these shunt springs must be a maximum of 0.050 inch with the dial in the normal position.

(c) The main spring of a break/make combination must break its back contact before making its front contact.

NOTE: This requirement also applies to three springs of a four-spring combination when the operating spring opens a back contact and closes a make contact.

(d) When there are two break contacts (normally open) or three break contacts in a shunt spring assembly with two operating buffers, springs 1 and 2 must

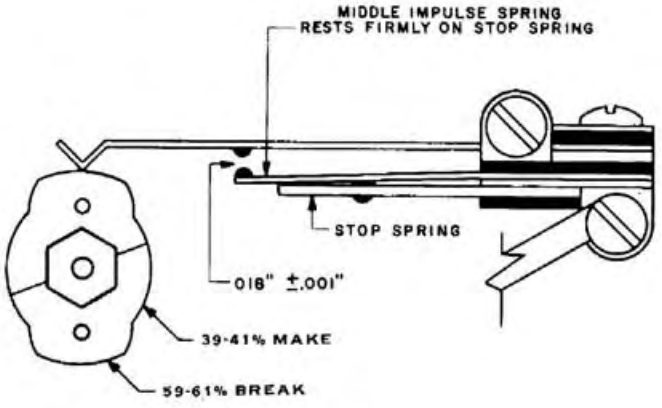


Figure 13. Standard Dial Impulse Cam Adjustment.

break before the springs operated by the second buffer. There must not be more than a perceptible clearance (if any) between the second buffer and the first buffer cap, with the dial off-normal. Springs 4 and 5 may break any time.

(e) In shunt spring assemblies having four or five springs, with the dial off-normal, there must be more than perceptible movement of the number one spring, due to the tension of the outside buffer spring against the inside buffer spring.

(f) In shunt springs having three pairs of make contacts, the third pair must make first and break last.

NOTE: Contact separation for pairs 1 and 2 must be a maximum of 0.050 inch when in the normal position.

(g) The highest point of the operating shunt spring buffer must engage the shunt spring operating cam with the dial in the normal position.

NOTE: Alignment must be such that contact gap is a minimum of 0.005 inch when the dial finger plate is pulled out when at the normal position.

(h) Clearance between the shunt spring operating cam and the impulse spring buffer must be 0.005 inch minimum during windup as gauged visually.

10.08 Governor. Adjust the governor as follows:

(a) There must be perceptible end play in the governor but this end play must not exceed 0.008 inch.

(b) The governor wings must be formed so that the buffers are equidistant from the worm shaft.

NOTE: This requirement is critical and must be met.

(c) The dial must be adjusted for speed as follows (unless otherwise specified):

(1) During manufacture and readjustment, adjust the dial to operate at not less than 9 impulses per second and no more than 11 impulses per second.

(2) For maintenance inspection, the dial must operate at not less than 8 or more than 12 impulses per second.

NOTE: After adjustment for speed, recheck the buffer position as in (b).

10.09 Ratchet Pawl. Adjust the ratchet pawl as follows:

(a) With the dial in the normal position, the pawl must rest against its stop to give a minimum of 0.008 inch and a maximum of 0.030 inch clearance between the shaft stop arm and its associated stop.

SATT Dial

10.10 The main difference between the Type A SATT and Type B SATT dial adjustment is in the position of their impulse cams with respect to the spotter cams. The impulse springs and spotter springs, however, are adjusted for the same tension and contact gap and are covered in later paragraphs.

10.11 Type A SATT Impulse Cam. Set the impulse cam so that the scribed line on the cam is in line with the V-formed tip of the main impulse spring, with the fingerwheel held off-normal (Figure 14). On some cams, a locating mark of 12 degrees is provided for dial-adjusting operations.

NOTE: Special location of the impulse cam is necessary on Type A SATT dials because some of the party designations require sending a spotter pulse before the first dial impulse when the digit 2 is dialed. The Type B SATT dials do not have such a requirement because digit 0 is always dialed to obtain party identification. Prior to 1955, Type B SATT dials were manufactured with special cam locations.

10.12 Type B SATT Impulse Cam. Set the impulse cam with the long axis parallel to the impulse springs. The dial should remain in the normal position when setting the impulse cam for Type B SATT operation (Figure 15).

10.13 Spotter Cam. Position the spotter cam to just close the spotter springs on a lobe when the formed tip of the impulse spring is opposite the scribe mark on the impulse cam. To accomplish this adjustment, hold the impulse cam with the thumb and allow the cam (as the dial is being returned to normal) to rotate counterclockwise sufficiently past the formed tip so that when the play is taken up in a clockwise direction, the scribe mark is in line with the formed tip. Tighten the cam locking nut and recheck the cam setting (Figure 16).

10.14 Impulse Springs. For proper dial operation, the impulse springs must be mechanically adjusted for correct spring tension and spacing, and electrically checked with an impulse ratio meter or an equivalent meter for proper percent break reading. In addition, for Type A SATT dials, contact synchronization between the impulse spring contacts and spotter spring contacts must be maintained to ensure correct party identification. This is a mechanical adjustment and is dependent upon the system employed (Type A SATT or Type B SATT dial). The following procedures set forth the contact clearance and spacings that should be maintained in adjusting the impulse springs, shunt springs, and spotter springs.

10.15 Adjust the impulse springs as follows:

(a) Apply tension to the middle impulse spring so that it rests firmly against the stop spring when the impulse shorting arm is clear of the middle impulse

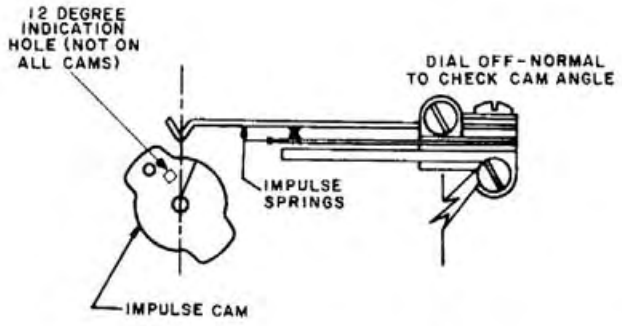


Figure 14. Position of Impulse Cam for Type A SATT Dial.

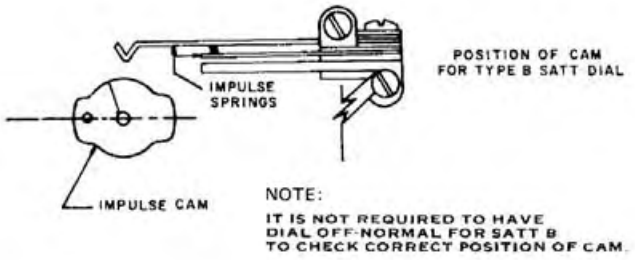


Figure 15. Position of Impulse Cam for Type B SATT Dial.

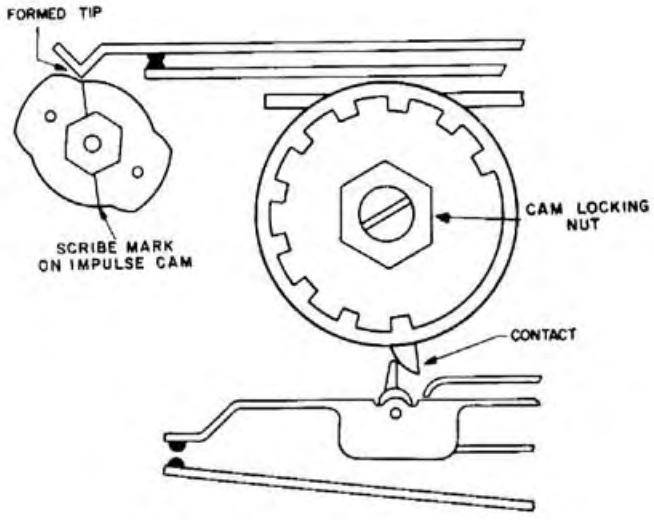


Figure 16. Spotter Spring Adjustment.

spring buffer (Figure 13). On Type 24 and 24A36 dials, the middle impulse spring must have a tension of from 20 to 40 grams against the stop spring, measured at the contacts.

(b) With the fingerwheel rotated off-normal until the tip of the main impulse spring is opposite a low side of the cam, both contacts of the main impulse spring must rest against the middle impulse spring with a total pressure of 30 to 50 grams (Figure 17). Impulse spring tension is measured at the contacts while the dial is held off-normal.

(c) Move the fingerwheel off-normal and check to see that both contacts are closed and both bifurcations of the middle impulse spring are resting against the stop spring. A perceptible gap (not more tha 0.002 inch) between one of the bifurcations and the stop spring is permissible. (Type 24, 24A36, and 51 dials are single-contact springs.)

(d) Move the fingerwheel off-normal until the formed tip of the main impulse spring is resting against a lobe on the impulse cam (Figure 13). Check the contact separation between the main impulse and middle impulse spring; it must be 0.018 inch ±0.001 inch as adjusted by gauging. (Dials adjusted to percent break may show contact separation slightly outside the specified gauging limits.) An impulse ratio meter or an equivalent meter should be used to check the percent break/make. A pen recorder is also useful in this measurement. The limits should be 59 percent to 61 percent break (41 percent to 39 percent make) readjusted, and 58.5 percent to 61.5 percent break (41.5 percent to 38.5 percent make) test.

NOTE: When a meter is available, disregard the previous mechanical adjustments and adjust the stop spring until the proper percent break meter reading is obtained.

10.16 Adjust the impulse shorting arm as follows:

(a) The highest point of the middle impulse spring buffer must engage the contacting portion of the arm (Figures 18 and 19).

(b) With the dial restoring to normal, the tip of the main impulse spring must clear the impulse cam by a minimum of 0.015 inch, a maximum of 0.030 inch. The impulse shorting arm must not cause the middle impulse spring to move until after completion of the last pulse (Figure 18).

(c) Rotate the fingerwheel off-normal, retard dial restoration by riding the impulse cam with the thumb, and verify that the buffer on the middle impulse spring does not land on the heavy stop spring.

(d) Visually inspect the clearance between the impulse shorting arm and the shunt spring buffer. The minimum clearance during windup must be 0.005 inch (Figure 19a).

10.17 Shunt Springs. Check the shunt springs as follows:

(a) With the fingerwheel rotated off-normal, the tension of the No. 3 shunt spring must be sufficient to produce a follow of 0.015 inch minimum on shunt spring No. 1 (Figure 19b).

(b) With the dial at normal, adjust the shunt springs for contact separation of from 0.015 to 0.030 inch.

(c) On party 3, 4, and 5 SATT dials, shunt springs No. 2 and 3 must be closed when the last spotter pulse is sent out. Figure 20 shows the numbering sequence of the springs. Check the adjustment by rotating the fingerwheel until the spotter pulse lobe (nearest the spotter spring pawl) is almost touching the pawl. Under this condition, shunt springs No. 2 and 3 must make contact (Figure 21).

NOTE: If the shunt spring assembly has four or more springs and includes three springs that make common contact when the dial if off-normal, contact separation for shunt springs when the dial is in the off-normal position should be a maximum of 0.050 inch.

(d) Verify that the main spring of a break-make combination breaks its back contact before making its front contact.

NOTE: This requirement also applies to three springs of a four-spring combination when the operating spring opens a back contact and closes a make contact.

(e) When there are two break contacts (normally open) or three break contacts in a shunt spring assembly with two operating buffers, verify that springs No. 1 and 2 break before the springs are operated by the second buffer and the first buffer cup as the dial goes off-normal.

(f) In shunt spring assemblies having four or five springs, with the dial held off-normal, the movement of the No. 1 spring must be no more than perceptible because of the tension of the outside buffer spring against the inside buffer spring (Figure 20).

(g) Verify that the highest point of the operating shunt spring buffer engages the shunt spring operating cam with the dial in the normal position (Figure 19).

(h) Verify that the clearance between the shunt spring operating cam and the impulse spring buffer is a minimum of 0.005 inch during dial windup.

10.18 Spotter Cam Mounting Plate. Check the staking of the spotter cam mounting plate for any looseness. If loose, discard it and install the new assembly. Inspect the spotter spring pawl for any binding. Rotate the fingerwheel slowly, observing the pawl as it rides over and drops off the cam lobe. The spotter pawl must restore immediately to its normal position.

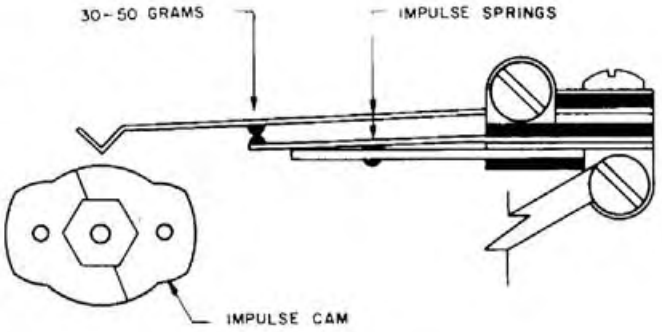


Figure 17. Main Impulse Spring Adjustment.

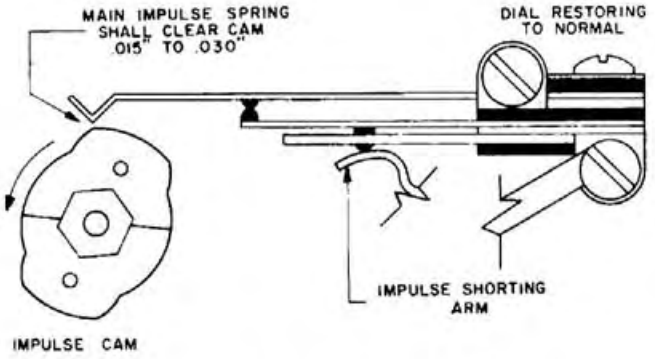


Figure 18. Impulse Shorting Arm Adjustment.

10.19 Pawl Spring. Check the tension of the pawl spring against the spotter pawl. The pawl spring must rest against the spotter pawl with 3 to 5 grams of pressure with the armature springs held with the thumb, giving a 0.001- to 0.008-inch clearance between the spotter pawl and spotter cam as measured between the lobes (Figures 22 and 23).

10.20 Armature Spring. Apply tension to the armature spring (Figure 22) so the pawl and armature spring assembly rests against the cam with 7 to 10 grams of pressure, as measured at the end of the spring with the stop spring held out of the way.

10.21 Stop Spring. Adjust the stop spring (Figure 23) for a clearance of 0.001 to 0.008 inch between the spotter pawl and the spotter cam, as measured between lobes or close to the lobe.

10.22 Spotter Cam. To perform the spotter cam visual check, rotate the dial fingerwheel and release, while riding the impulse cam with a finger to retard restoration. Allow the cam to rotate slowly while sighting through the impulse contacts to the governor shaft or using white paper placed beneath the contact. During rotation, listen for the spotter pawl to drop off the spotter cam lobe. Stop impulse cam rotation when the drop is heard and observe that the im-

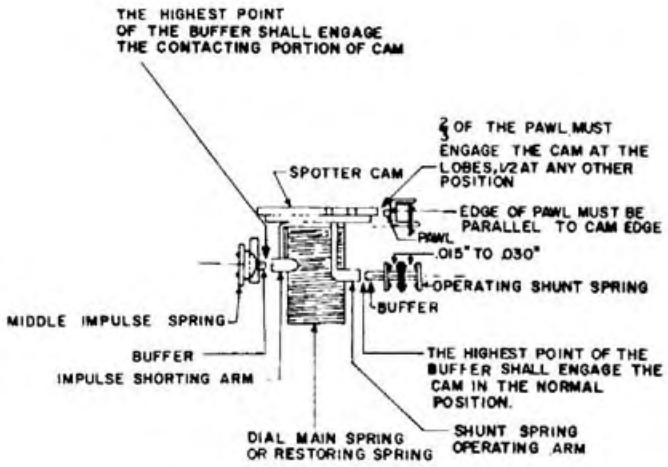


Figure 19a. Horizontal View.

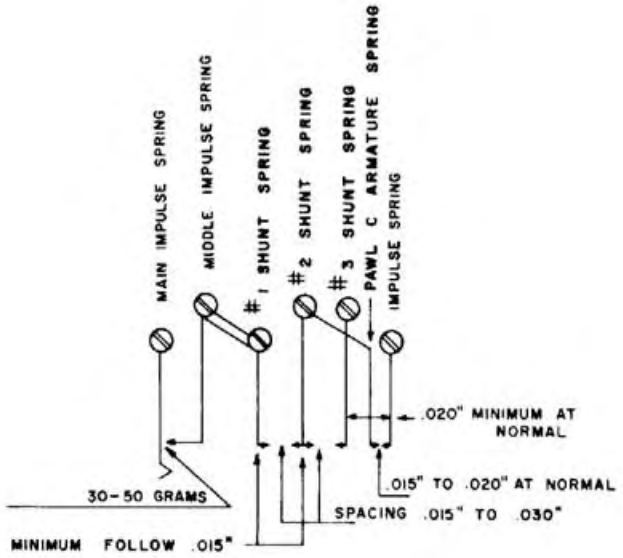


Figure 19b. Vertical View.

Figure 19. Overall Inspection of Spotter Cam, Shunt Spring Cam, and Contact Separation.

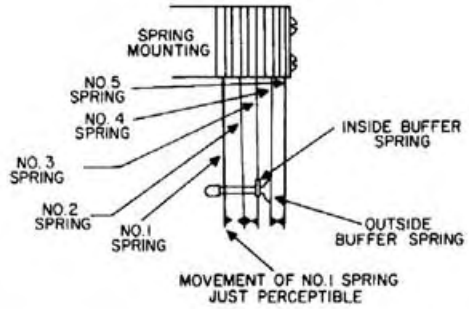


Figure 20. Shunt Spring Assembly with Five Springs.

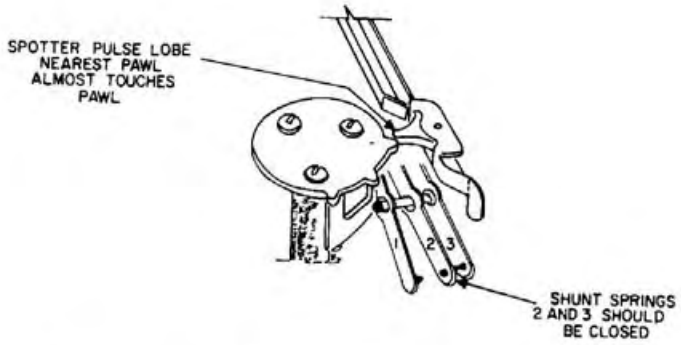


Figure 21. Adjustment of Spotter Lobe with Relation to Shunt Springs.

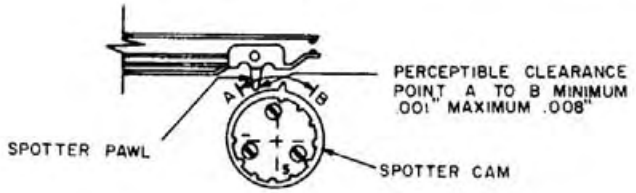


Figure 22. Armature Spring Adjustment.

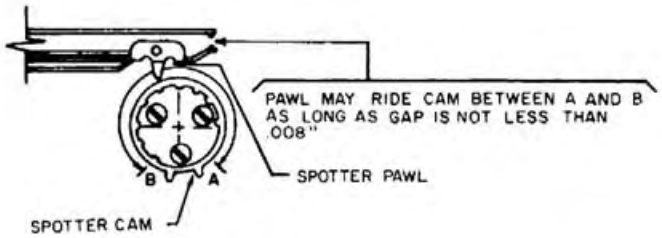


Figure 23. Stop Spring Adjustment.

pulse contacts are not open (Figure 24). If impulse contacts are not closed, reposition the spotter cam and repeat the visual check. Also verify that the impulse springs are closed when the spotter springs just close.

10.23 Final spotter cam adjustment can be verified only through an electrical test that measures the overlap interval.

10.24 Governor. The governor wings must be formed as nearly alike as possible. The distance between the flyball and the governor cup must be approximately the same for each governor wing. Check the governor as follows:

(a) Inspect the form of the governor wings; they must be positioned so that the buffers are equidistant from the worm shaft.

(b) It is extremely important that governor shaft end play be checked and adjusted if necessary. Minimum governor shaft end play must be perceptible movement but must not exceed 0.008 inch maximum. Do not remove all end play. Play between the governor worm and impulse cam shaft gears is not critical; however, excessive governor end play may cause spotter overlap or preliminary impulse trouble.

(c) Using a dial speed meter, adjust the governor wings for a dial speed of not less than 9 and no more than 11 pulses per second. A closer adjustment of 10±0.5 pulses per second is desirable; however, an extended amount of time should not be devoted to reaching this goal.

10.25 Ratchet Pawl. Adjust the ratchet pawl with the dial at normal; the pawl must rest against its stop so as to give a maximum clearance of 0.020 inch between the shaft stop arm and its associated stop.

10.26 Main Bearings. Check the main bearing for loose staking by applying pressure alternately to one side of the fingerwheel and then the other side while observing the bearing movement. Excessive bearing movement is cause for rejecting the dial.

Type 154A Dial

10.27 The Type 154A dial is properly adjusted and lubricated before shipment from the factory and will operate for long periods of time. However, minor adjustments may be required occasionally to ensure proper dial operation. Where limits of the adjustments are given, the dials should be inspected for the extreme limiting values and readjusted only if they are found to be outside these limits. Deviations from nominal values are to be expected and are not cause for readjustment.

10.28 Impulse Spring. The impulse spring requirements are as follows:

(a) The main impulse spring must rest against both contacts of the middle spring with a total pressure of 30 ±5 grams as measured from the front of the main

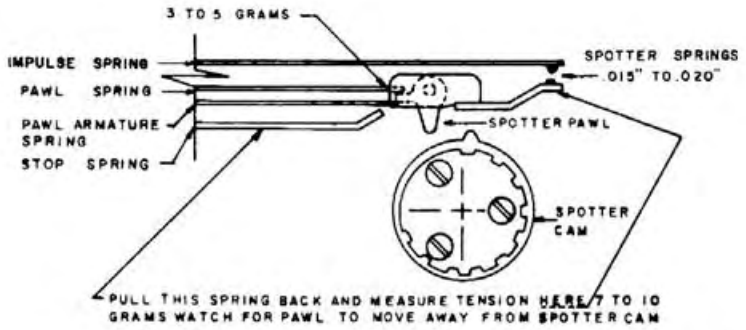


Figure 24. Spotter Pawl Clearance in Relation to Contact Gap.

impulse spring contacts, as near the center of the contacts as possible (Figures 25 and 26).

NOTE: If the 0.002-inch make tolerance is met and one of the two contacts meets the gram requirement, both contacts shall be considered to be within tolerance.

(b) With the fingerwheel off-normal and the tip of the main impulse spring resting on the high side of the cam, the middle spring must rest against the heavy spring stop spring with a minimum pressure of 20 grams. The impulse cam thickness (including the resulting end play in both directions) must be within the edges of the main impulse spring.

(c) The index mark on the old impulse cam must be 1/32 ±1/64 inch counterclockwise from the centerline of the radius of the impulse spring as gauged visually (Figure 25). The index mark on the new impulse cam must be in line with the centerline of the radius of the impulse spring as gauged visually (Figure 26).

NOTE: This is a critical requirement. Care must be taken to ensure proper alignment.

(d) The heavy stop spring must be adjusted to give proper contact separation of the impulse spring. Determine this by measuring with an impulse ratio meter or by gauging if a meter is unavailable. The ratio limits are 59 to 61 percent break (41 to 39 percent make) readjusted, and 58.5 to 61.5 percent break (41.5 to 38.5 percent make) test. Dials in service may show a higher percent break ratio, but need not be readjusted if the ratio does not exceed 63 percent break. When an impulse ratio meter is not available, the separation between the impulse contacts during the open periods must be 0.021 ± 0.001 inch for dials containing the old impulse cam. The separation between the impulse contacts of dials with the new cam must be 0.016 ±0.001 inch.

NOTE: Dials adjusted to the percent break (percent make) may have a separation slightly outside the gauging limits specified above. The gauging limits are not applicable to dials adjusted by meter. When a meter is used, the dial must be disconnected from the telephone circuit.

(e) There must be a minimum perceptible clearance between the impulse cam and impulse spring during make periods.

10.29 Main spring requirements (for information only):

(a) The main spring must have 13-1/4 turns with the dial at normal postion.

(b) For Type 801 Handset telephones, the main spring must have 13-3/4 turns with the dial at the normal position.

10.30 Shunt Spring. The shunt spring requirements are as follows:

(a) The impulse shunt springs must be adjusted so that they have a contact gap of 0.012 inch minimum and 0.020 inch maximum. The network shunt springs must be adjusted so that they have a contact gap of 0.012. See Figure 27 for the relative positions of the impulse and network shunt springs.

(b) The impulse shunt spring must force the shunt cam gear against its upper bearing with a force of 15 ±5 grams as measured in the off-normal position. Make measurement at the point indicated in Figure 27.

NOTE: This is a critical requirement; care must be taken to ensure that it is met.

(c) The tension of the impulse shunt springs must be 15 ±5 grams as measured in the normal position. Make the measurement at the point indicated in Figure 27.

NOTE: If the 0.002-inch make tolerance is met, both springs are considered to be within tolerance.

(d) The impulse shorting spring must not operate before the 10th open pulse has been completed, but it must operate before the impulse springs reopen. To

take up the play in the impulse cam, press (or hold) it clockwise while releasing the dial.

(e) The shunt gear assembly must have a minimum of 0.004 inch and a maximum of 0.016 inch end play.

(f) The shunt gear must be assembled with the timing mark in a straight line with the timing mark on its mating gear, as viewed through the hole in the bearing plate between the gear shaft centers.

(g) On dials for the Type 801 Handset Telephone, the shunt gear must be assembled with the timing mark on the shunt gear being one tooth off in a clockwise direction from the mark on its mating gear.

10.31 Governor. The governor adjustments are as follows:

(a) There must be perceptible end play in the governor shaft, but this end play must not exceed 0.008 inch.

(b) The governor wings must be formed so that the buffers are equidistant from the worm shaft, within 1/32 inch as gauged visually.

NOTE: This is a critical requirement; care must be taken to ensure that it is met.

(c) Unless specified otherwise, the dial must be adjusted for speed as follows:

(1) During manufacture and readjustment, adjust the dial to operate at not less than 9 and no more than 11 pulses per second.

(2) For maintenance inspection, the dial must operate at not less than 8 and no more than 12 pulses per second.

(3) Dials for the Type 801 Handset Telephone must be adjusted to operate at not less than 9 and no more than 11 pulses per second.

NOTE: After readjustment for speed, recheck the buffer position.

(d) The pinion gear must have an end play of 0.007 inch minimum.

(e) The pinion gear on dials for the Type 801 Handset Telephone must have an end play of 0.007 inch minimum, 0.015 inch maximum.

(f) There must be a minimum of 0.008 inch and a maximum of 0.020 inch between the root diameter of the governor worm and the top land of the wormwheel gear tooth. The top land of the wormwheel gear tooth must be positioned parallel to the governor worm when measured.

10.32 Ratchet Pawl. The 0.665- to 0.635-inch dimension of the pawl spring must not be altered during manufacture or use of the dial.

10.33 Fingerwheel and Finger Stop. The fingerwheel and finger-stop requirements are as follows:

(a) The fingerwheel must be aligned with the number plate in such a way that TUV (at the number 8 position) is visible in the fingerhole when the dial is in the normal position. Adjust by bending the tab on the bearing plate.

(b) The finger stop must have a 0.030-inch minimum and a 0.060-inch maximum rotary play as checked in the normal position.

(c) The dial must operate freely on a complete windup from the 10th digit position to the stop, as well as when it restores from the 10th digit to the normal position (impulse springs closed). As the dial unwinds, restrain the dial to a slow speed with a finger in the 10th position fingerhole so that any binding or rubbing during operation can be felt.

11. TESTS

NOTE: The following tests should not be used for the Type 154A dial.

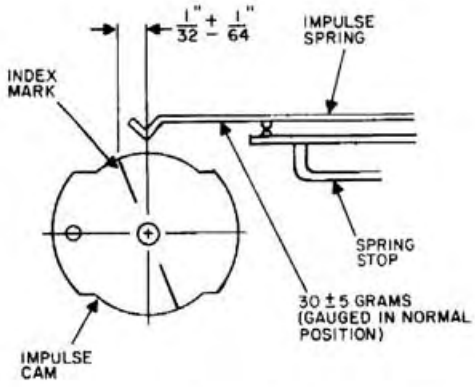


Figure 25. Positioning of Old Impulse Cam Relative to Impulse Spring.

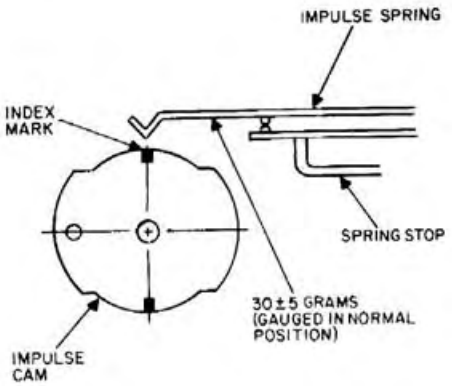


Figure 26. Positioning of New Impulse Cam Relative to Impulse Spring.

11.01 After all mechanical adjustments have been completed, the dial should be given a thorough electrical test. Figure 28 represents the relationship between pulses transmitted by the main impulse contacts and those transmitted by SATT spotter contacts. The exploded view inside the circle shows more clearly the condition commonly referred to as spotter overlap, which is defined as the time difference, during dial rolldown, between the instant the impulse contacts close and the instant the spotter contacts close. Since the SATT system cannot tolerate a leading overlap condition where the spotter contacts close prior to the impulse contacts, acceptable spotter pulse adjustment is based upon lagging interval.

11.02 At one time, two impulse cams with two different scribe marks were being used in the field: a 12-degree impulse cam is identified by a square indentation adjacent to one of its two locating holes. The 16-degree impulse cam adjustment required that the cam be set on a greater angle than that provided by the 12-degree cam. This meant that the placement of the cam would be more critical in that the lobe of the impulse cam would be positioned closer to the formed tip of the impulse spring, and any physical disturbance of the dial could readily cause a misaligned condition. However the 12-degree impulse cam is more perpendicular to the impulse contacts and lessens the chance of misalignment. As a result, manufacture of the 16-degree cam was discontinued and the 12-degree cam accepted as the standard. Because 16-degree cams were used in the field (exclusively in California on Type 51 and 52 dials), it is advisable that all dials in this area being returned for readjustment be inspected for 16-degree impulse cams and replaced when necessary.

11.03 Performing an electrical test on a dial ensures that the mechanical adjustment of the dial meets the requirements for proper operation.

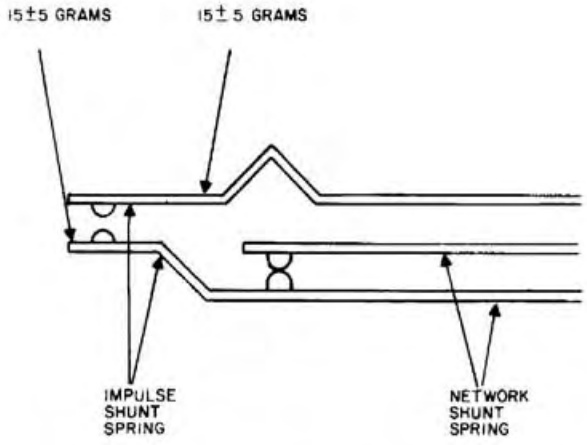


Figure 27. Impulse and Network Shunt Springs.

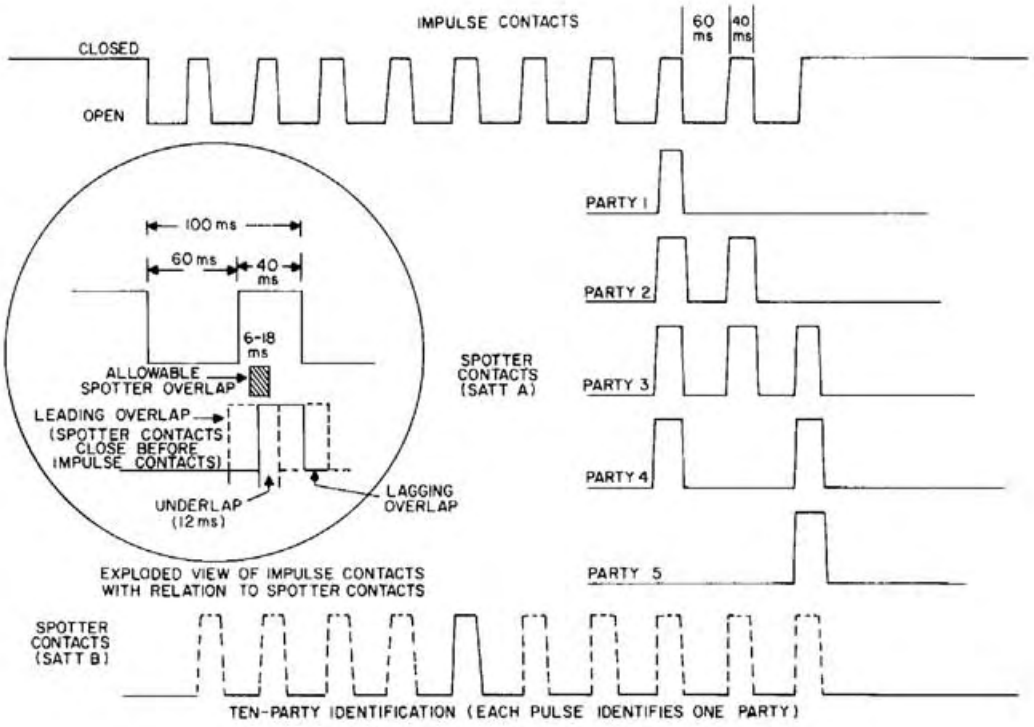


Figure 28. Main Impulse and Spotter Pulse Relationship.