

TYPE 24A36

DIAL

(Including Modified SATT Version)

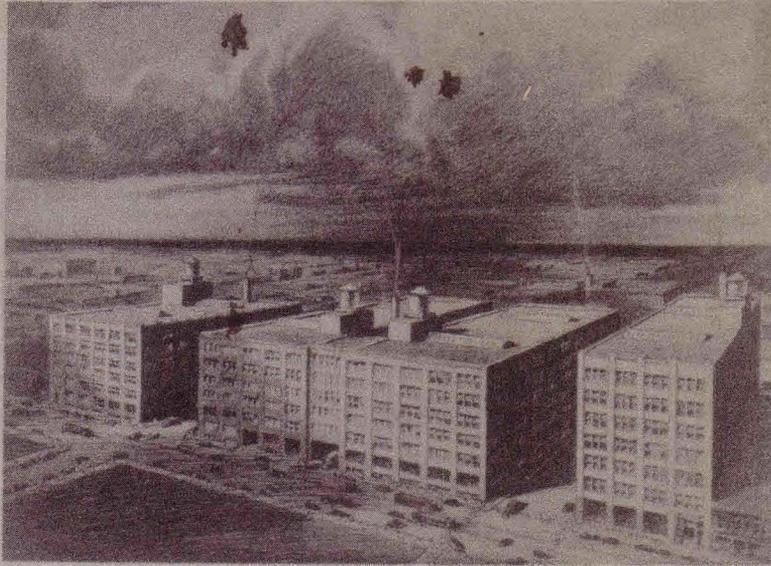
OPERATION, MAINTENANCE, ADJUSTMENT, and REPAIR

Bulletin 528

AUTOMATIC  ELECTRIC

**MAKERS OF TELEPHONE, SIGNALING AND COMMUNICATION APPARATUS
ELECTRICAL ENGINEERS, DESIGNERS AND CONSULTANTS**

1033 W. Van Buren St., Chicago, U. S. A.



Factory and General Offices of Automatic Electric Company, Chicago, U. S. A.

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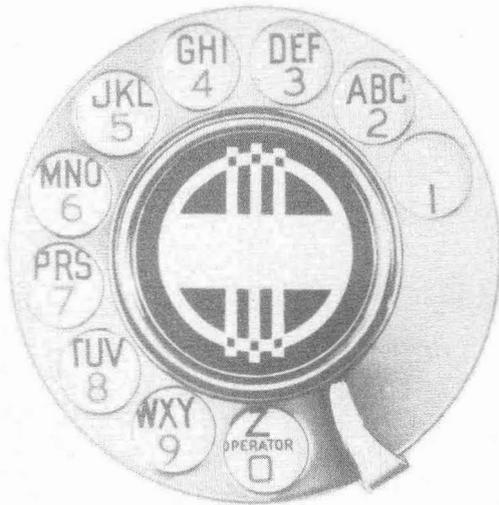
Makers also of electrical control apparatus for industrial, engineering and public utility companies, telephone apparatus for railroads and pipe line companies, private telephone systems of all types, electrical and communication devices for aircraft and airways control, and special communication apparatus for military and naval departments.

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*Fig. 1: Type 24A36 Dial With
Lettered Number Plate*

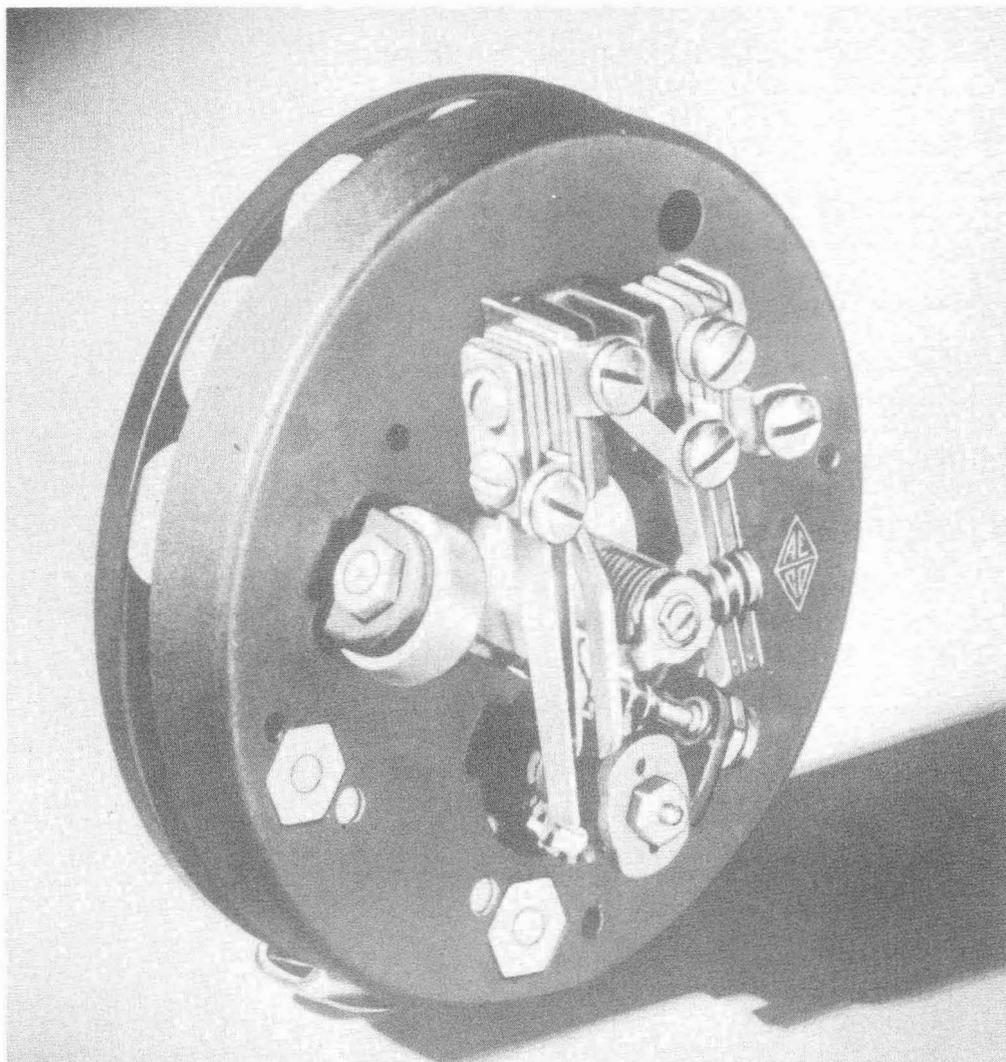


Fig. 2: Rear View of Type 24A36 Dial

TYPE 24A36

DIAL

(Including Modified SATT Version)

OPERATION, MAINTENANCE, ADJUSTMENT, and REPAIR

1. INTRODUCTION

This bulletin covers the operation, maintenance, adjustment, and repair of the Type 24A36 dial, and its modified SATT version. In ordinary service, this dial will operate for years without attention or lubrication. As a consequence of such reliability, this type of user will refer principally to section 5, which describes the replacement of the number card and its transparent cover when it is required to change the subscriber's number marked on the card, and section 6 which describes the operation of the Type 24A36 dial and the SATT version of the Type 24A36 dial. "Lubrication", section 12g., is also useful. However, the larger telephone companies who rebuild their own telephones and telephone dials will find the other information very valuable.

2. DESCRIPTION

2.1 Type 24A36 Dial: The Type 24A36 dial consists of a main assembly which includes all the standard working parts. Mounted on this are certain parts which are selected according to the customer's needs. These parts include the shunt spring assembly, the number plate, finger plate, number cards, adapters for cup mounting, and splash-proofing.

The governor on the dial is accurately adjusted so that the dial will have a normal pulsing speed of 10 p.p.s. (pulses per second). This pulsing speed is normally maintained through a long service life with little, if any, further adjustment. If adjustments are required, they may, in most cases, be easily made. Parts, such as the driving spring, governor, and spring assemblies are located on the back of the dial. Adjustments required on these parts may be made without removing the dial from the telephone or panel to which it is attached. However, it is sometimes necessary to adjust the pawl stop (which is inside the dial) to realign the finger plate. In this event removal of the dial is necessary to gain access to the pawl stop.

A double lobed cam (figure 8) of phenol-fibre has been selected to provide smooth and uniform pulsing; the lightweight worm-driven governor to keep pulsing speed within close limits; the helical driving spring for longest life and greatest ease of adjustment; and the lightweight finger plate to reduce "flywheel" effect when stopping. See figures 4 and 9. The worm is driven by a laminated gear built up of specially treated fibre between two phosphor bronze laminae. This laminated worm gear is driven thru ratchet gears from

the main dial shaft. See figure 12. The lobe shaped impulse cam is mounted on the same shaft as the laminated gear.

A special bearing and a taper on the non-thrust end of the worm limits the worm to rotation in one direction only, thus the worm rotates only during the restoration of the dial, and not during the windup.

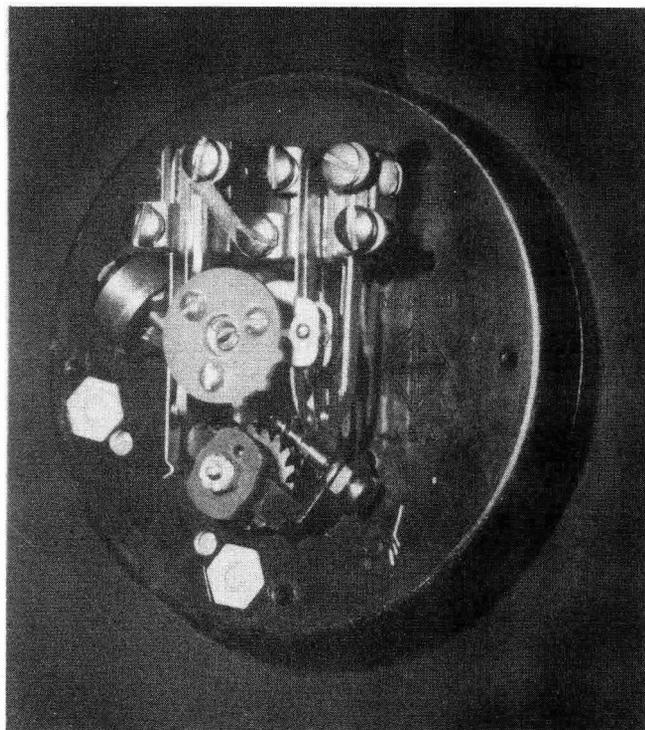


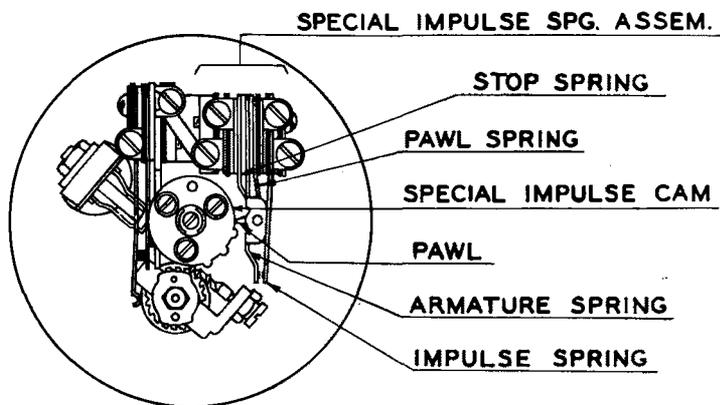
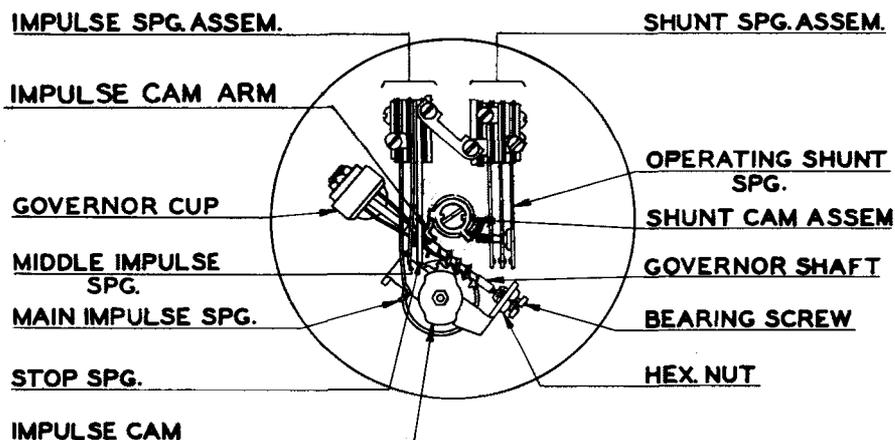
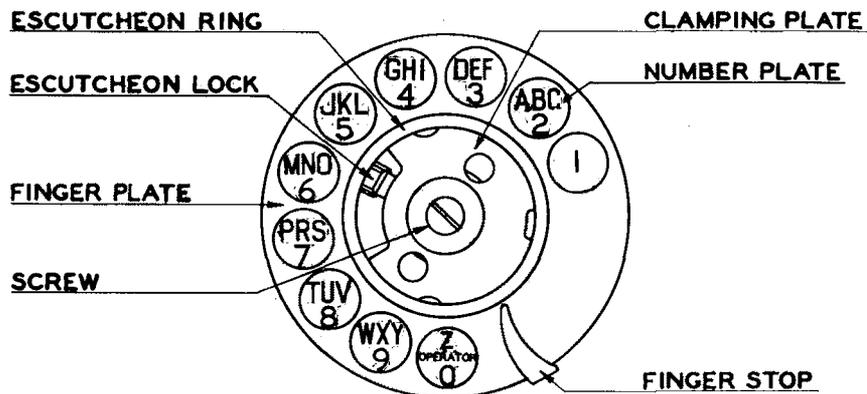
Fig. 3: Rear View of SATT Dial

2.2 SATT Version of Type 24A36 Dial: The SATT dial (Strowger Automatic Toll Ticketing Dial) is a Type 24A36 dial equipped with an additional pulsing cam and pulse spring combination. The additional cam is mounted on the shunt cam hub and the additional pulse spring combination is mounted in the shunt spring pileup. The cam is made from a phenol fibre sheet. The outer circumference may have 1, 2, or 3 lobes, or 2 lobes, in positions 1 and 3 which operate the extra pulse springs to give the proper number of special pulses for party identification.

The impulse spring differs in shape from the standard impulse spring. The tip of the impulse spring is curved upward so as to place the contact point in line with the

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USE: TRANSPARENT COVER
DIAL CARD



REAR VIEW OF SATT DIAL
SHUNT SPGS. NOT SHOWN

Fig. 4: Dial Assembly (Including Rear View Drawing of SATT Dial)

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armature spring contact and the special pulsing cam which operates against the armature spring. The armature spring is special in that it is equipped with a pawl which, when the dial finger plate is pulled off normal, rides over the projection or lobe on the cam without operating the impulse spring, but operates the impulse spring when the dial is allowed to return to normal. The ratchet action is made possible by an additional spring (pawl spring) in the pileup. It is a short spring made of phosphor bronze and of the same shape but shorter than the pulse spring. This is called the pawl spring. The remaining spring in the pileup is a stop spring which is added to insure positive action of the armature and impulse springs.

3. THE STANDARD DIAL

The standard dial is regularly supplied with a chrome finger plate, either "A-B-C" or "1-0" number plates, and the black number card with space for the subscriber's number and exchange name.

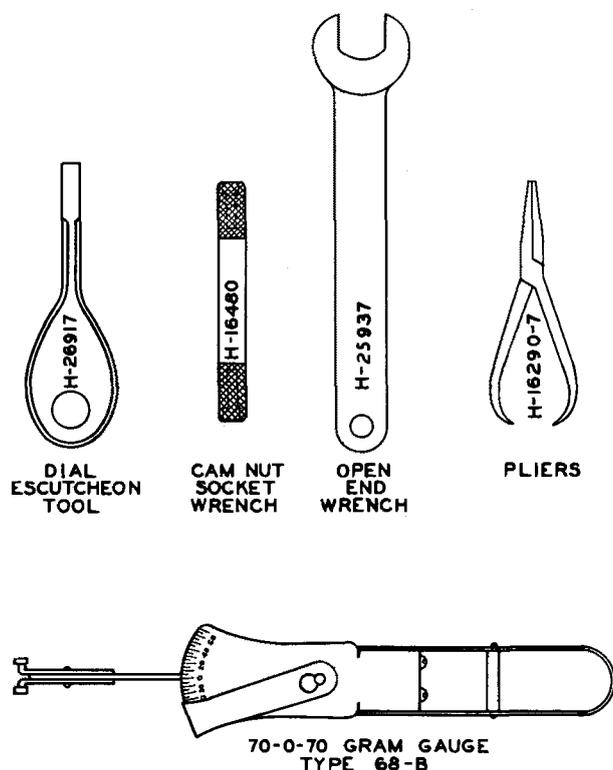


Fig. 5: Dial Tools

Two spring combinations are employed; (a) set of impulse springs (figure 4) and (a) set of shunt springs (figure 4). The impulse springs are normally closed but are opened once by the cam for each digit dialed. The contacts on the shunt spring assembly are normally open but close as the dial is turned from the normal position. This action shunts the receiver which prevents dial clicks from being heard, and also shunts the transmitter which decreases the circuit resistance. A detachable link connects the shunt spring pileup to the impulse spring pileup. This link may be easily removed if circuit conditions require.

No soldering is required to replace a dial. Screw terminals are employed so that the leads may be connected and disconnected easily and quickly in any location.

A delayed impulse feature is included to provide an appreciable interval of time between the completion of the last impulse as the dial is returning to normal and the completion of rotation. In effect this adds an interval of time equal to one pulse between each series of impulses. This added time interval allows the relays of each switch or other device that is operated extra time to function before the next series of impulses is dialed. Ample time is provided for trunk hunting. This delayed impulse feature is accomplished by the use of an 11-pulse dial, one pulse, the last, being shunted out by means of an impulse shorting arm (figure 4) which pushes the closed impulsing contact springs away from the cam following the last impulse. The dial and the cam continue to rotate through the delayed impulse range.

4. TOOLS

Only five tools (see figure 5) are required to do maintenance work on the Type 24A36 dial, plus a screw driver and a pair of stub-nosed pliers.

- Escutcheon tool (H-26917) used in removing escutcheon ring, transparent cover, dial number card, and clamping plate. See section 5.
- End wrench (H-25937) fitting the governor bearing nuts and the larger nut of the impulse cam.
- Socket wrench (H-16480) for tightening the impulse cam clamping nut (smaller of the two nuts).
- Pliers, impulse and cam spring adjusting (H-16290-7).
- Gram gauge for measuring tension in contact springs; 50-gram capacity is necessary. Type 68-B 70-0-70 grams is suitable. Needed in a repair shop only.

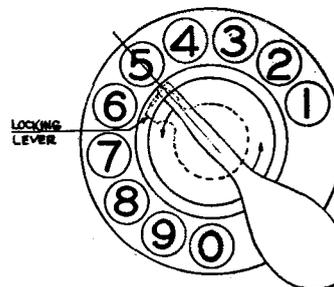


Fig. 6a: Unlocking Escutcheon Ring

5. REMOVAL OF DIAL NUMBER CARD IN ORDER TO CHANGE NUMBER

To remove the dial escutcheon assembly, insert dial tool (H-26917) under the escutcheon ring opposite the digit "5" finger hole as shown in figure 6a. Press the tool down against the locking lever underneath the escutcheon

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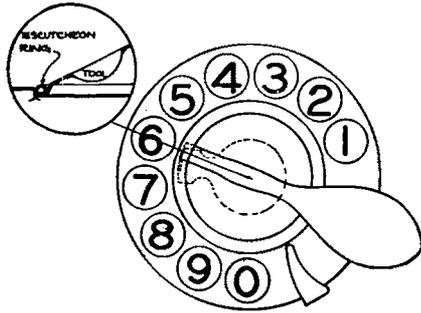


Fig. 6b: Escutcheon Ring Unlocked

and move the tool counter-clockwise to the digit "6" finger hole as shown in figure 6b. This unlocks the escutcheon.

With the tip of the tool lift the escutcheon ring at the digit "6" finger hole and withdraw the escutcheon.

- a. The escutcheon ring, transparent cover, number card, and number card clamping plate will come free in one assembly. Release components by turning the assembly face down and slightly rotating the notched clamping plate in a counter-clockwise direction. Note the relative position of the parts as they are removed.
- b. Print correct number on the dial card.
- c. In reassembling the components of the escutcheon, place the transparent cover in the escutcheon ring first so that it will protect the number card. The number card is placed in the ring next, and last, the number card clamping plate is placed over the number card. The clamping plate is turned in a clockwise direction to engage its tongue, locking the assembly.

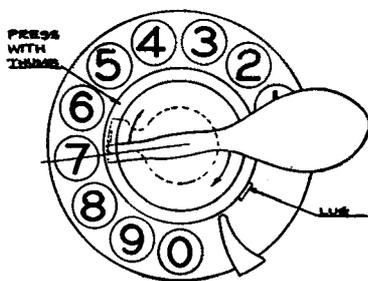


Fig. 6c: Locking Escutcheon Ring

- d. To mount the escutcheon on the dial, first check to see that the locking lever on the finger plate is pointed midway between digits "6" and "7". Then proceed to insert the small lug on the escutcheon ring into the slot located just above the finger stop, and press the assembly down into the finger plate. Hold the assembly in place and insert the dial tool under the escutcheon ring opposite the digit "7"

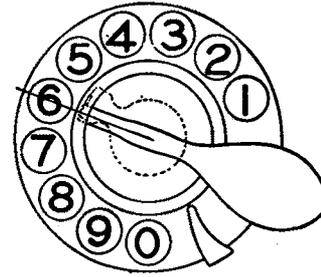


Fig. 6d: Escutcheon Ring Locked

finger hole as shown in figure 6c. Press the tool down against the locking lever underneath the card and move the tool in a clockwise direction to the digit "6" finger hole, as shown in figure 6d. This locks the card in place. Remove the tool.

6. OPERATION

6.1 Type 24A36 Dial: The Type 24A36 dial is essentially a signaling device for transmitting a numerical code to a remote location. Commonest application is, of course, to the telephone, where it controls central-office automatic switching equipment from a distance.

The dial is operated by inserting the index finger into one of the ten digit holes in the finger plate, pulling the finger plate in a clockwise direction to the finger stop and then removing the finger. The dial automatically returns to the normal position in a counter clockwise direction and at a uniform speed. During the return movement the impulse springs are opened and closed, the number of times corresponding to the digit dialed. In this manner, all of the digits of a telephone number are dialed. Each time the finger plate is pulled from the normal position, the shunt-spring contacts operate. This connects a short circuit across the receiver and transmitter to prevent the impulses from being heard in the receiver and the variable resistance in the transmitter from affecting the impulses. As the finger plate comes to rest in the normal position, the shunt spring contacts operate in the reverse direction and remove the short circuit.

6.2 SATT Version of Type 24A36 Dial: The SATT dial (Strowger Automatic Toll Ticketing) version of the Type 24A36 dial provides a means for automatically identifying each subscriber on a five party line. This is accomplished by sending out special identifying pulses automatically from the dial. These pulses, which are ground pulses, operate a differential relay circuit which through auxiliary relays causes a minor switch to step and identifies the calling party. These pulses do not in any way interfere with regular pulsing operation. Any one of the five parties are identified by the number of special pulses as follows: no identifying pulses, first party; one identifying pulse, second party; two identifying pulses, third party; three identifying pulses, fourth party; the first and third identifying pulses, the fifth party.

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7. MINOR ADJUSTMENTS AT SUBSCRIBER'S PREMISES

In order not to turn the telephone subscriber's premises into a workshop, only minor repairs should be made there. If the dial requires replacement of parts, it should be replaced by a new dial and the worn dial returned to the repair shop.

If this system is followed, the troubleman need not be a dial expert. He need only be instructed in the simple repairs listed below which repairs can be made on dials at the subscriber's premises.

- a. Increase or decrease the tension of the main spring. See section 11.b.
- b. Regulate the speed of the dial by making the necessary adjustment of the governor wings. Check speed of dial by calling the test desk and dialing into dial speed test unit if one is provided.
- c. Adjust the impulse springs and regulate their tension. See section 11.c.
- d. Adjust the shunt springs and the position of the operating arm. See section 12.c.
- e. Tighten and re-set a loose impulse cam.
- f. Tighten the finger stop or replace a bent one.
- g. Replace or make changes on the designation card, escutcheon ring, or transparent cover. See section 5.
- h. Lubricate the dial bearing surfaces if the dial appears sluggish. Follow figure 14 which covers all lubrication points including governor shaft worm, governor shaft bearings, worm-gear shaft bearings, main shaft, and other points.

To lubricate the main shaft and the main gear bearing which runs on a sleeve surrounding the main shaft (figure 12), it is necessary (1) to remove the dial escutcheon; (2) to remove the finger plate mounting screw. Place a drop of the correct lubricant (figure 14) in the hole. While the dial finger plate is off, lubricate other interior points as shown in figure 14.

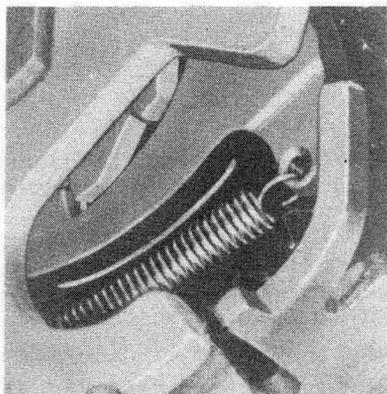


Fig. 7: Finger Stop Serving as Pawl Stop

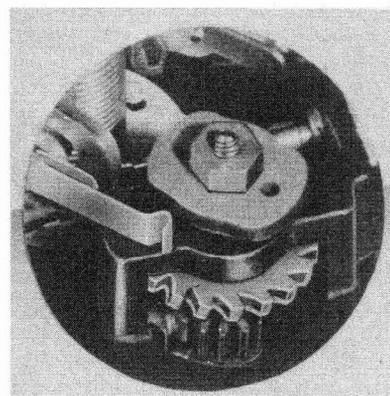


Fig. 8: Dial Impulse Cam and Armature Spring of Impulse Spring Assembly

Replace finger plate, locking lever, and finger plate mounting screw. Attach dial escutcheon.

When the dial was manufactured, the fibre tips of the governor weights were lubricated. These may require further lubrication after the dial has been in service for a period of time.

8. DISASSEMBLY

Note that the spring assemblies (section i), also main spring (section c) and governor worm (section j) may be removed separately without disassembling the dial.

a. Dial Escutcheon Assembly. -- Remove as directed in section 5.

b. Dial Finger Plate. -- Remove finger plate mounting screw. Lift escutcheon locking lever and finger plate from mechanism

c. Main Spring and Cam Assembly. -- The main spring and the cam form one assembly. (The delayed impulse dial has a cam with two arms). The end of the main spring passes through the socket of the cam to form a key which slides into a slot on the main shaft. At the bottom of this slot is a bayonet slot into which tension in the spring forces the key-like end.

To remove the spring and cam assembly, hold the dial face down in the left hand so that the dial finger plate can not revolve. Seize the cam in the right hand and turn slightly counterclockwise (the direction which tightens the spring). This will release the spring end from the bayonet slot. Lift up on the cam. The spring and the cam should slide off the shaft. When released, the spring will unwind suddenly.

d. Main Shaft Assembly and Ratchet Pawl. -- Remove main spring and cam assembly as described in section c preceding. Lift shaft assembly carefully from the base. Ratchet pawl is part of the shaft assembly. The main gear idles on the main bearing but will not come free until the number plate and finger stop have been removed. Note the spring in the center of the pawl which reduces the noise of the pawl clicking over the ratchet teeth.

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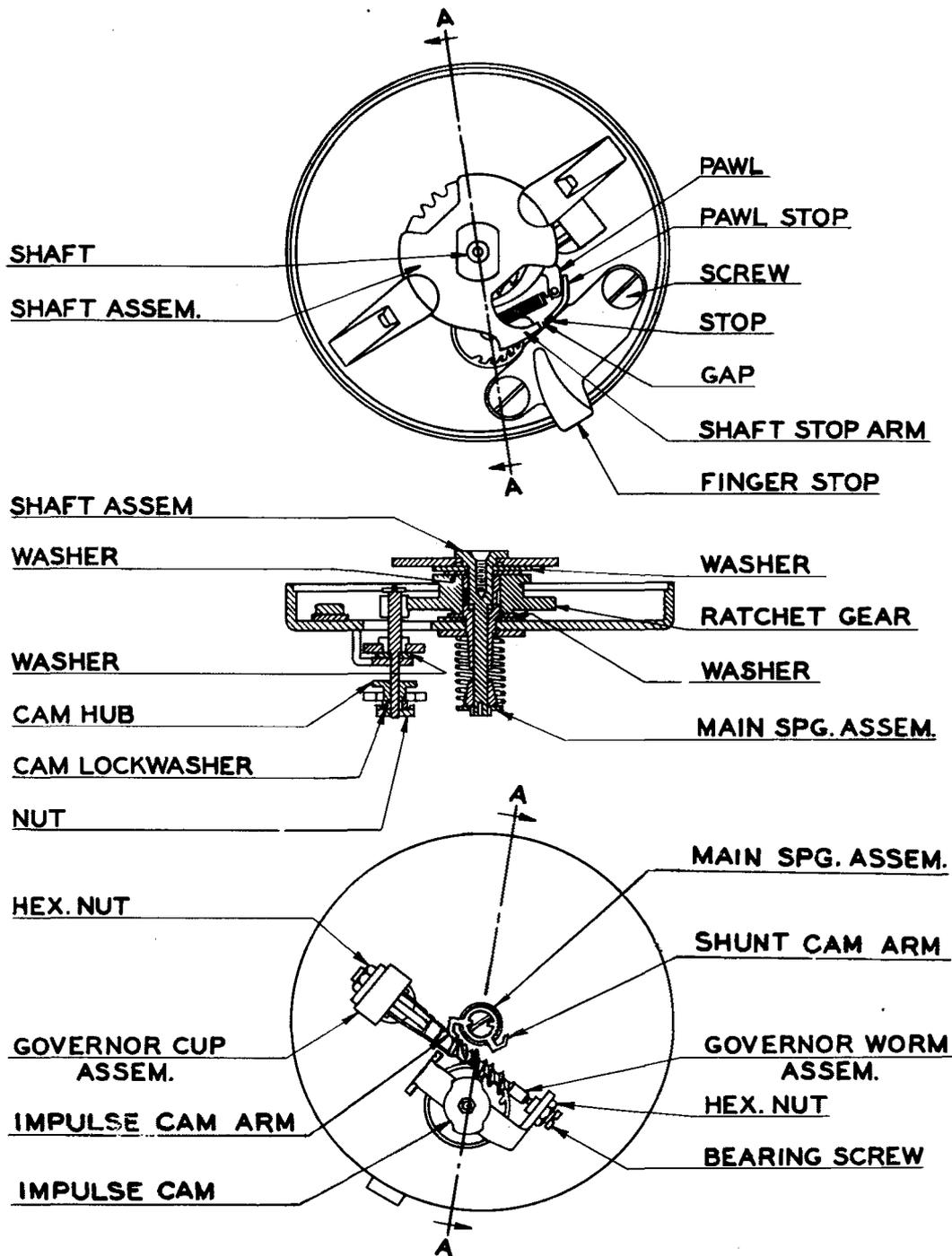


Fig. 9: Dial Sub-Assembly

e. Impulse Cam. -- Detach impulse cam in the following manner. Use wrench H-25937 to hold the large (hub) nut under the cam. Then loosen the small lock nut with the cam nut socket wrench (H-16480). Do not lose the small lock washer which lies beneath the nut. See figure 13. The cam is designed to give an impulse ratio of 38.5% make.

NOTE: The special cam on the SATT dial may be removed by removing the 3 screws which hold it in place.

f. Number Plate. -- Push aside the clamping lips of number plate lock spring. The dial number plate is now free.

g. Finger Stop (figure 9). -- The finger stop may now be removed by unfastening two screws.

h. Worm Gear (and Pinion) Assembly. -- Complete steps a, b, c, d, e, f, and g above. Worm gear (and pinion) assembly then may be lifted from its bearing.

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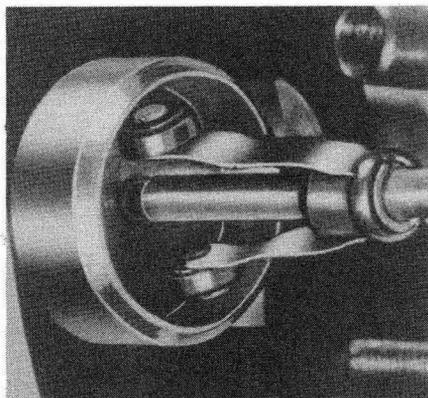


Fig. 10: Governor and Governor Cup

i. Spring Assemblies. -- Either the shunt or the impulse spring assembly may be removed by unfastening two screws. Remove springs only when replacement is necessary.

NOTE: The special impulse springs on the SATT dial are in the shunt spring assembly and may be removed by unfastening two screws.

j. Governor Assembly and Governor Cup. -- The governor assembly which includes the worm, and governor weights, may be removed by loosening the lock nut with wrench H-25937 and backing out the bearing screw. Remove the nut holding the governor cup in place by using wrench H-25937. The cup will now come free from its mounting bracket.

The dial is now completely disassembled. Before re-assembling, clean all parts and replace any worn or damaged parts.

9. REASSEMBLY

a. Main Gear, Pinion Gear, and Finger Stop. -- Place the lower thrust washer and main gear, over the bearing hub.

Place the pinion gear assembly in the lower bearing with a small washer between the gear and the bearing. Fasten finger stop with two machine screws and nuts. This holds the above parts in position. The finger stop including the upper bearing form the pinion gear assembly.

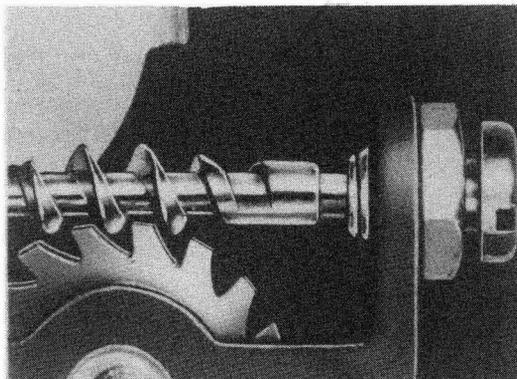


Fig. 11: Worm Wheel Driving Governor Worm Assembly

b. Governor Assembly and Governor Cup (figures 10 and 11). -- Attach governor cup by means of the governor

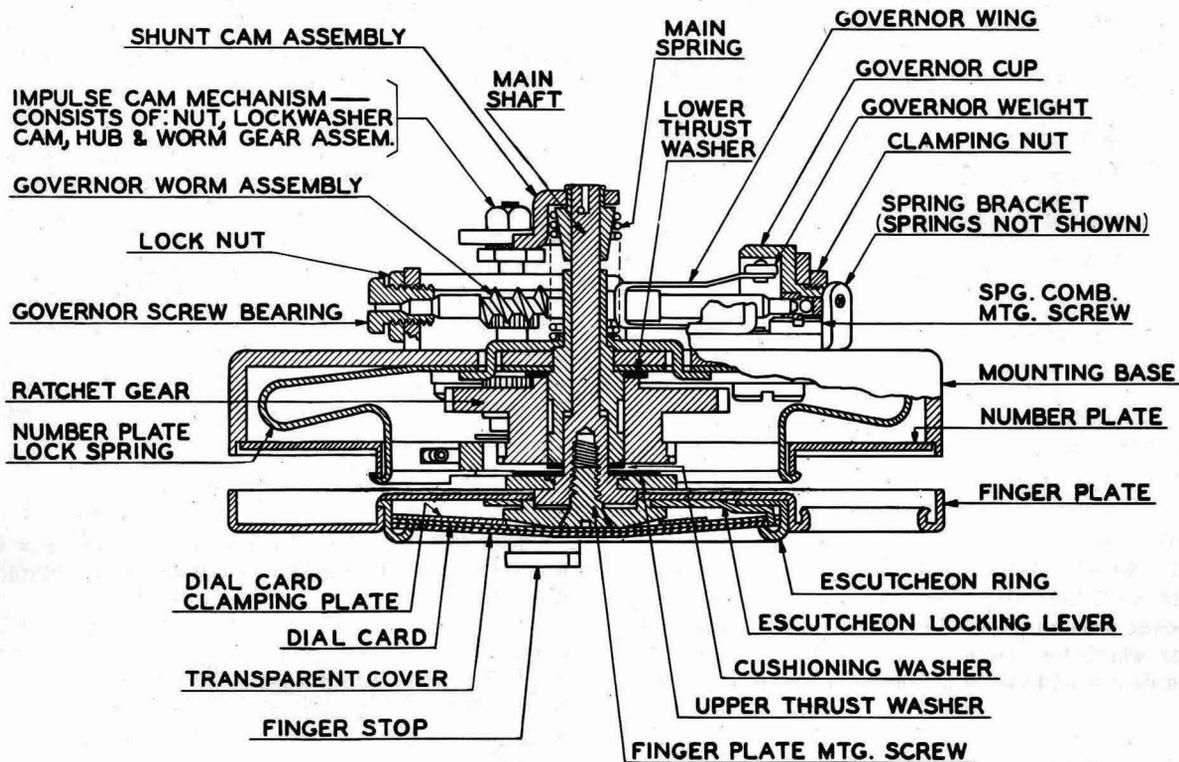


Fig. 12: Cross-Sectional View of Type 24A36 Dial

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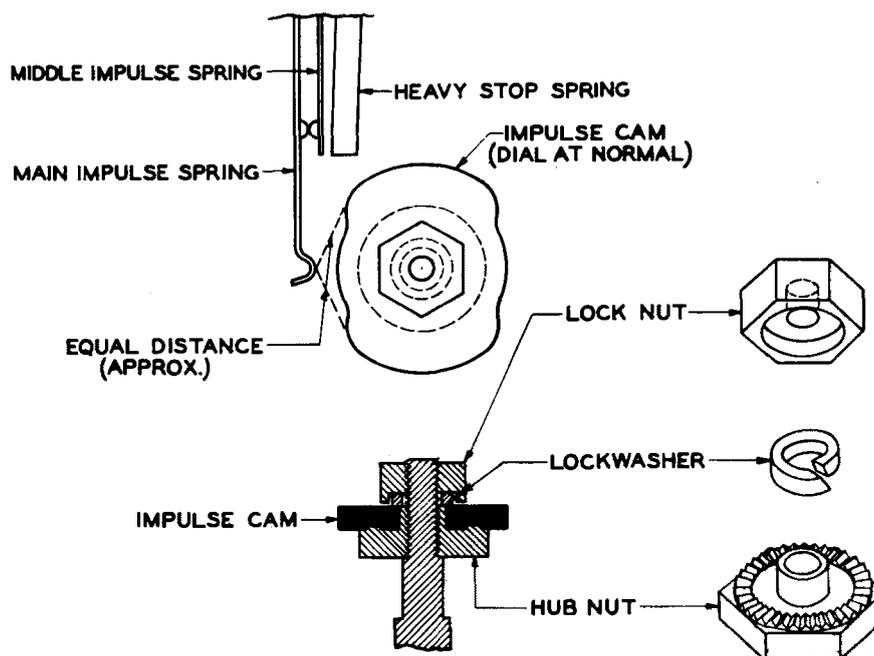


Fig. 13: Impulse Cam Assembly

bearing nut. Tighten nut with wrench H-25937. A steel ball is permanently located in the bearing of the governor cup. This ball was inspected for freedom from bind at the time of manufacture. Insert the governor assembly into the cup bearing. Tighten the opposite bearing screw and lock nut sufficiently to hold the assembly in place and yet allow perceptible end play, but not more than 1/64 inch play. When this point is reached, hold screw with screw driver and tighten lock nut with wrench H-25937.

c. Spring Combinations (figure 4). -- Attach spring combinations to the dial by means of two screws each. Each spring is separated from its neighbor by a fibre strip. A terminal screw strip is in contact with each spring. A metal link connects the two spring assemblies.

NOTE: On SATT dials the special impulse springs are in the regular shunt spring pile-up and hence are held in place as such by the two screws along with the shunt springs.

Lubricate the fibre buffers on the shunt and impulse springs with one drop of low temperature lubricant (Spec. 5660), which is used throughout the dial.

d. Main Shaft Assembly (figure 14). -- Apply one drop of oil to the pawl bearings. Apply one drop of oil to the dial shaft bearings. Cover the exposed portion of the main bearing on the governor side of the mounting die-cast plate for protection. Apply one dip of oil to the ratchet teeth on the main gear. Slide main shaft assembly into the central bearing hub. See that the ratchet pawl engages the teeth of the ratchet wheel. Rotate the main shaft assembly in a counterclockwise direction (seen from the front) until the pawl has come

to rest against the stop. The rear end of the main shaft is slotted. The main spring assembly slides over this part of the shaft. Place the spring assembly over the shaft and rotate the spring until the cams are in the normal position - in contact with both the buffer of the impulse springs and the buffer of the shunt springs. Rotate the spring one-third of a revolution backwards (clockwise). Catch the foot at the bottom of the spring in the nearest of the three hooks on the base.

Hold dial in the left hand with the thumb pressing the shaft assembly against its backstop. Rotate spring approximately one-third of a revolution in a counterclockwise direction. The cam should now be in the normal position. Continue rotating the spring for one full revolution. This is accomplished most easily if both hands turn, one turning the spring, the other turning the base. When the cam again reaches its normal position, push down until the spring end slides into the key slot in the shaft. The cam should then turn slightly clockwise as the spring end locks in the bayonet slot.

e. Impulse Cam (figure 13). -- Screw the knurled impulse cam nut, knurled side up, tight on the end of the worm gear shaft. Apply one dip of oil to the edge of the fibre cam, and then wipe off the surplus oil. Place the impulse cam on the pinion shaft with its long axis parallel to the impulse springs. Place the small lock washer on the cam and tighten clamping nut. Be certain to hold the knurled cam nut with cam nut wrench (H-25937) and tighten the clamping nut with the cam nut socket wrench. By holding the larger cam nut with the wrench (H-16480), damage to the worm gear and governor is prevented.

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f. Adjustment of Finger Stop (section 11.a). -- The finger stop also serves as a pawl stop as well as the worm gear bearing. This pawl stop must be bent to meet the conditions of section 12.e.

g. Inspection of Dial for Action. -- Check to see that the dial mechanism operates properly, smoothly, and without sticking. Refer to section 11.

h. Number Plate (figure 4). -- Place the dial number plate over the incomplete assembly. With a nail or slim tool, reach under the number plate and pull out number plate locking springs. They will snap into position, holding the number plate firmly in place.

i. Finger Plate (figure 4). -- Attach dial finger plate to the front of the dial sub-assembly, using finger plate mounting screw and placing escutcheon locking lever beneath the screw.

j. Dial Escutcheon Assembly (figure 6). -- Attach as described in section 5.

k. Adjustment and Inspection. -- Adjust and inspect as described in sections 11 and 12.

10. GENERAL ADJUSTMENT REQUIREMENTS

- a. All parts shall be tight.
- b. Defective, marred, or mutilated parts shall be replaced.
- c. Spring contacts shall not be out of alignment with respect to each other more than 1/3 of their diameter measured at the base of the contact points as gauged by eye.
- d. The equipment shall be free from grease, dirt, or any other foreign matter which is likely to impair operation or detract from appearance.
- e. The finger plate shall not bind on the finger stop.
- f. The number plate shall be clean and undamaged.

11. ROUTINE INSPECTION

Dials are properly adjusted and lubricated before shipment from the factory and will operate for long periods of time without adjustment. However, minor adjustments may be required occasionally. The inspection of the dial should be made in the following order with adjustments made only as necessary. Where limits of adjustments are given, the dial should be inspected with the extreme limiting values and readjusted only if it is found to be outside these limits. Deviation from nominal values is to be expected and is not cause for readjustment.

a. Ratchet Pawl. -- Inspect and adjust the clearance between the shaft stop arm and its associated stop. Refer to section 12.e. It will be necessary to remove the finger plate to inspect the pawl and pawl stop. If adjustments are necessary the number plate will also have to be removed. Bend the pawl stop to obtain proper clearance.

b. Restoring. -- Inspect the main spring according to section 12.b. In general the spring will not need readjusting. However, if it should need adjusting, increase or decrease the tension by removing the spring and then remounting it with the lower end engaging the hook back of, or in front of, the previously used hook as the case may be. Refer also to section 9.d.

c. Impulse Springs. -- Inspect and adjust the impulse springs as per sections 12.a.(1) and 12.a.(3). Inspect and adjust, if necessary, the contact separation and clearance between cam and tip of main impulse spring. See section 12.a.(4). This adjustment consists of bending the heavy stop spring.

Inspect and adjust if necessary the impulse shorting arm (sections 12.a.(5) and (6)). This adjustment consists of bending the impulse shorting arm. Inspect and adjust the timing of the shorted impulse (section 12.a.(6)).

d. Governor. -- Inspect and adjust the governor. (Sections 12.d.(1) and (2)). Adjust the speed of the dial (section 12.d.(3)). This adjustment is made by bending the governor wings so that the weights (when in motion) will bear against the governor cup with sufficient pressure to maintain the correct dial speed.

e. Operation. - Check the dial for binds according to section 12.f.

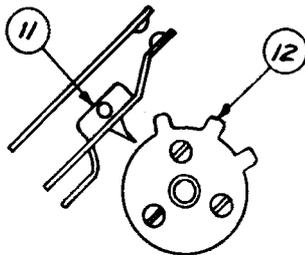
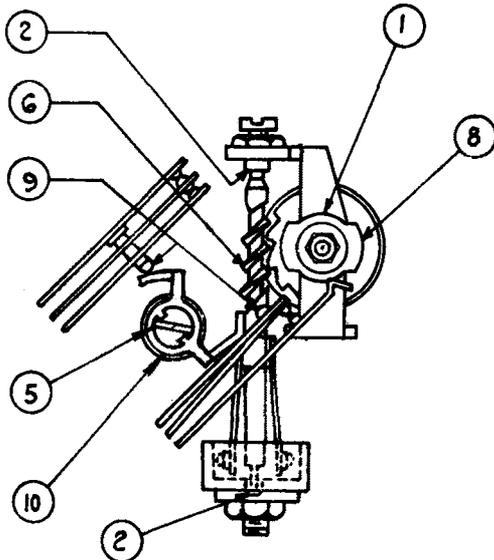
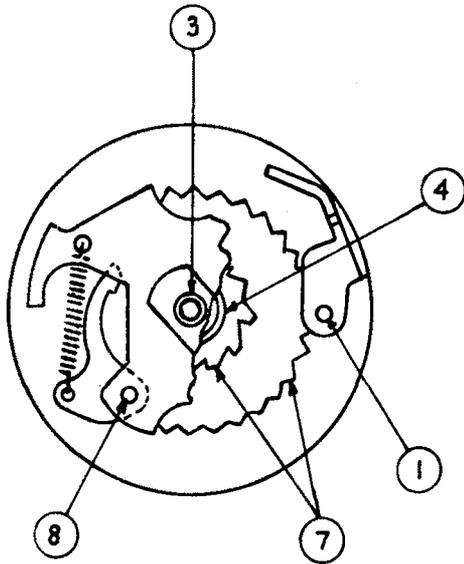
12. SPECIFIC ADJUSTMENT REQUIREMENTS

- a. Impulse Springs (figure 4).
 - (1) When not engaged by the impulse shorting arm, the middle impulse spring shall rest firmly against the heavy stop spring from its own tension.
 - (2) With the finger plate off normal and the tip of the main impulse spring opposite a low side of the cam, the main impulse spring shall rest against the contact of the middle spring with minimum 25 grams, maximum 50 grams contact pressure.
 - (3) With the finger plate off normal and the tip of the main impulse spring opposite a low side of the cam, the heavy stop spring shall hold the middle and main impulse springs so as to make the separation between the main impulse spring and a low side of the impulse cam approximately the same as the space between contacts when the main impulse spring is resting against the high side of the cam.

NOTE: The above adjustment is considered as having been met if with the finger plate off normal and the tip of the main impulse spring opposite the low side of the cam clockwise from the locating hole, the separation between the spring tip and the cam is $.015'' + .002''$ and, if with the finger plate off normal and the main impulse spring resting against the high side of the cam adjacent to the locating hole, the contact separation is $.015'' + .003''$.

TYPE 24A36 DIAL

LUBRICATION CHART FOR DIALS



For SATT dials only

Low Temperature Lubricant (Spec. 5660, Issue 2 or later) shall be applied as follows:

1. Distribute one dip to the worm wheel shaft bearings and brush a small amount over surface of worm wheel shaft from worm wheel to finger stop bearing for rust protection.
2. Distribute one dip to the governor shaft bearings.
3. One dip to dial shaft bearing.
4. One dip to main gear wheel bearing.
5. Cover the exposed portion of main bearing on governor side of the mounting plate with one dip for rust protection (spring removed).
6. Governor shaft worm -- one dip. Brush small amount on shaft under governor wings for rust protection.
7. One dip brushed evenly over ratchet teeth and one dip over gear teeth.
8. Distribute one dip to the edge of the cam and threaded portion of cam shaft and to the pawl bearing.
9. Distribute one dip to the buffers. Allow to stand a short time and then remove surplus oil. (Do not apply to rubber buffers).
10. Distribute one dip between spring coils for rust protection.
11. On SATT dials apply one dip between pin and bushing of the pawl and armature assembly.
12. On SATT dials distribute one dip to edge of new cam.

Excessive lubricant shall not be allowed to remain on any surface.

A dip shall be considered to be the amount retained in a No. 4 artist's sable rigger brush after being dipped in the lubricant to a depth of 3/8" and then scraped on the edge of the container to remove surplus. There should not be sufficient lubricant adhering to the brush to form a drop at the end of the bristles.

Lubricate only when necessary to provide smooth and positive mechanical performance.

Fig. 14: Lubrication Chart

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- (4) When an impulse shorting arm is used, the plane parallel to the dial mounting plate, which passes through the center line of the buffer on the middle impulse spring, shall pass through a point within the width of the contacting portion of the impulse shorting arm.
 - (5) The impulse shorting arm, when used, shall cause the main impulse spring to clear the cam by minimum .015" maximum .030" during the shorted impulse.
 - (6) The impulse shorting arm shall not cause the impulse springs to move until after the completion of the last pulse sent out.
- b. Restoring Spring. -- The restoring spring shall have one to one and a third turns tension with the dial at normal.
- c. Shunt Springs. --
- (1) Shunt springs shall be tensioned so that as the dial returns to normal or moves off normal each spring will make contact with its adjacent spring while traveling through a space of not less than .015".
 - (2) Contact separation for shunt springs either in their operated or normal position shall be from .015" to .030"
- NOTE:** If the shunt spring assembly has four or more springs and includes three springs which make common contact when the dial is off normal, contact separation for shunt springs when the dial is in the off-normal position shall be maximum .050".
- (3) The main spring of a break-make combination shall break contact from its back contact before making contact at 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.
- (4) When there are two break contacts (normally open) in the shunt spring assembly springs 1 and 2 shall break contact before springs 3 and 4 break contact. There shall not be more than perceptible clearance (if any) between the bushing of spring 4 and spring 2.
 - (5) The shunt spring operating cam width shall be aligned within the width of the buffer on the operating shunt spring in the normal position with respect to shaft end play.
- NOTE:** Alignment shall be such that contact gap is min. .005" when dial finger plate is pulled out when at normal.
- d. Governor. --
- (1) There shall be perceptible end play in the governor but this end play shall not exceed 1/64".
 - (2) The governor wings shall be formed as nearly as possible alike.
 - (3) The dial shall operate at a speed of not less than eight impulses per second nor more than twelve impulses per second unless otherwise specified on the assembly drawing.
- e. Ratchet Pawl. -- With the dial at normal, the pawl shall rest against its stop so as to give minimum .008" maximum .030" clearance between the shaft stop and its associated stop.
- f. Operation. -- The dial shall operate freely as it restores from the tenth digit to normal when retarded slowly by hand.
- g. Lubrication. -- For points requiring lubrication, for description of the lubricants, and for definitions of "drop" refer to the lubrication chart, figure 14. Note that excessive oil shall not be permitted to remain on any surface as it tends to collect dust and dirt.
- h. Variable Features. --
- (1) Delayed Impulses: This is the standard type dial using an impulse shorting arm and a two lobe cam which shall be set so that, with the dial at normal, the tip of the main impulse spring is approximately equally distant from either high side of the cam.
 - (2) Non-Delayed Impulse-Normally Open: This type of dial employs a two lobe cam which shall be set so that with the dial at normal the tip of the main impulse spring shall rest on a high side of the cam at a point such that it passes over approximately 2/3 of the high side of the cam before coming to rest.
 - (a) Shunt springs #1 and #2 shall not open until the impulse springs have opened after the last impulse.
 - (3) Non-Delayed Impulse, Normally Closed: This type dial employs a two lobe cam which shall be set so that, with the finger plate at normal, the tip of the main impulse spring shall clear the cam a minimum of .005".
 - (a) The shunt springs shall not open until the impulse springs have closed after the last impulse.
 - (4) W.E.Co. Selector Supervisory System: This dial is a non-delayed impulse type and employs a single lobe cam which shall be set so that with the finger dial at normal the tip of the main impulse spring rests either in line with the center of the low side or on the center of the high side.
 - (5) Three-Wire Delayed-Impulse, Normally Open: This dial employs an impulse shorting arm and a two lobe 2 to 1 ratio cam which shall be set so that, with the dial at normal, the tip of the main impulse spring shall rest on or opposite a high side of the cam at a point such that it passes over approximately 2/3 of the high side of the cam before coming to rest.

TYPE 24A36 DIAL

- (a) Shunt springs #2 and #3 shall not close until the impulse springs have opened after the last impulse.
- (b) With the dial at normal, the tip of the main impulse spring may or may not rest on a high side of the cam, but the cam, and not the impulse, shorting arm, shall cause the impulse contacts to break after the last impulse.
- (c) Shunt springs shall be so adjusted that, with the dial off normal, only springs #1 and #2 are in contact.
- (d) As the dial restores to normal, shunt springs #1 and #2, remaining in contact, shall move until spring #2 contacts spring #3, after which spring #1 shall follow a minimum of .015" before breaking contact with spring #2.
- (e) Shunt springs #1 and #2 shall break contact before springs #3 and #4 make contact.
- (f) Follow for spring #4 after being contacted by spring #3 shall be minimum .015".
- (g) Contact separation for shunt springs of this assembly in either the normal or operated positions shall be minimum .015" maximum .060".
- (h) As the dial returns to normal, just after shunt springs #2 and #1 break contact, springs #2 and #3 shall remain in approximately a stationary position while the main spring shunt cam moves at least 1/8" measured on the surface which contacts the shunt spring buffer.
- (6) Two-Wire Delayed Impulse-Normally Open: This dial employs a special cam (H-43736-3) and special impulse springs with large flat contacts. The cam shall be set so that with the dial at normal the curved part of the tip of the main impulse spring which contacts the cam shall pass over approximately 2/3 of the high side of the cam before coming to rest. With the dial at normal the main impulse spring shall clear the cam.
 - (a) The shunt springs shall not open until the impulse springs have opened after the last impulse.
 - (b) The impulse spring contacts when closed shall appear to be in contact for at least 7/8 of their diameter in any direction across the flat faces of the contacts, and shall not be out of alignment more than 1/8" of their face diameter.
- (7) Two-Wire Non-Delayed 11 Impulse-Normally Closed: This dial employs an 11 hole finger plate and number plate to match the eleventh position being designated "Test". A 38 1/2% make contact cam is used. The cam is set so that, with the dial at normal, the tip of the main impulse spring is approximately equally distant from either side of the cam.
 - (a) Shunt springs #1 and #2 shall not open until the impulse springs have closed after the last impulse.
 - (8) Where the shunt spring assembly has 5 springs using two break contacts (3 springs) and a make contact, springs #1 and #2 shall break before #2 and #3 and springs #2 and #3 shall break before springs #4 and #5 make.
 - (9) SATT Dial:
 - (a) The SATT dial has an extra cam (one, two, or three lobe) and a set of four springs actuated by the cam. Check the position of the extra hole in the cam against drawing D-84799, D-84800, D-84801 and D-84804.
 - (b) The pawl and cam must be aligned so that the pawl does not extend more than 1/3 its thickness beyond the cam at the lobe nor more than 1/2 the thickness at any part of the cam.
 - (c) The edge of the pawl must be substantially parallel to the edge of the cam. As the pawl rides over the top of any of the lobes there must be no more than perceptible clearance between the pawl and edge of the cam (as judged visually). Greater gap at the edges due to rounded corners on the pawl, is permissible.
 - (d) The contact gap for the added spring assembly shall be .020" + .003" with the pawl at normal.
 - (e) The pawl and armature spring assembly should rest against the cam with 7 to 10 grams pressure measured at the end of the spring with stop spring held out of the way. The pawl spring should rest against the pawl with 3 to 5 grams pressure.
 - (f) The stop spring is so adjusted that there is at least a barely perceptible clearance but not over .008" between the pawl and cam measured between pairs of lobes for the 2 or 3 lobe dials and close to the lobe for the 1 lobe dial.
 - (g) The pulse spring must clear the shunt springs with dial at normal by .020" minimum judged visually.
 - (h) The pawl should ride over the cam lobes freely, and not cause the contact gap to decrease by less than .010" at any time when the finger plate is moved off normal and rotated fully. When the pawl is pushed back completely it should have no tendency to hook on the pawl spring.
 - (j) Locate the lobed cam slightly clockwise from normal position so that the tip of the main impulse spring is approximately opposite the indentation on the cam. Check to see that requirements of paragraphs a.(6) are met.
 - (k) Locate the cam so that the pawl is not moved radially, but is close (0-.005") to any one of the lobes at the moment that the impulse springs just make contact. Take up play in the impulse cam by pressing it clockwise while releasing dial.

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If the adjustment is properly made, the impulsing contacts will close before and open after the special contacts when the finger plate is released slowly. Take up the play in the impulse cam by pressing it clockwise while releasing finger plate. An electrical check should show no more than a slight overlap when the dial is operated at normal speed.

- (l) Only the first pair of contacts on the shunt springs may open before the last identifying pulse is completed. The second pair of shunt spring contacts must make (judged visually) when the finger plate is moved off normal until the pawl just touches the first lobe. Contact separation for the second pair of shunt springs with the dial at normal shall be .010" to .030". Keep tensions of shunt springs on the low side to avoid overloading the restoring spring of the dial.

- (m) When lubricating, add oil to edge of the lobed cam and between pin and bushing of the pawl and armature assembly. Use one dip for both. Wipe off excess oil.

Excessive lubricant shall not be allowed to remain on any surface.

A "DIP" shall be considered to be the amount retained in a No. 4 artist's sable rigger brush after being dipped in the lubricant to a depth of 3/8" and then scraped on the edge of the container to remove the surplus. There should not be sufficient lubricant adhering to the brush to form a drop at the end of the bristles.

Lubricate only when necessary to provide smooth and positive mechanical performance.

NOTE ON DIALS LUBRICATED TO OLD STANDARDS: Light mineral oil (Specification 5231) and watch oil (Specification 5228) may continue to be used by customers until their present stocks are exhausted.

The watch oil (Specification 5228) was formerly recommended for application to shaft bearings of worm wheel, governor, and dial as well as the pawl bearings, main gear wheel bearing, and worm.

Light mineral oil (Specification 5231) was formerly applied to ratchet teeth on the main gear, edge of the cam, and fibre buffers.

In order to obtain the full benefits of the new oil (Specification 5660) when lubricating dials on which the old oils have been used, clean the parts in lead-free gasoline or in carbon tetra-chloride. Lubricate immediately as shown in figure 15, the lubrication chart. Cover the exposed portion of the main bearing on the governor side of the mounting plate with one dip of oil (Specification 5660) to prevent rusting.

NOG:av
Revision 8-49

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