GEK-99350

INSTRUCTIONS

ADJUSTMENT TECHNIQUES
FOR
ELECTROMECHANICAL RELAYS

These instructions do not purport to cover all details or variations in equipment nor provide for every possible contingency to be met in connection with installation, operation, or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company. To the extent required the products described herein meet applicable ANSI, IEEE, and NEMA standards; but no such assurance is given with respect to local codes and ordinances because they vary greatly.

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INTRODUCTION

This instruction book is to be used as a supplement to specific instruction books on relays that are currently being manufactured. It has been developed to show in detail the actual physical operation involved in obtaining the desired mechanical adjustments that are numerically detailed in instruction books on specific relays.

The sections below are formatted by relay types such as induction disc or plunger relays. Common elements such as the seal-in unit are included in only one section but the adjustment procedures are the same regardless of the final relay into which they are incorporated. Although most of the adjustments are straight forward, there are a few such as "contact stroking" that require practice to obtain proficiency.

A collection of special tools for relay adjustments is shown in figure 19. The tool kit can be obtained from GE by specifying model XRT12A1.

Letters shown throughout this book in parentheses refer to highlights on the referenced figure.

INDUCTION DISC RELAYS

Disc Stop Arm (Refer to fig. 1)

The disc stop arm has a phosphor bronze leaf spring (A) behind the stop arm (B) that rests against the time dial stop (D). This leaf spring is to prevent any sticking of the stop arm to the time dial stop if the relay disc has not moved for a long period of time.

The leaf spring should be deflected approximately 1/64 inch from the stop arm. If there is no deflection or a larger deflection, the proper deflection should be obtained by using a tweezers to bend the leaf spring into the proper position.

This check and/or adjustment should be done before any other adjustment because any adjustment will affect the zero time dial position.

Stationary Contact & Zero Time Dial Position (Refer to Fig.1)

Rotate the time dial to the zero position. At this point the contacts (C&D) should just make and it should be possible to manually rotate the disc, in the closing direction, for approximately 1/32 inch of stationary contact travel before the stationary contact is restricted from further movement.

If the contacts are not making at the zero time dial position the following procedure should be performed:

Back out the stationary contact adjusting screw (E) until the contacts just make. Now manually rotate the disc in the contact opening direction. The contact should open before the stop leaf spring is fully compressed. Now rotate the disc manually in the contact closing direction until the stationary contact is restricted from further movement. This amount of overtravel or "wipe" should be approximately 1/32 inch.

If the "wipe" is in excess of 1/32 inch the following procedure should be performed:

Set the wipe for 1/32 inch with the stationary contact adjusting screw "E" of figure 1. Readjust the disc position by backing off the two clamping screws (F) on the stop arm (B) and then rotate the stop arm relative to the disc until the contacts just make. Tighten the clamping screws and make a final readjustment of the stationary contact adjusting screw.

Where there are two stationary contacts, the lower contact should be used to adjust the zero time dial position. The upper stationary contact (G) should then be adjusted by means of its adjusting screw to make at the same time as the lower contact or slightly later.

Disc Centering & End Play (Refer to Fig. 2)

The disc and shaft assembly must be free to rotate in the air gaps of the U-magnet or Wattmetric magnet and drag magnet from the zero to the #10 time dial positions. This corresponds to approximately 270 degrees of disc rotation.

Before making any centering adjustments examine the air gaps (A) of the U-magnet and drag magnet to insure that all gaps are clean and that both the top and bottom surfaces of the disc are clean.

To clean any gap it is suggested that a piece of adhesive type of tape be folded against itself so that the sticky surfaces are on the external surface. This folded piece of tape should then be inserted into the air gaps to gather any pieces of external matter.

The gap on the U-magnet and drag magnets are approximately 0.080 inches while the thickness of the disc is 0.030 inches. This should leave approximately 0.025 inches clearance above and below the disc. With the disc at the #1 TDS loosen the set screw (B) holding the upper pivot (C) in the shaft and raise the pivot to have about 1/16 inch end play. Loosen the set screw (D) holding the jewel screw in place. Place a screw driver in the jewel screw slot and raise or lower the jewel screw until the disc is approximately centered. Tighten the jewel screw set screw. Lower the upper pivot until there is approximately 0.015 inches end play when the disc is lifted manually. Lock the upper pivot set screw in this position.

Open the time dial (F) to its maximum position (#10 TDS for most relays - mechanical stops prevent rotation beyond #3 TDS for IJD relays). Close the contacts by rotating the disc by hand and release. The clearance between the disc and either U-magnet or drag magnet must be 0.010 inches for any position of the disc.

Energize the relay so that the contacts close and reduce the input to 75% of pick-up and allow the disc to reset all the way. The disc should move at a slow rate (depending on control spring windup and drag magnet) and reset to its maximum position (usually #10 TDS). This resetting time can take several minutes but a complete reset will insure that there is minimum friction present.

Time Dial (Refer to Fig. 2)

The time dial is located at the top center of the induction disc unit. It is used to set the travel of the disc which sets the contact closing time for a given current.

On most induction disc relays the time dial is continuously adjustable from 0 to the #10 time dial position (TDS). On these relays just a rotational force applied to the time dial run is all that is required to rotate the time dial to the desired position. This is because the internal hub inside of the time dial has a step deep enough to allow a wave washer to be placed between the hub and time dial affording a frictional rotation.

On a few relays a "locked" time dial is used. The locked time dial is used when reversed torque can be applied to the relay which can cause the time dial to eventually be moved to the #10 TDS position. Relays that use this mechanism are IJD differential relays and others that develop high reverse torques during external fault conditions.

On these locked time dial relays it is necessary to loosen the two screws (G) located on the frame shelf located above the time dial before attempting to rotate the time dial. After turning the time dial to the proper position be sure to re-tighten the aforementioned two locking screws. On these relays the internal hub is made shorter and the wave washer omitted. This tightening of the screws forces the hub against the time dial preventing rotation.

Drag Magnet (Refer to Fig. 2)

The drag magnet (H) on induction disc relays is used to adjust the level of time delay. It is not used to change the shape of the time curve.

The time delay of the relay can be adjusted by loosening the locking nut (J) on the underside of the drag magnet shelf and sliding the magnet in towards the center of the relay or out towards the edge of the disc. The drag magnet should not be drawn out towards the edge of the disc so far as to cause the edge of the keeper to extend beyond the cutout in the disc when the cutout is pointed straight ahead.

Movement of the drag magnet towards the center of the relay will cause the relay to operate faster while movement of the drag magnet towards the edge of the disc will cause the relay to operate slower. The total range of adjustment is approximately 15%.

The nut on the bottom of the drag magnet shelf should be fastened securely after final magnet positioning.

When a replacement magnet is ordered, it is virtually impossible to supply a permanent magnet with the exact strength required for a particular relay. This is because the basic torque level of the relay will vary due to tolerances in air gap, control spring strength, lamination thickness, etc. The drag magnet will be received in a fully saturated condition less an initial demagnetization of 10% for stabilization. This level will normally be in excess of the level required for most relays. It will therefore be necessary to demagnetize the drag magnet to the level required for the particular relay involved.

To perform this operation, place the drag magnet in the middle of the shelf. From the time curve determine the operating time for the particular time dial, tap and multiple of pickup to be applied to the relay. Apply the desired input to the relay and note the operating time. Take a 120 volt AC HFA operating coil (366A772G49) and place the top or bottom of the coil as close as possible against the drag magnet. Energize the coil with 10 volts AC and then remove the coil. Re-time the relay with the original input and note the operating time.

Repeat the HFA coil procedure gradually increasing the input to the HFA coil until the operating time is that required. By noting the decrease in operating time with the increase in HFA coil voltage, it is possible to arrive at the proper magnetization level with relatively few steps. If further demagnetization is required than that obtained by the above procedure remove the magnet from the relay and place the magnet as mounted in the relay (horizontally) on top of the HFA coil and repeat the voltage application process. Since this is a more efficient demagnetization process smaller increments of applied voltage should be used.

Be careful not to demagnetize the magnet to a level below that required because specialized equipment is required to re-magnetize the drag magnet.

Seal-In Unit (Refer to Fig. 3)

The seal-in unit is the most universally used auxiliary function in protective relays. It is a hinged armature unit with a tapped coil (A). The taps are usually 0.2/2, 0.6/2, or 1/4. The various coil ratings are associated with the trip coil current drawn by circuits in conjunction with various types of circuit breakers.

In addition, the unit has an armature (B) which when operated closes either one or two sets of contacts (C) in addition to raising an orange striped flag (D) which latches. De-energizing of the unit will leave the flag in the latched, visible position until the reset lever (E) is operated which resets the latch (J) and allows the target flag to fall to its normal black position.

The first thing to be done is to align the contacts and check the overtravel or "wipe". As in many electromechanical relay adjustments, one adjustment will affect another adjustment. This final overtravel will possibly affect stationary contact position. To see how this operates, gradually raise the armature until the two moving contacts just touch the stationary contacts at the same time. If this does not happen it will be necessary to loosen the right hand stationary contact retaining screw (F) and move the stationary contact up or down until both contacts just touch at the same time. At this point there should be approximately 1/64 inch gap between the top of the molded projection (G) protruding through the armature and the unit pole piece (H). This will allow for an approximate 1/32 inch contact overtravel or "wipe".

If this is not met , then both stationary contacts will have to be moved until the proper gap between molded projection and pole piece as well as almost simultaneous contact closure is obtained.

With the armature held against the pole piece raise the orange flag with a sharp tool, such as a knife, and insure that there is an additional 1/64 inch travel of the flag before all motion is restricted.

With the target flag latched, a tapping of the top of the unit with the handle of a screw driver should not cause the flag to fall down. We are now ready to electrically check the operation of the seal-in unit.

With an adjustable source of direct current in series with the contact and seal-in circuit, close the relay contact to complete the circuit. The DC source should not have a ripple of more that 5% because of the possibility of introducing contact chatter at the point of pick-up.

Gradually increase the current until the armature picks up and comes to rest against the pole piece in one smooth motion. The value of current for this pick-up should be between 75% - 95% of seal-in unit tap value.

If the armature fails to seat against the pole piece or chatters, the mechanical load caused by contact wipe is larger than the attractive force of the electromagnet. This can be corrected by either of two approaches.

One method is to raise both stationary contacts so that the armature will be closer to the pole piece when the contacts just touch. Adequate wipe must be checked for after this adjustment.

A second approach is to reduce the tension on the moving contact brush (K) (or brushes in the case of electrically operated contacts). This can be done by grasping the moving contact between the jaws of a tweezer and sliding the tweezers along the brush while exerting a force to reduce the tension in the brush.

After the pick-up is adjusted properly, apply a current in excess of pick-up to insure the seal-in unit is operating. While the seal-in unit is picked-up, open the induction disc contact. At this point the seal-in unit should stay picked-up through its own seal-in contact.

Gradually reduce the applied DC current until the unit drops out. This should be at a value of 25% of tap value or higher.

To check the remaining tap of the seal-in unit remove one of the two screws on the left side of the unit and screw it into the remaining seal-in tap on the right side. Remove the other seal-in unit tap screw and place it in the available screw hole on the left side. Repeat the prior pick-up and drop-out tests on the unit keeping in mind the new value of the operating tap. Pick-up and drop out values are the same allowable percentages on each tap.

Instantaneous Units (Refer to Fig. 4)

There are two types of instantaneous units. One is the standard unit which provides for a D.O./P.U. ratio of 75% or more. The other is a high drop out unit which produces a D.O./P.U. ratio of 90% or more.

Both units are similar in construction to the seal-in unit as far as general appearances are concerned. The main difference between the seal-in unit and instantaneous unit is in the pole piece arrangement. The pole piece for the instantaneous unit has a shading ring (A) placed around approximately 50% of the pole piece area. When the armature is picked up by hand the armature should touch the shaded half of the pole piece (but not the shading ring) only and the rounded section of the shading ring should always be to the front of the unit.

The top portion of the pole piece has a threaded core (B) which moves in or out of the pole piece assembly. This movement changes the effective air gap and thus the pick-up of the unit.

With the armature slowly raised by hand, both contacts (C) should make at approximately the same time. If not, loosen the two screws (D) holding one stationary contact and slide the stationary contact up or down until both contacts make at approximately the same time. Tighten the loosened screws in this position.

With the armature against the pole piece, the cross member of the "T" shaped moving contact brush (F) should lie in a horizontal plane and there should be at least 1/32 inch wipe on the contacts. This can be checked by inserting a 0.012 inch feeler gauge between the armature and the front half of the pole face with the armature held closed. The contacts should be closed with feeler in this position.

In units with electrically separate contacts there is no "T" brush, which holds the two moving contacts, but two separate contacts brushes.

There are some units that have a 4:1 current range with just a single coil. There are other units that have a 8:1 range obtained by the connection of two coils either in series for a low range of 4:1 or by connecting the coils in parallel a range of 4:1 that is twice the level of the series arrangement is obtained. Finally there is a 25:1 range that is obtained by a tapped series coil arrangement. All dual range units have overlapping ranges by means of the coil connections and position of the adjustable core so that there are no "dead spots" present.

To operate the unit electrically, connect a source of adjustable AC current to the studs containing the instantaneous unit. Loosen the hex nut (E) locking the threaded core and adjust the core to a position that approximates the desired pick-up. Gradually increase the current until the unit picks up. This should be one motion. At this level of current there might be some slight chatter. Chatter at this level is acceptable if an increase of current by 5% will cause a contact indicating light to be steady even though the unit may be noisy. Excessive contact chatter is usually caused by too much contact pressure. Excessive contact pressure can be reduced by two methods.

One method is to raise both stationary contacts so that the armature will be closed to the pole piece when the contacts just touch and thus ultimate contact deflection will be less. A check for adequate wipe must be made often with this approach.

A second approach is to reduce the tension in the moving contact brush (F) (or brushes in the case of electrically operated contacts). This can be done by grasping the moving contact between the jaws of a tweezer and sliding the tweezers along the brush while exerting a force to reduce the tension in the brush.

If the pick-up current is not at the proper value, the adjustable core should be moved. It should be up for higher currents. At no time should the core adjustment be left at its lowest position against the internal pole piece. This will result in a zero air gap position with a resulting low drop out.

Depending on the final current pick-up desired, the proper coil connection should be used along with the adjustable core to obtain proper pick-up.

The hi-dropout instantaneous unit is identical to the standard instantaneous unit with one exception. This is, that the pole piece is secured with a wave washer so that it can be rotated to change the dropout. The pole piece assembly is tight enough to remain in position but can be rotated by means of an open end wrench on the retaining nut at the top of the unit.

With the pole piece in such a position as to have the shading ring pointing forward, the most efficient shading is obtained. Rotation of the pole piece which also rotates the shading ring will reduce the efficiency of shading and thus increase the D.O./P.U. ratio of the unit.

With a high D.O./P.U. ratio, there will be a greater tendency for contact chatter. Therefore when adjusting the unit for a particular D.O./P.U. ratio, the pole piece should be moved only enough to obtain the proper ratio.

With the core set for minimum calibration the D.O./P.U. ratio will be at its lowest ratio. As the core is raised to obtained a higher pick-up, the D.O./P.U. ratio will increase.

D/O Case Checks (Refer to Fig. 5, 6,& 7)

The connection system in the D/O case consists of one contact block (Fig.5) which is attached to the cradle at the bottom or two contact blocks attached at the top and bottom, the corresponding terminal block (Fig.6) assembled into the case and the connection plug (Fig.7) which connects the terminal block to the contact block.

The contact block consists of a molded block (5A) to which are riveted a series of spring (5D) loaded fingers. These fingers maybe of either "short" (5B) or "long" (5C) configuration. As the connection plug is inserted into the cradle case assembly, connection is made to the "long" fingers prior to the "short" fingers. This allows power to be applied to the circuits connected to the "long" finger circuits thus setting up the proper conditions prior to final connections to "short" finger circuits which usually contain trip circuits.

The terminal block consists of a molded block ,(6A) into which are secured a series of riveted, spring loaded, long finger assemblies (6B) into the desired positions. The terminal block assembly also has provisions which can short (6C) together two or more adjacent finger assemblies when the connection plug is removed. Insertion of the connection plug (Fig.7) will make connection between the cradle block and terminal block prior to the point where the shorting mechanism is opened. Removal of the connection plug will make the shorting connection prior to the disconnection of the cradle block from the terminal block.

The fingers of the terminal block should also lie in the same plane. Again if there is any severe misalignment, the finger should be bent to proper alignment. If there are shorting bars present there should be at least 200 grams of pressure holding the lip of the finger against the shorting bar. This can be measured by using a gram gauge to measure the force against the flat portion (6D) of the finger until the shorting circuit is opened. If the force to open the shorting circuit is to low, the shorting bar should be removed and the connection finger that would bear against the shorting bar be pulled in a direction to increase the force. The shorting bar should then be screwed (6E) back into place and an additional measurement be taken to insure at least 200 grams of pressure be present at the finger shorting bar junction.

Pick-up adjustments (Refer to Fig. 1)

The pickup of the relay is controlled by a combination of tap selection and control spring adjustment. The pickup of General Electric relays is defined as the point where the contacts just close. To set a pickup at a particular tap value, place the current tap selector plug at the value desired. Now increase the current to a value above pickup so the contacts close. Gradually reduce the current until an indicating light monitoring the contacts shows a flickering action. This is the pickup of the relay.

If the pickup is not within the tolerance of the tap value the control spring (H) must be adjusted to bring the pickup within tolerance. Place the blade of a screwdriver in one of the slots of the control spring adjusting ring (J). Movement of the screwdriver towards the stationary contact will reduce pickup while movement away from the stationary contact will increase pickup. With the current at the desired value of pickup move the screwdriver until the indicating light flickers. Increase the current to obtain a solid indication, and then gradually reduce the current until the indicating light flickers again. If this current is the desired value, you have adjusted pickup.

If pickup is to be a value that is not exactly an available tap, place the tap plug in the tap that is closest to the value of pickup desired. Follow the above procedure to obtain the desired pickup. It must be recognized that if pickup is not at a value corresponding to an available tap, the published time curves will not be valid for the setting. This is because the torque level of the relay has been changed by the control spring to a value that is different than the design parameter.

The above discussion was concerned with relays having only normally open contacts. There is a class of induction disc relays, mainly voltage operated, that provide an "over and under" function. These relays have both a normally open contact and a normally closed contact that are electrically separate. This requires two control springs and the adjustment is more involved.

The pick-up of the normally open or "over" contact is adjusted in the same manner as that mentioned above. The normally closed or "under" contact closure is a function of the disc travel. Determine at what level the "under" contact closes. Now slightly loosen the two screws that hold the "under" moving contact between two rectangular bars near the top of the shaft. If the drop-out of the under contact is too high the disc travel must be increased. If it is too low the disc travel must be decreased.

Grasp the disc in one hand while rotating the upper moving contact in a direction to cause the proper correction. Movement of this upper contact will change the torque on the upper control spring. Thus the normally open or "over" contact must be reset. As you can see this procedure must be repeated until both "over" and "under" conditions are met.

At this point tighten the two screws which lock the upper moving contact in place.

8 POLE INDUCTION CUP RELAYS

Ball type stationary contact & contact gap (Refer to Fig. 8,& 10)

The ball type stationary contact is the most commonly used stationary contact used in 8 pole induction cup type relays. It consists of an brass cylinder (A) into which is placed a 0.5 inch steel ball (B), a thin diaphragm (C), spacer ring (D) and a spiral contact assembly (F&G) all retained by an aluminum cap (E) which has a hole in the center which allows the contact to protrude.

Although there are a number of contact assemblies, there are three commonly used assemblies. The identification of these types are stamped on the rear of the cylinder. The stampings are "L" which stands for low wipe of 0.002-0.004 inches, "S" which stands for standard wipe of 0.004-0.009 inches and "H" which stands for high wipe of 0.013-0.018 inches.

The term "wipe" in ball barrel contacts stands for the amount of travel the stationary contact can move from the point where the stationary contact is first touched to the point where the stationary contact travel is stopped because the stationary contact comes in contact with the diaphragm.

Measurement of this wipe can be done in the following manner. Loosen the locking screw (10A) on the stationary contact block support (10B) so that the stationary contact barrel (10C) can be rotated with relatively little pressure. With the moving contact resting against the stop screw (10D),or with the moving contact held against the normally closed stationary contact (10E), screw in the stationary contact under consideration until the stationary contact just touches the moving contact as shown by an indicating lamp, placed in the contact circuit, lights. Place a pencil line on the rear of the contact barrel to show a reference position. Gradually screw in the stationary contact until further movement is restricted. Estimate the angular rotation of the stationary from the reference point to the stop point. Since the contact barrel has 32 threads per inch, each complete rotation corresponds to 0.030 inches. Thus a standard wipe contact of

0.004-0.009 inches corresponds to 4/30*360 to 9/30*360 degrees or 48-108 degrees of rotation of the stationary contact under consideration.

If the wipe is not within limits the contact must be re-adjusted. Loosen the locking screw on the stationary contact block support further so that the stationary contact can be easily removed. Unscrew the stationary contact cap and remove the contents of the barrel in order. Observe the spiral contact assembly. All convolutions should be reasonably parallel. Pick up the spiral assembly by holding the outer convolution with your thumb and forefinger. Grasp the innermost convolution next to the actual silver conical contact with a pair of tweezers, either straight or offset, and extend the inner spiral while holding the outer edge in a direction to either increase or decrease the total height of the spiral assembly. Re-assemble the stationary contact in the following manner: Hold the contact cap upside down and place the spiral contact in the cap so that the contact tip protrudes through the cap. Then place the spacing ring, diaphragm and ball in the cap. Place the ball in the cap and screw the barrel into the cap. Place the contact assembly into the support block so that the split in the retaining band (10F) lines up with the split in the contact support block. Tighten the locking screw so that the contact barrel is firm in the support block but so the barrel can still be threaded. Repeat the measuring procedure and determine the wipe. This procedure may have to be repeated until the proper wipe is obtained.

The contact gap should now be set. Before actually setting the contact gap the moving contact assembly should be positioned so that the contact arm is pointing straight out. On relays with only normally open contacts, loosen the locking nut (10G) which holds the back stop screw in position. Turn the back stop screw until the moving contact arm is pointing straight out. Lock the back stop screw in this position. On relays with both normally open and normally closed contacts the normally closed contact serves the same function as the back stop screw.

Screw the stationary contact in until the indicating lamp is lit. Back off the stationary contact until the proper gap is obtained remembering that each stationary contact revolution is 0.030 inches. Thus if a contact gap of 0.020 inches is required 2/3 of a revolution will be required. Lastly tighten the locking screw slowly until it is not possible to turn the locking screw by hand. If the locking screw is tightened too much, the contact barrel will collapse and the ball will not be able to roll freely in the barrel.

There have been some instances where the stationary contact was hitting on the lower edge of the moving contact. To correct this situation it is necessary to remove the jewel screw from the relay and place a washer (10L) on the jewel screw. Replacement of the jewel screw will now in effect lower the moving contact to a point where the stationary contact is hitting the moving contact closer to the center.

Low Gradient Contacts (Refer to Fig. 9)

Low gradient contacts are those which require very little force to move the stationary and moving contact brushes. They are used in applications where large internal torques can produce a vibration which can cause contact infidelity in ball-type contacts.

To check these contacts the following procedure should be used. In the vertical position the moving brush of both the stationary and moving contacts should be resting against their respective stops. For a relay with the stationary contact on the left side of the relay lay the relay on its left side. In this position the stationary contact movable brush should just move away from stop due to its own weight. Lay the relay on its right side . In this position the moving contact movable brush should also just move away from its stop due to its own weight.

If this slight movement away from its stop does not occur, an adjustment will be necessary. Grasp the contact brush that does not conform with a pair of tweezers. Bend the moving contact so it just rests against its stop. With the relay on the proper side so a slight movement can be observed check for the slight movement away from the stop. If the movement is not present it will be necessary to reduce the initial tension on the contact brush. Again grasp the contact brush with a pair of tweezers. Holding the brush firmly between the tweezer arms, run the tweezers along the brush while exerting a force at right angles to the brush in a direction away from the stop. Continue to check the two criteria-with the relay in a vertical position the contact brush must remain against the stop while with relay on its side the moving brush must move away from its stop a slight amount.

Cup & Shaft End Play (Refer to Fig. 10)

The cup and shaft assembly is pivoted between the lower jewel screw and the upper pivot. Since the lower jewel screw is in a fixed position the only way to adjust the end play is by movement of the upper pivot (J). Loosen the set screw (H) which locks the upper pivot in place. Raise and/or lower the upper pivot and tighten the upper pivot set screw so that there is 0.015 inches of end play when the moving contact assembly is lifted vertically.

Clutch Adjustment (Refer to Fig. 11)

The clutch on the 8 pole cup relay consists of a piece of felt (A) wrapped around the cup shaft (B). Surrounding this piece of felt is a brass split cylinder (C). The cylinder is held around the felt and shaft by a spring (D) loaded pin (E) that can be variably loaded by a screw (F) that projects through the moving contact carrier on the right side of the unit.

To check and/or adjust the clutch slippage value the following procedure should be followed. Apply an input to the relay at a value below that which should cause the clutch to slip. Gradually increase the input value until the shaft starts to slip relative to the moving contact. This can be observed by watching the "hairpin" (10K) at the top of the shaft which prevents the moving contact carrier from moving any higher. When the hairpin starts to move this is the indication of clutch slippage. To change the value at which the clutch starts to slip, loosen the locknut (G) which holds the clutch adjusting screw in place. Turn the screw in to increase the clutch slippage value or out to reduce the clutch slippage value. When the desired clutch slippage value is obtained tighten the clutch adjusting screw locking nut.

There are certain relays which require that the clutch be tightened to maximum. When screwing in the clutch adjusting screw be sure not to force the screw beyond the point where the internal spring is fully compressed because of possible breakage of the moving contact molded part.

Core Adjustment (Refer to Fig. 10)

The core on 8 pole induction cup relays is used to complete the magnetic circuit from the outer stator through the cup into the inner stator (core) then through the cup and back to the outer stator. On relays with more than one input quantity, the core is also used to eliminate the effect of any dissymmetry in the air gaps. This is done by having a flat, notch or notches around the periphery of the core which can then be rotated to place the core in its most advantageous position.

When adjusting the core it is necessary to have two open ended wrenches. A 13/16 inch wrench to loosen the core locking nut (N) and a 7/16 inch wrench to fit over the jewel screw (M) which, when turned, will rotate the core. With the desired inputs applied to the relay, loosen the core locking nut enough to allow rotation of the core by means of the wrench which fits over the hex head of the jewel screw. Incrementally rotate the core until the desired action is obtained. At this point, with the jewel screw held in position by its wrench, tighten the core locking nut with the other wrench.

Pickup Setting (Control Spring) (Refer to Fig. 12)

The induction cup relay usually has a 4:1 pickup range. This is accomplished by changing the windup of the control spring located near the top of the shaft. To set the pickup of the relay at a particular value first apply the desired input. Loosen the hex nut (A) located at the rear of the yoke (C) which supports the control spring adjusting ring (B). Now rotate the ring, in its groove, to which one end of the control spring is soldered. Rotation of the ring towards the stationary contact will reduce the pickup while rotating away from the contact will increase the pickup. With the control spring rotated to a position which gives the desired pickup, now tighten the hex nut at the rear of the yoke making sure that the control spring adjusting ring is as far into the groove as possible. Relays manufactured prior to 1972 have a molded phenolic yoke which will break if the spring adjusting ring is not back into the groove as far as possible. Newer relays have a injection molded yoke which is more forgiving if the ring is not back as far as possible.

Holding Coils (Fig. 10)

Holding coils are present on some 8 pole relays. The holding coil assembly consists of a coil (P) with a split pole piece (R) extending from the top and bottom of the coil with an air gap between the two portions. Mounted on the moving contact support arm (S) at the rear of the unit and in line with the holding coil pole piece is an armature which essentially straddles the pole piece The gap between the pole piece and armature with the contacts just picked up should be 0.055 inches.

To obtain this gap, loosen the screw (T) (or Hex nut) at the top of the holding coil and slide the coil and turn the pole pieces as required. The armature and holding coil pole pieces should be parallel when the final adjustment is reached. Now tighten the holding coil screw (nut).

4 POLE DISTANCE TYPE RELAYS

Stationary Contacts (Refer to Fig. 13)

The stationary contacts are very similar in construction to those used on induction disc relays. The adjusting screw (A) which controls the position of the stationary contact brush should be moved in such a direction as to provide a 0.003-0.005 inch allowable deflection when the moving contact forces the stationary contact (B) to its stop.

Cup & Shaft End Play (Refer to Fig. 13)

The cup and shaft end play should be 0.010-0.015 inches. If this is not present loosen the locking nut (D) at the bottom of the upper pivot (C) located at the top of the unit. Now screw the upper pivot up or down until the end play is within limits. Tighten the locking nut in this position.

Contact Gap (Refer to Fig. 13)

To set the contact gap on relays with only normally open contacts loosen the hex head screw (E) which holds the moving contact back stop (F). Move the back stop in such a direction as to meet the required contact gap. Tighten the back stop locking screw in this position.

On relays which have normally closed contacts as well as normally open contacts there is no contact back stop. In this case loosen the screw (H) which holds the normally closed stationary contacts in place and slide the normally closed stationary contact assembly in a direction to set up the proper gap. When this position is obtained tighten down the screw which maintains the stationary contacts in position.

Control Spring Setting (Refer to Fig. 13)

On relays with only normally open contacts, the control spring should be adjusted to just hold the moving contact (G) against the back stop. Place a screw driver blade in one of the slots of the spring adjusting ring and rotate the spring adjusting ring in a direction to just bring the moving contact against the back stop.

On relays with normally closed contacts such as carrier start relays there is a specified pickup which is set by the control spring. Set the desired input parameters on the relay and adjust the control spring by means of the screw driver blade in the control spring adjusting ring slot (J) and rotate the adjusting ring until the desired pickup is obtained.

Clutch Adjustment (Refer to Fig. 13)

The clutch on distance relays depends on the friction between the moving contact arm (N) and a spring loaded molded pressure plate (M).

To adjust the clutch slippage value the following procedure should be followed. Apply an input to the relay at a value below that which should cause the clutch to slip. Gradually increase the input value until the shaft starts to slip relative to the moving contact. This can be observed by watching the cup (P) start to move in a relatively constant manner. To change the value at which the clutch starts to slip place the special open end clutch wrench around the molded part (K) just above the "damper" and a 3/8 inch wrench around the top nut (L) which has a nylon insert. While holding the clutch wrench in place rotate the upper nut in a clockwise direction to increase the clutch slippage level or a counter-clockwise direction to reduce the clutch slippage value. When the desired clutch slippage level is obtained simply remove the wrenches. The nylon insert in the upper nut will maintain the desired position.

Core Adjustment (Refer to Fig. 13)

The core on the 4 pole distance relays has the same function as in the 8 pole relays, i.e. completing the magnetic circuit and adjusting for variations in the air gap.

However, the core on the distance type relays has a spring loaded wave washer that holds the core in place without any locking nut. By the use of a special core wrench against the large nut (R) on the bottom of the unit, the core may be rotated 360 degrees in any direction without having to re-tighten any parts after the final position of the core has been determined. With the desired inputs applied to the relay rotate the core incrementally to obtain the desired action and leave the core in that position.

PLUNGER RELAYS

Moving Contacts (Refer to Fig. 14)

The moving contacts have contact buttons (A) on the top and bottom surfaces of the moving contact carrier and do not require any adjustments. The moving contacts are connected to the internal wiring of the relay by means of a piece of flexible braided wire (B). The flexible leads of the moving contact should be formed so that they do not tend to restrain the motion of the assembly or cause it to bear against the molded parts.

Stationary Contacts (Refer to Fig. 14)

The stationary contact assembly consists of two or three parts fastened to the relay base. These are the stationary contact brush and tip assembly (C), the contact rest arm (D) and the back stop (E) (used on normally open contacts only).

The force with which the brush and tip assembly bears against the contact rest arm is called the "initial tension". This is the amount of force that would have to be exerted against the stationary contact brush, at the contact tip, to just cause the stationary contact to move away from the contact rest arm. On relays with only one normally open or one normally closed contact, the initial tension at that one contact should be 15 grams as measured with a gram gauge at the contact tip. On relays with two or more contacts of the same variety, the initial tension of those contacts should be 5 grams. To adjust the initial tension of the stationary contact brush, it is only necessary to bend the moving contact brush at a point near where the contact brush is attached to the base.

The back stop (only used on normally open contacts of PJC relays) should be bent so that with the plunger in the fully picked up position the stationary contact arm just engages the back stop with a deflection of no more than 5 mills.

In general the motion of the moving assembly has a travel distance of at least 9/64 inches. If a contact arrangement of one normally open and one normally closed contact (code 11) is used, the normally closed contact should have a "wipe" or distance the stationary contact is deflected by the moving contact of approximately 1/32 inch. The normally open contact should have a gap of approximately 3/32 inch. As the plunger moves up until the normally closed contact arm rests against its rest arm, the normally open contact gap will be approximately 1/16 inch. As the plunger continues to move up, it will cause the normally open contact to make and wipe approximately 3/64 inch, and about this point the plunger rod completes its travel and rests solidly against the pole piece with the normally open stationary contact against the back stop.

Pickup Adjustment (Refer to Fig. 14)

The pickup is determined by the setting of the armature on the plunger rod. There are normally four lines scribed on the calibration tube. These marks correspond to calibration values listed on the nameplate. In the de-energized mode the pickup point corresponds to the relationship of the bottom of the armature to the calibration lines marked on the calibration tube. Turning the armature on the threaded plunger rod in an upwards direction will lower the pickup while turning the armature in a downwards direction will increase the pickup. The armature is supplied with an internal locking spring which maintains the armature in the given position.

Contact Conversion (Refer to Fig. 14)

It is possible to change normally open contacts to normally closed contacts and visa-versa. However, when changing from normally closed to normally open it will be necessary to order the contact back stop, part V-6242343. This is necessary since the back stop is not used on normally closed contacts.

To change the contacts from one version to another it is only necessary to remove the screw (F) and lock washer (G) from the existing set of stationary contacts, remove the contact brush and rest arm, invert the contact brush and rest arm and fasten the group of parts to the base at the new location with the screw and lock washer. Remember that if the new contact is a normally open PJC contact that a backstop must be added.

After the parts have been relocated to the new position it will be necessary to align the contact so that both contacts, if they are the same, will make at approximately the same time. The initial tension must also be adjusted to the correct value for the new contact arrangement. If the new contact is a normally open PJC contact the backstop must be adjusted so that the stationary contact just touches it at the end of the contact travel.

HINGED ARMATURE RELAYS

Stationary Contacts (Refer to figs. 15, 16. & 17)

The stationary contacts are generally firmly affixed to the base by either screws or rivets and should need no adjustment. On HGA14 type relays, the stationary contacts are adjustable in order to obtain a short contact gap. On these relays the contact gap can be changed by loosening the locknut (15A) on the stationary contact, screwing the contact (15B) to the new desired position and then tightening the locknut.

Contact gap is usually controlled by the normally closed stationary contacts and no adjustment is possible. However, on the HFA relay with only normally open contacts there is a stop screw which restricts the motion of the armature in the contact resetting direction. To obtain the proper gap of approximately 7/32 inch, loosen the stop screw locknut (16A) and turn the stop screw (16B) to obtain the proper gap and then tighten the locknut.

Moving Contacts (Refer to figs. 15, 16, &17)

The moving contact assemblies have contact buttons on both the front and back side of the moving contact arms. This is to provide for both normally open and normally closed contacts. The contact arms (C) are positioned into the molded contact support (D) by means of notches in the contact arms and corresponding projections in the contact support as well as compression springs (E) that provide for contact pressure and wipe.

The moving contacts should be bent to provide almost simultaneous closure of all contacts. This can best be accomplished by means of a contact bending tool. Placing the slotted end of the tool over the moving contact arm and applying pressure to bend the contact arm in the proper direction will accomplish this. Moving contact adjustment will also provide for the contact wipe on normally open contacts. There must always be at least 1/16 inch contact wipe on all normally open contacts. Normally closed contact wipe is determined by the number of closed contacts and the strength of the control spring.

Pickup Adjustment (Refer to figs. 15, 16, & 17)

Pickup adjustment is controlled by the strength of the tension spring (F) attached to the relay armature. The tension of this spring is adjusted in various manners depending on the relay type.

On HFA relays the control spring can be adjusted by turning the control spring adjusting screw (16G) in or out. Be sure that the nut (16H) through which the adjusting screw is threaded lies in the hexagonal depression in the armature. This arrangement will allow a relatively fine adjustment of pickup.

On HGA relays the control spring can be adjusted by means of moving one end of the spring into one of four notches in the tang (15G) at the end of the relay armature. This arrangement will allow a relatively coarse adjustment of pickup.
On HMA relays the control spring can be adjusted by bending the tab (17G) into which one end of the control is placed. This arrangement will allow a relatively small range of adjustment.

Contact Conversion (Refer to Fig. 16)

The only hinged armature relay that can have normally open contacts converted to normally closed contacts and visa-versa is the HFA relay. This is an easy process for relays with standard contacts. Standard contacts are those with no long wipe or heavy contact springs such as in HFA53 relays. Contact conversion on these relays will require the ordering of special contact springs.

Remove the screw (16J) that holds the stationary contact (16K) in place. Reverse the stationary contact and screw the contact back into its original location.

The following is the procedure to be followed after converting one or more HFA relay contacts:

Normally open contacts

The moving contact arms must be adjusted so that the normally open contacts make approximately simultaneously (+/- 0.008) when the relay is operated by hand. All normally open contacts must have a wipe of 3/64 to 3/32 inches. The contact gap must be approximately 7/32 inches. This can be adjusted in the following manner

1. Insert a 0.058 inch gage between the armature and pole face and close the armature.

2. Bend the left hand moving contact to just light the continuity lamp.

3. Remove the 0.058 gage and bend the remaining moving contacts so that all moving contacts make at the same time.

4. To check performance, turn the stop screw in until one contact continuity lamp is lit. Turn the stop screw in an additional 1/2 turn and all continuity lamps should be lit. Back off the stop screw to obtain at least 1/4 inch contact gap.

5. Insert a 7/32 inch gage between any of the normally open moving contacts and turn the stop screw clockwise until the continuity lamp lights. Lock the stop screw in this position with the locking nut.

Normally closed contacts

The moving contacts must be adjusted so that the normally closed contacts make approximately simultaneously (+/- 0.008) when the relay is operated by hand. The wipe and gap are automatically set by the formation of the stationary contacts and the strength of the control spring. Adjustments can be made as follows:

1. Turn the stop screw clockwise until the first normally closed contact opens.

2. Turn the stop screw an additional 1/2 turn clockwise. All normally closed contacts should be open.

3. Turn the stop screw counterclockwise until there is approximately 1/8 inch gap between the stop screw and armature. Lock the stop screw in this position.

Re-check pickup after the above changes or adjustments.

TELEPHONE TYPE RELAYS

Contact Adjustments (Refer to Fig. 18)

The contacts of telephone type relays consist of two or more flat spring arms (A) on the end of which are welded palladium-silver contact tips (B). These contact arms are mounted on the relay frame and insulated from one another. The moving contact arms have insulated spacers mounted on them which in turn are operated by an insulated spacer (C) mounted on the operating arm. Movement of the armature causes the operating arm to move, which in turn pushes the moving contact against the stationary contact.

With the relay de-energized there should be a contact gap of 0.010-0.015 inches. Since there is a ratio of 2:1 between movement of the armature and movement of the moving contacts, this gap can be determined by the use of a feeler gage. Place a 0.008 inch gage between the residual screw and pole piece and close the armature by hand. The contact should not close. Place a 0.005 inch gage between the residual screw and pole piece and again close the armature by hand. The contact should be closed in this position. The gap can be adjusted by bending the stationary contact spring with a telephone relay adjusting tool.

The wipe on the normally open contact should be approximately 0.005 inches. This can be checked by using a 0.003 inch shim in the armature gap and closing the armature by hand. The contact should close before the residual screw touches the shim. The wipe on the normally closed contact can be observed by deflecting the stationary contact towards the frame. The wipe should be approximately 0.005 inches.

Pickup Adjustments (Refer to Fig. 18)

The pickup of the telephone relay is affected by two parameters. One of these parameters is the tension on the moving contact arms. Since the operating arm insulator rests against the moving contact arm the tension or spring constant of the arm directly affects the amount of force required to move the arms. Reduction of this tension will reduce the pickup value.

The tension of the moving contact arm can be reduced by "stroking" the contact arm. This is done by applying the telephone relay adjusting tool to the contact arm and pulling in both an outward and upward direction at the same time from the back of the arm to the front of the arm. If the upward direction is changed to a downward direction the tension will be increased.

The second parameter that affects pickup is the armature gap. Reducing the armature gap will reduce pickup while increasing the gap will increase pickup. The armature gap can be changed by placing an adjusting tool on the armature operating arm, closing the armature by hand and then bending the operating arm with the tool while maintaining the armature closed.

Naturally after either of the above methods of changing pickup, the contact gap and wipe must be checked and adjusted.

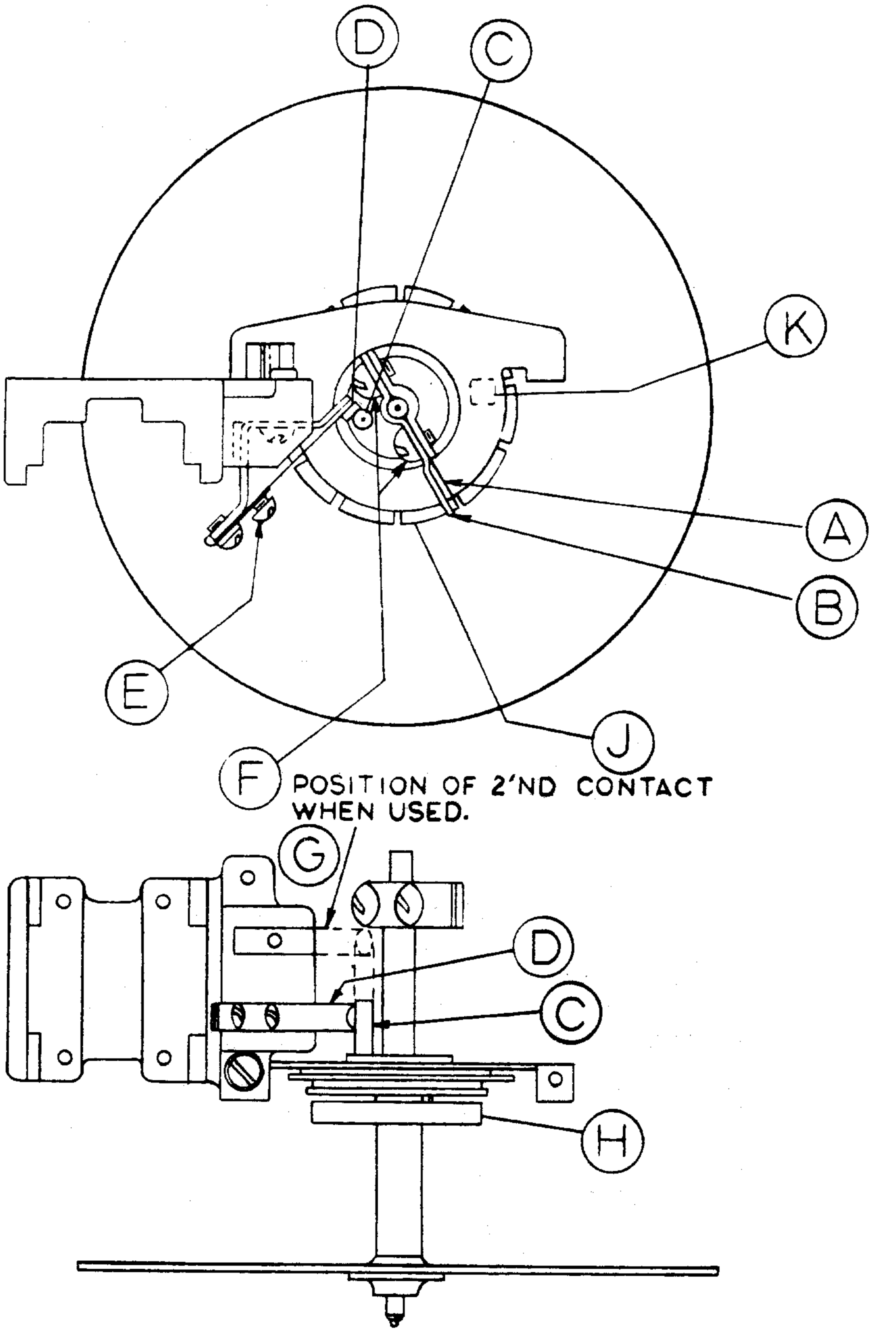
Time Delay Adjustments (Refer to Fig. 18)

The standard telephone relay has no intentional time delay, either on pickup or dropout. Whatever time delay is present can be changed by means of the residual screw in the armature. Turning in the residual screw which increases the final armature gap will reduce the dropout time while turning out the residual screw will increase the dropout time. The minimum air gap must be 0.002 inches between the armature and pole piece.

To change the gap loosen the locknut holding the residual screw in place and adjust the residual screw to the desired position. When the desired dropout time is obtained tighten the residual screw locknut. Again since any adjustment of the residual screw will affect armature travel, the contact gap and wipe will have to be re-checked and adjusted if necessary. The contact pressure should never be less than 10 grams when measured at the contact tips.

Relatively large time delays are possible by having a copper slug as part of the coil. The copper slug will delay the build up and decay of the flux and thus cause a delay in relay operation. An armature end slug will cause a delay on both pickup and dropout while a heel end slug will mainly cause a delay on dropout. Relatively large time delay dropouts in the order of 0.25 seconds or more have no residual screw but have a fixed non-adjustable residual plate. Time delay adjustment on dropout is adjustable by changing the tension on the contact brushes.

Time delay adjustment on pickup for all types of telephone relays is mainly adjusted by changing the tension on the contact brushes or changing the size of the armature air gap.



A	PHOSPHOR BRONZE LEAF SPRING	F	CLAMPING SCREW
B	STOP ARM	G	UPPER STATIONARY CONTACT
C	MOVING CONTACT	H	CONTROL SPRING
D	STATIONARY CONTACT	J	CONTROL SPRING ADJUSTING RING
E	STATIONARY CONTACT ADJUSTING SCREW	K	TIME DIAL STOP

Figure 1 (0286A2011 Sh.1) Induction Disk Relay Sub-Assembly

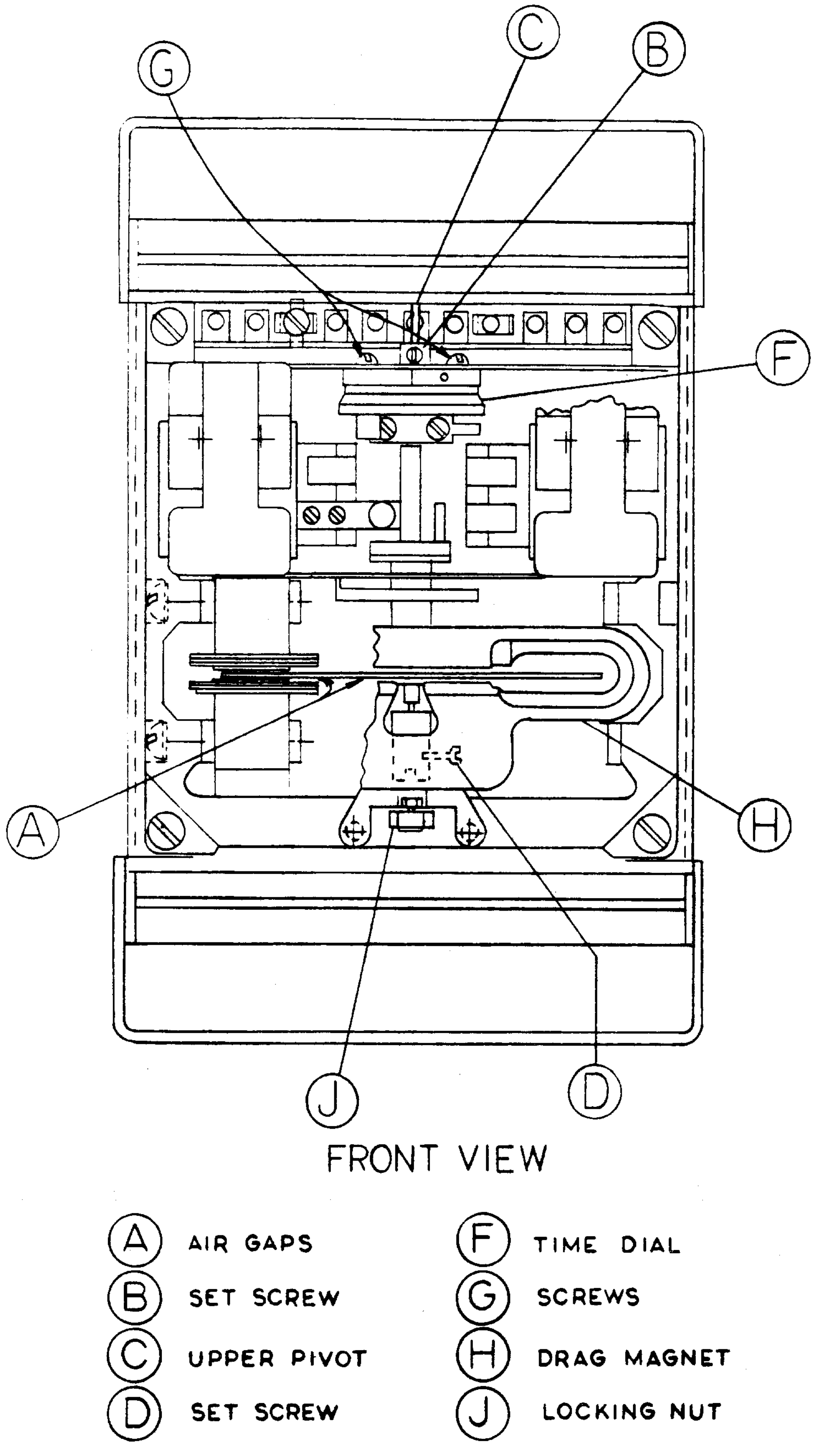
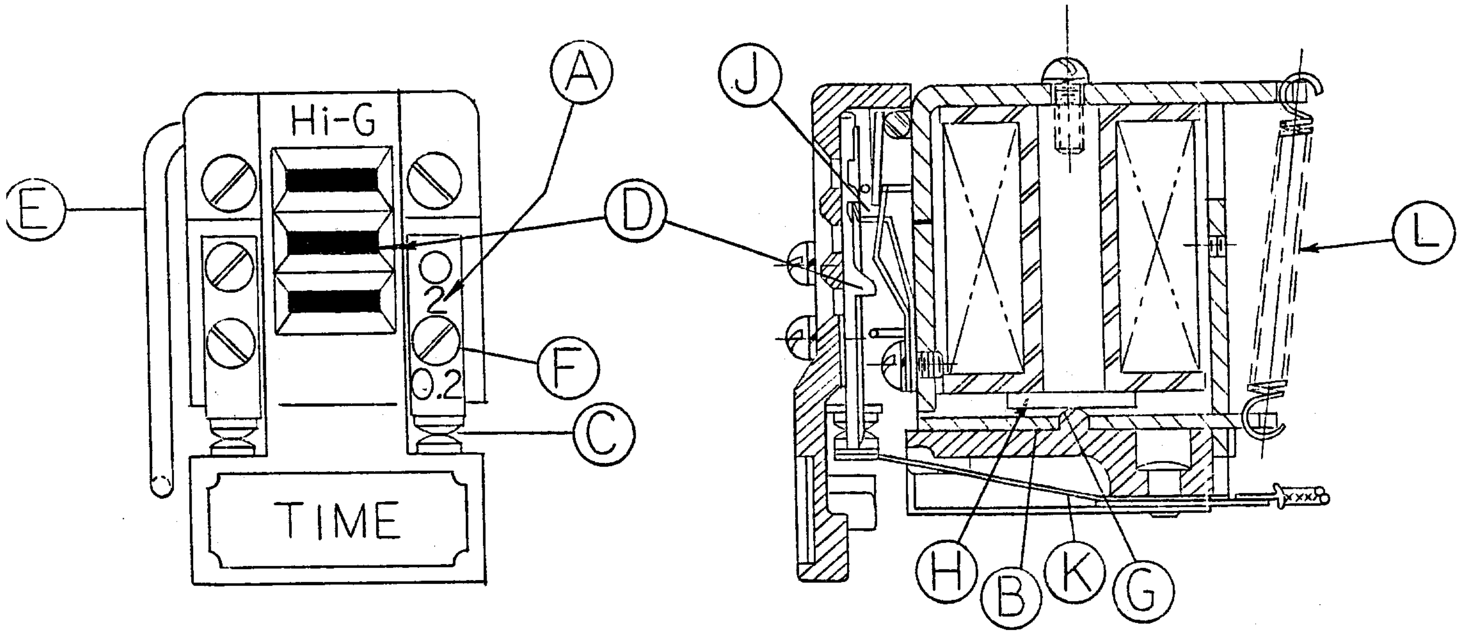


Figure 2 (0286A2011 Sh.2) Induction Disk Relay Complete Assembly



(A) TAPPED COIL

(B) ARMATURE

(C) CONTACTS

(D) ORANGE STRIPED FLAG

(E) RESET LEVER

(F) STATIONARY CONTACT RETAINING SCREW

(G) MOLDED PROJECTION

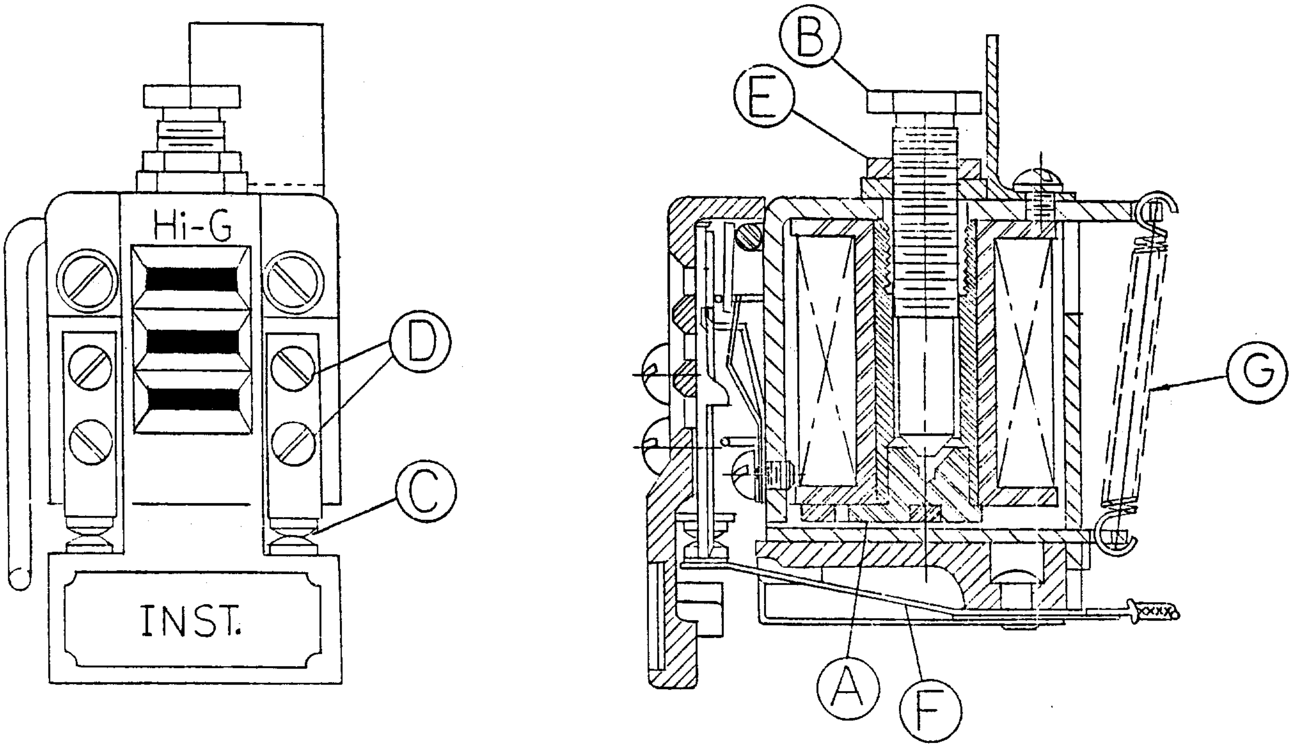
(H) UNIT POLE PIECE

(J) LATCH

(K) CONTACT BRUSH

(L) TENSION SPRING

Figure 3 (0286A2011 Sh.3) Seal-In Unit (HI-SEISMIC)



A SHADING RING

B THREADED CORE

C CONTACTS

D SCREWS

E HEX NUT

F CONTACT BRUSH

G TENSION SPRING

Figure 4 (0286A2011 Sh.4) Instantaneous Unit (HI-SEISMIC)

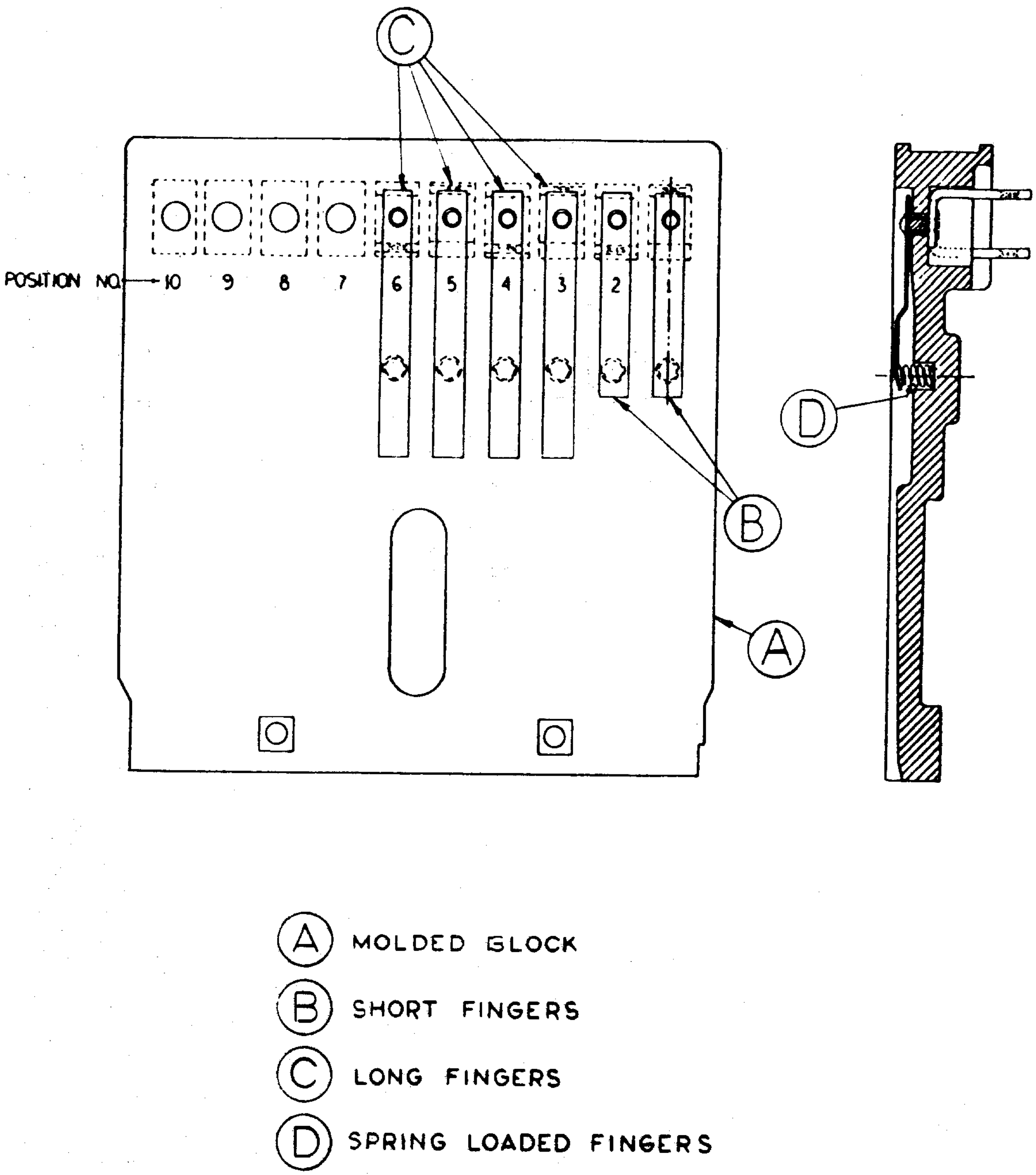
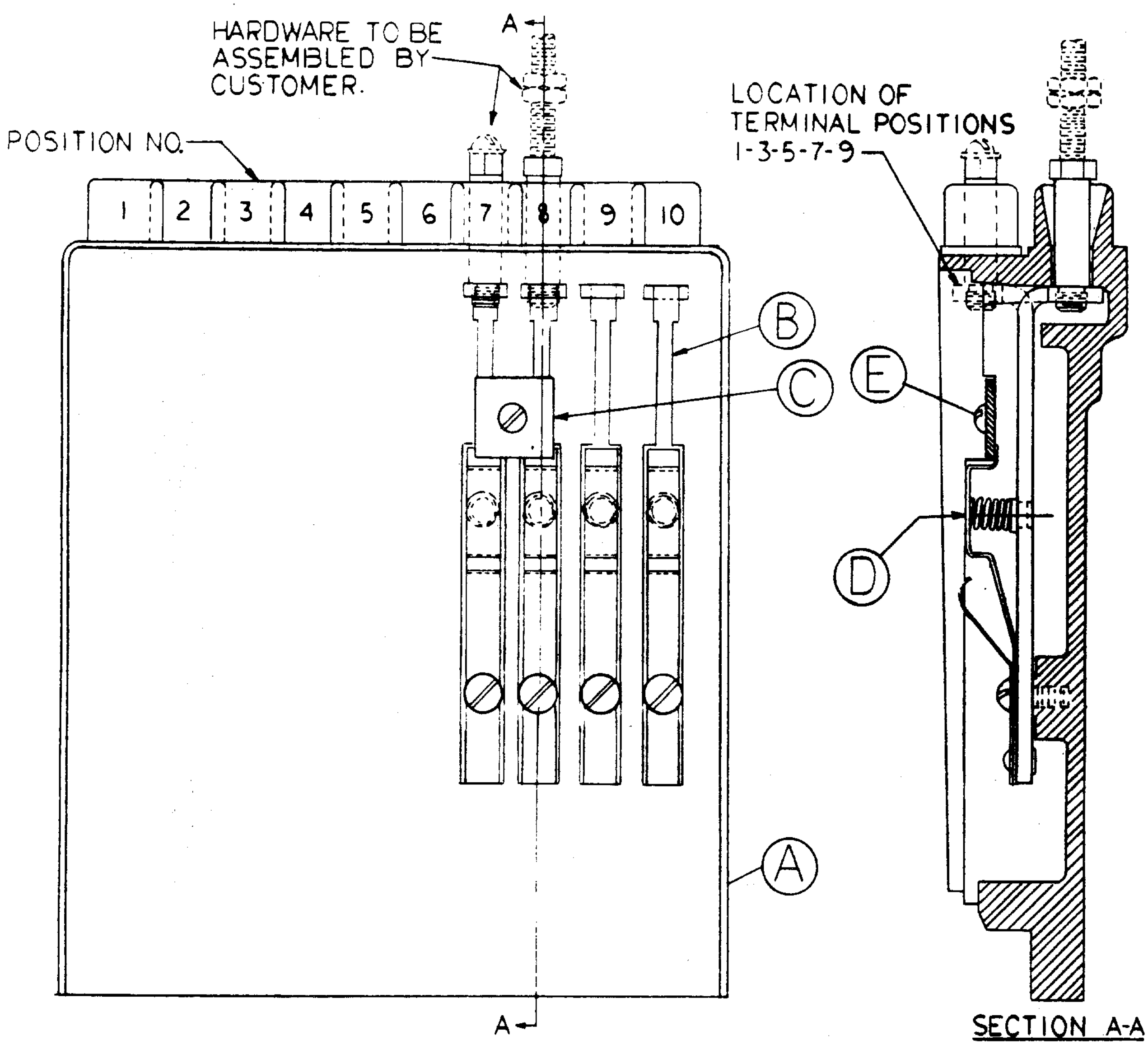


Figure 5 (0286A2011 Sh.5) Contact Block



(A) MOLDED BLOCK

(B) LONG FINGER ASSEMBLIES

(C) SHORTING BAR

(D) MAIN BRUSH

(E) SHORTING BAR SCREW

Figure 6 (0286A2011 Sh.6) Terminal Block

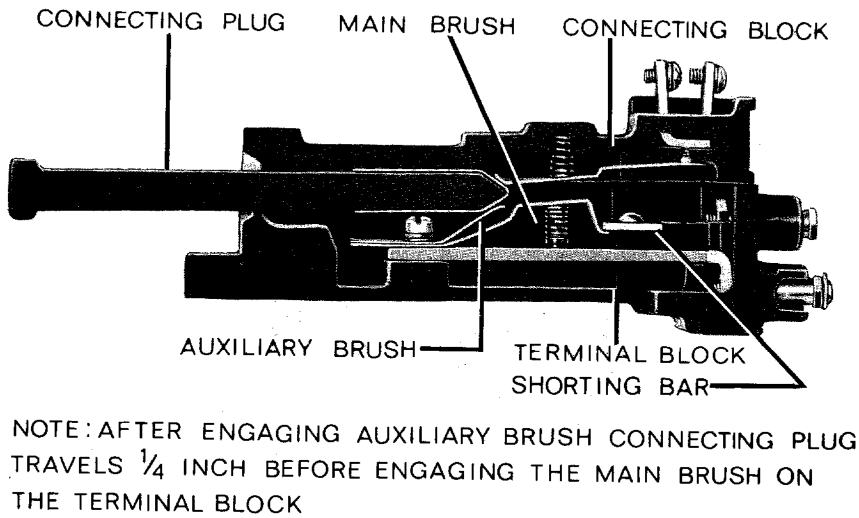


Figure 7 (8025039) Cutaway of Drawout Case Showing Position of Auxiliary Brush and Shorting Bar.

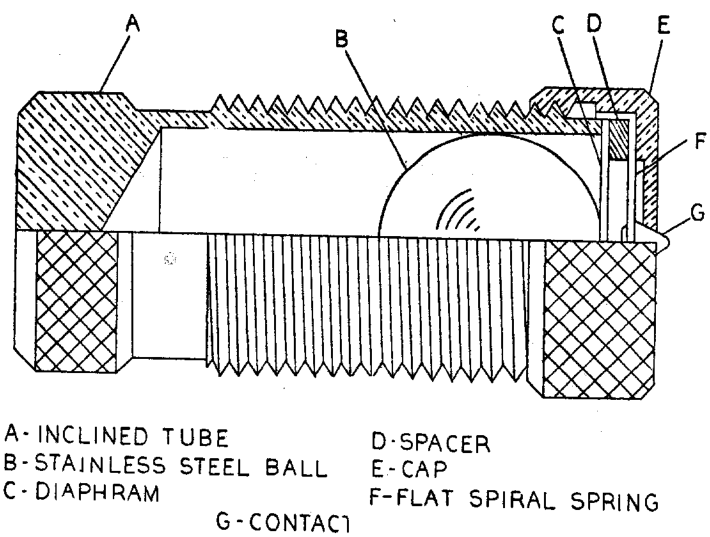
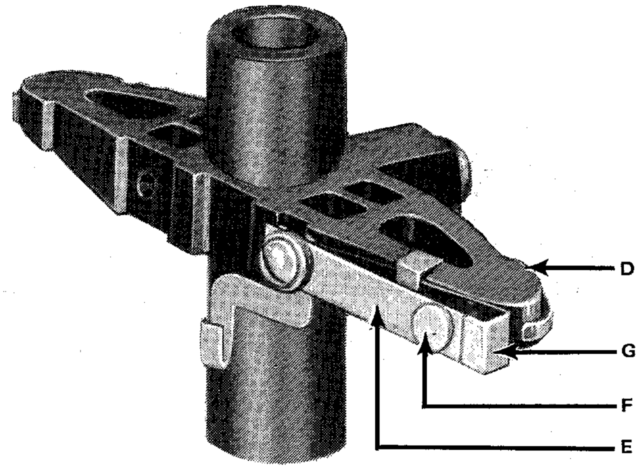
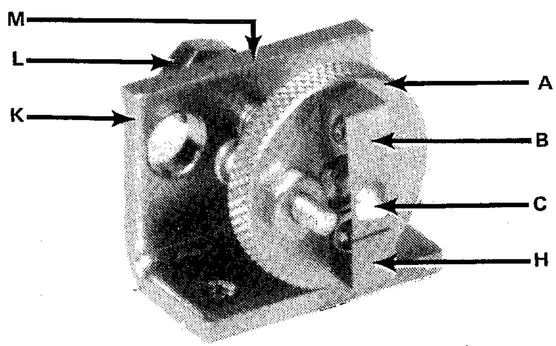


Figure 8 (K-6077069-4) Stationary-Contact Assembly



D - Moving Contact Arm
E - Moving Contact Brush
F - Button Contact Tip
G - Moving Contact Brush Retainer



A - Contact Dial
B - Stationary Contact Brush
C - Conical Contact Tip
H - Brush Retainer
K - Stationary Contact Support
L - Mounting Screw
M - Locknuts

Figure 9 (8023399 and 8027689) Low Gradient Contact Assembly for the Directional Unit

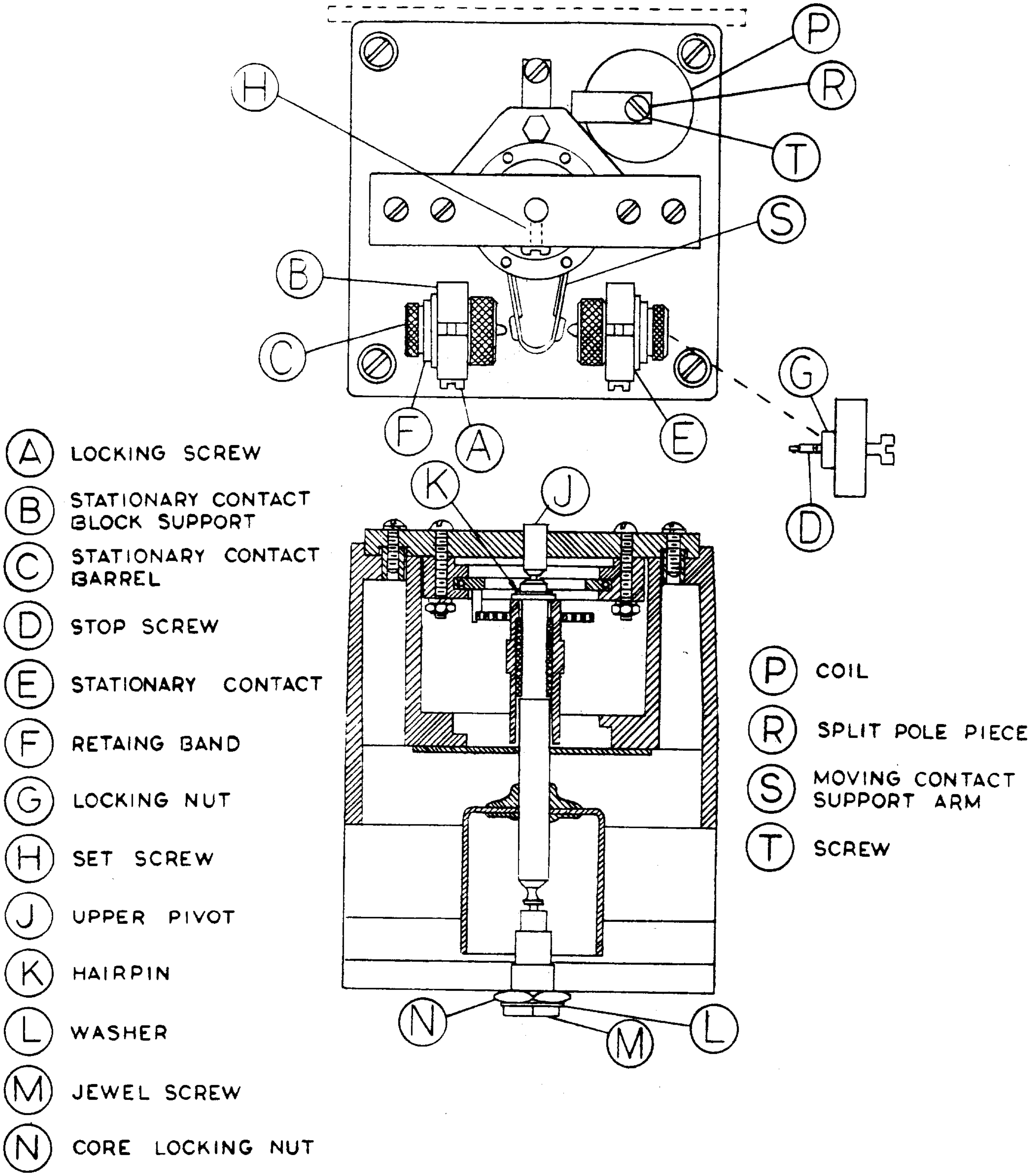
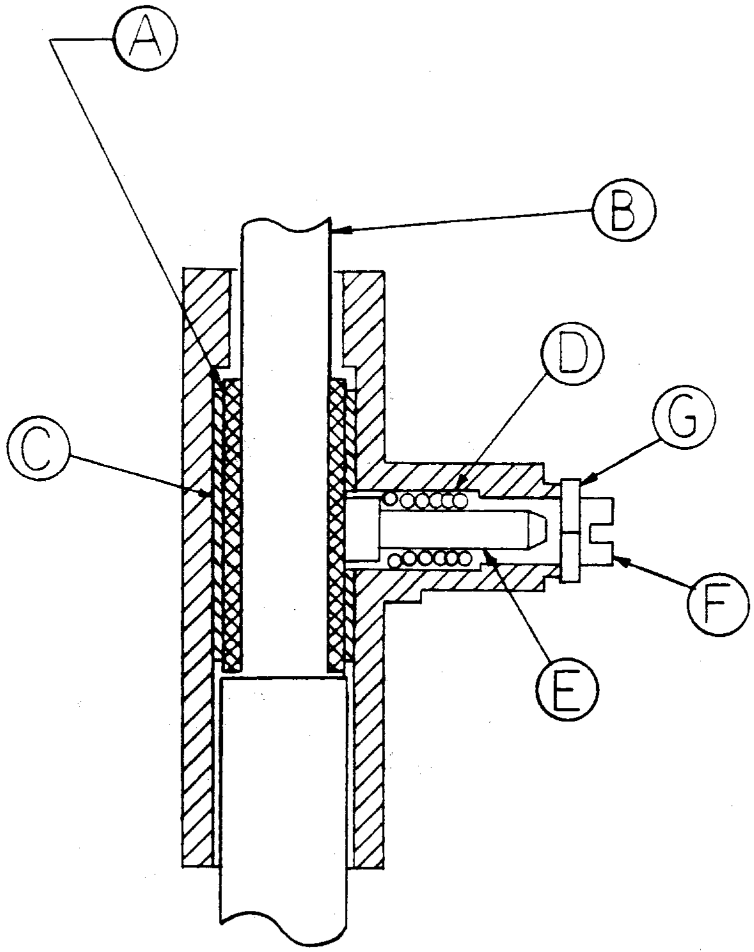


Figure 10 (0286A2011 Sh.7) Cup Relay



(A) FELT

(B) CUP SHAFT

(C) BRASS SPLIT CYLINDER

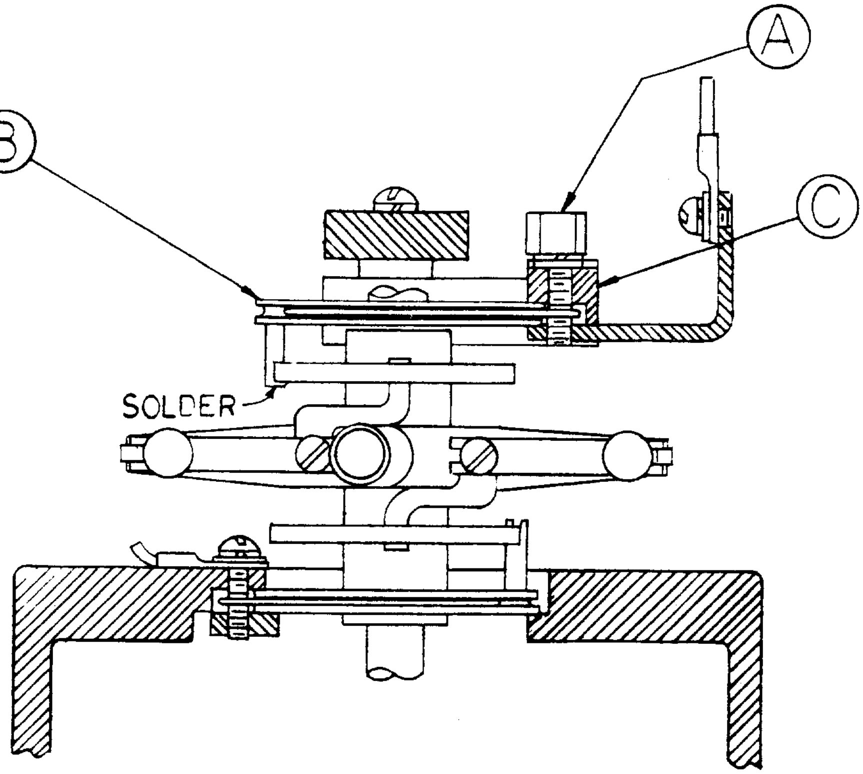
(D) SPRING

(E) LOADED PIN

(F) SCREW

(G) LOCKNUT

Figure 11 (0286A2011 Sh. 8) Moving Contact Assembly



(A) HEX NUT

(B) CONTROL SPRING ADJUSTING RING

(C) YOKE

Figure 12 (0286A2011 Sh. 9) Spiral Assembly

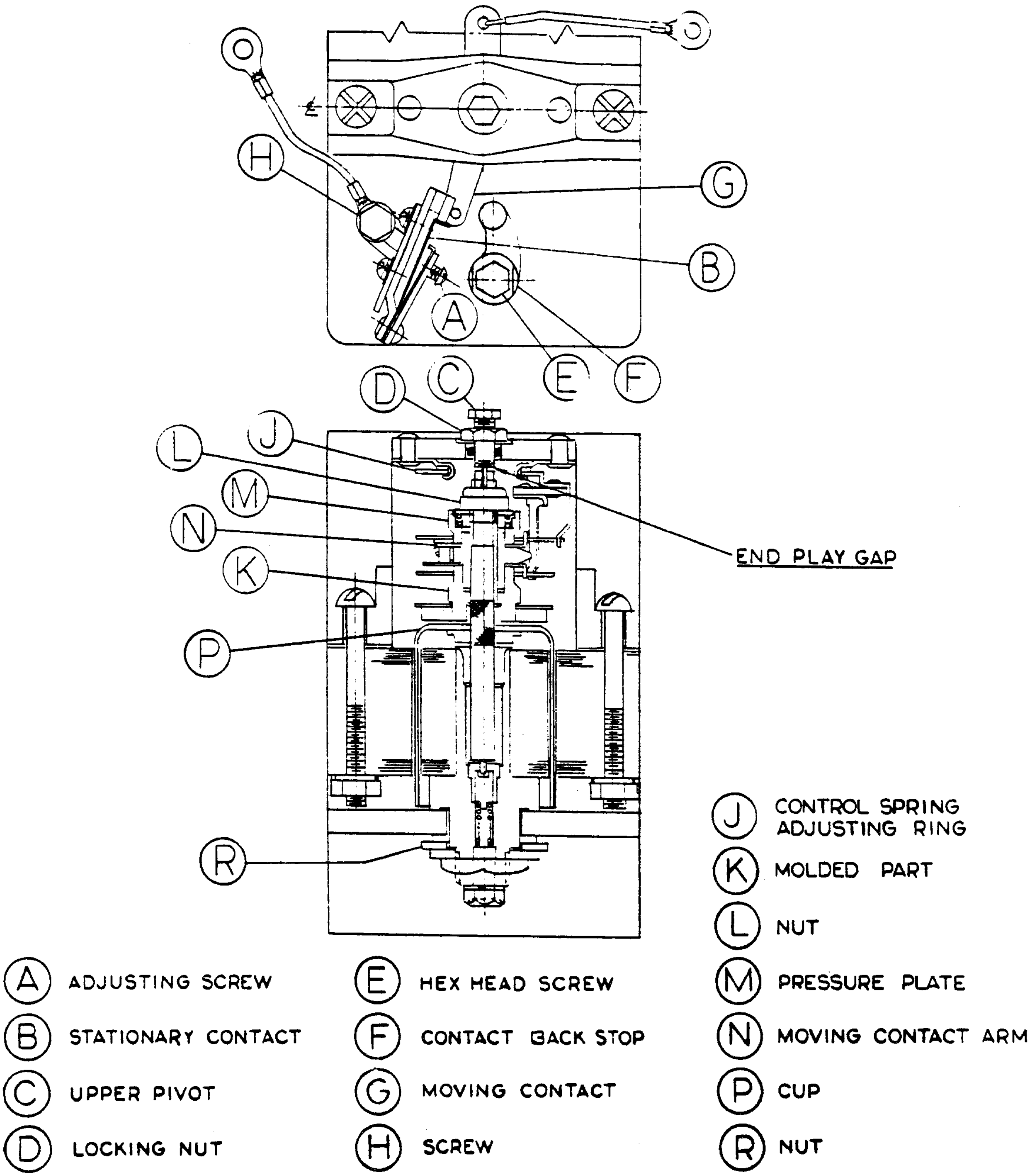


Figure 13 (0286A2011 Sh. 10) Mho, Ohm, and Starting Units Assembly

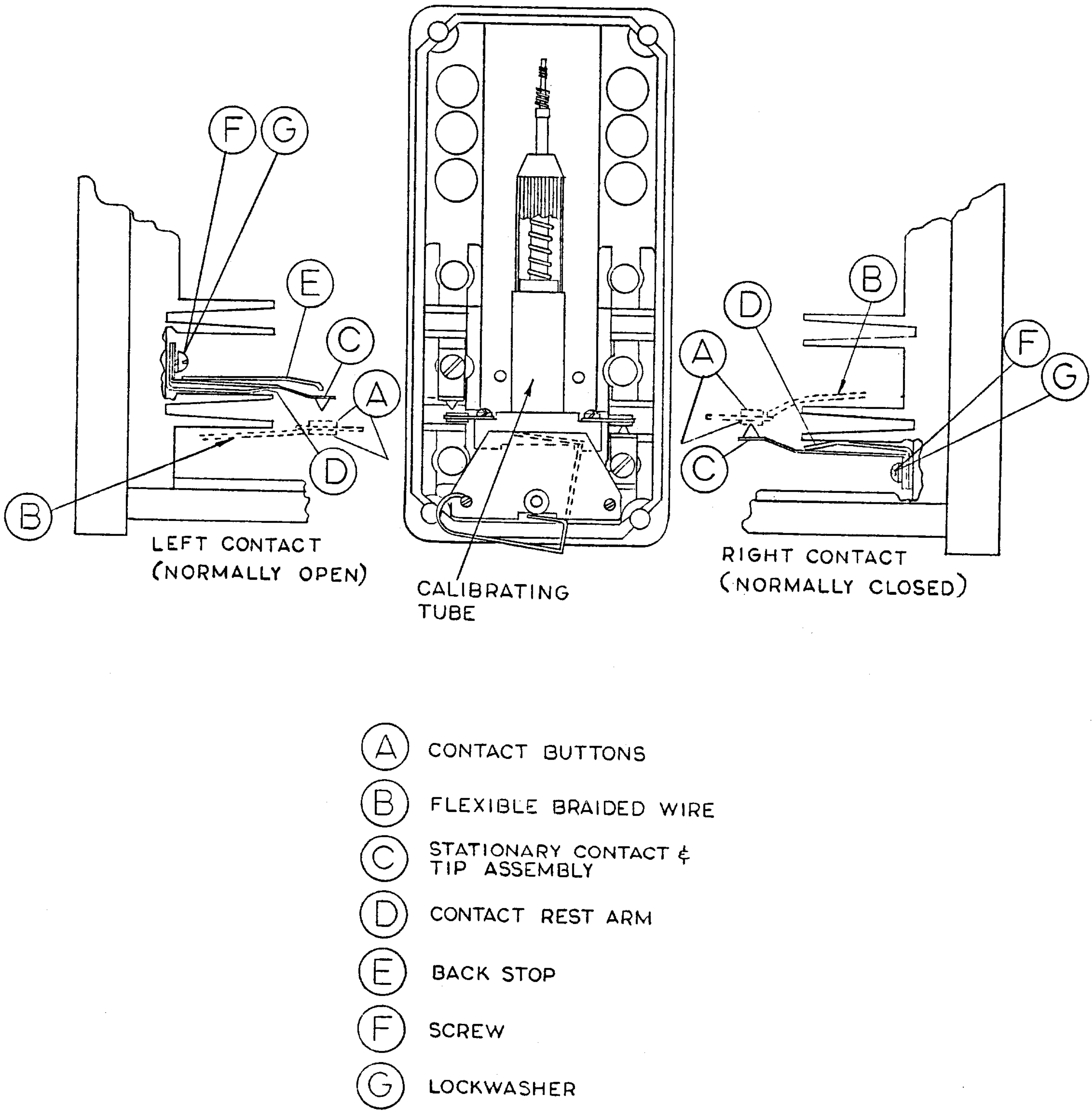


Figure 14 (0286A2011 Sh. 11) PJC/PJV Relay

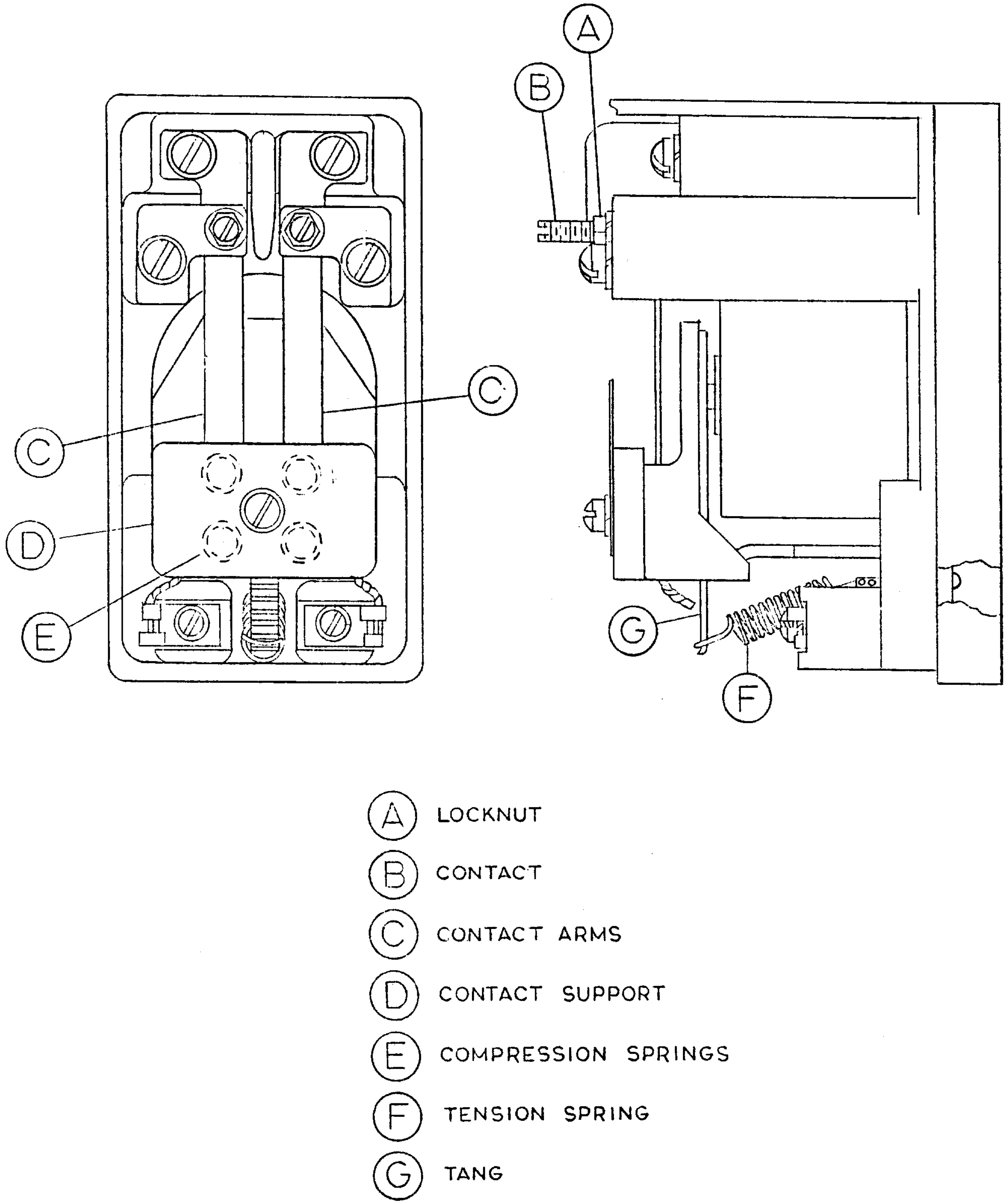
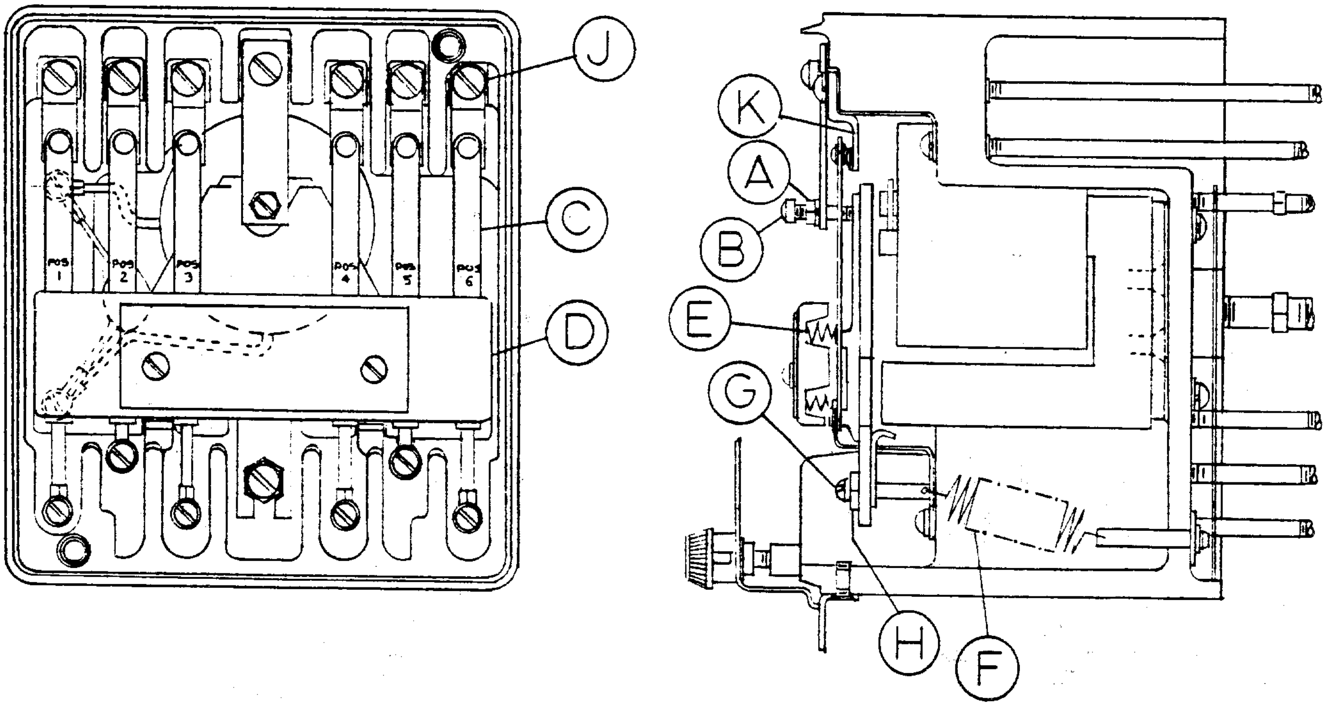


Figure 15 (0286A2011 Sh.12) HGA RELAY



(A) SCREW LOCK NUT

(B) SCREW

(C) CONTACT ARMS

(D) CONTACT SUPPORT

(E) COMPRESSION SPRING

(F) TENSION SPRING

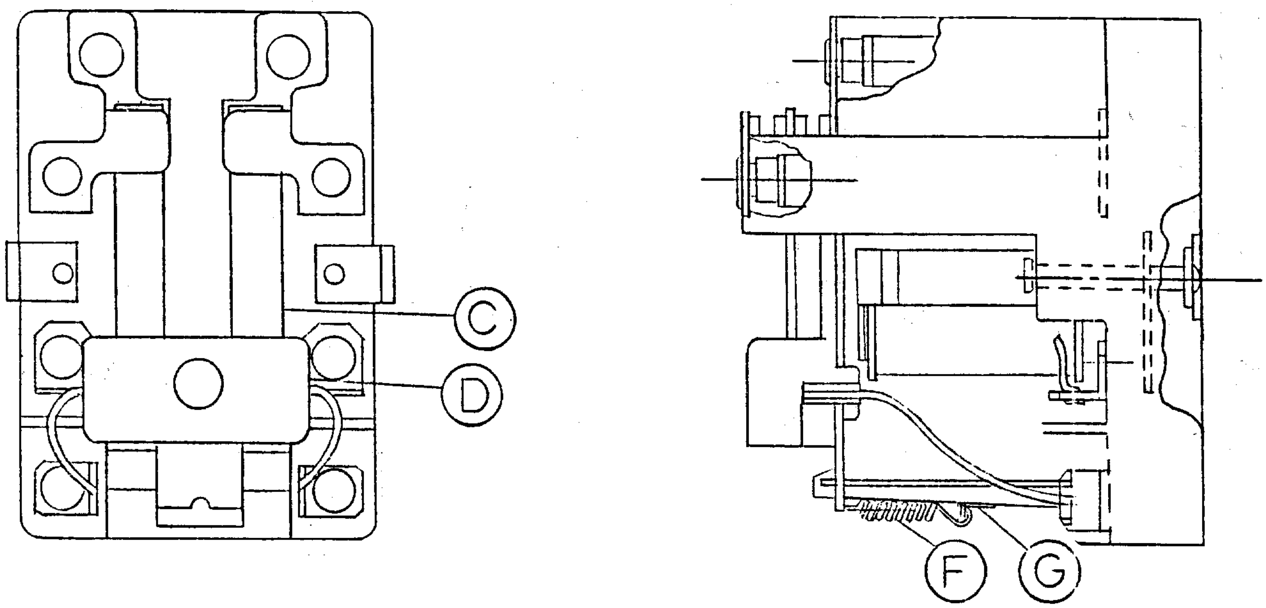
(G) CONTROL SPRING ADJUSTING SCREWS

(H) NUT

(J) SCREW

(K) STATIONARY CONTACT

Figure 16 (0286A2011 Sh. 13) HFA Relay



(C) CONTACT ARMS

(D) CONTACT SUPPORT

(F) TENSION SPRING

(G) TAB

Figure 17 (0286A2011 Sh. 14) HMA Relay

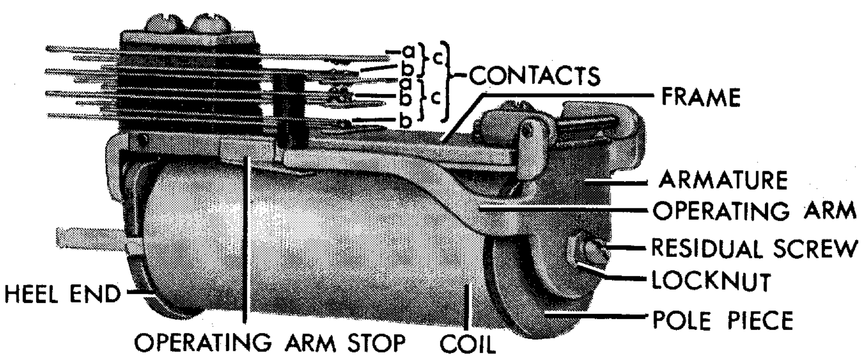
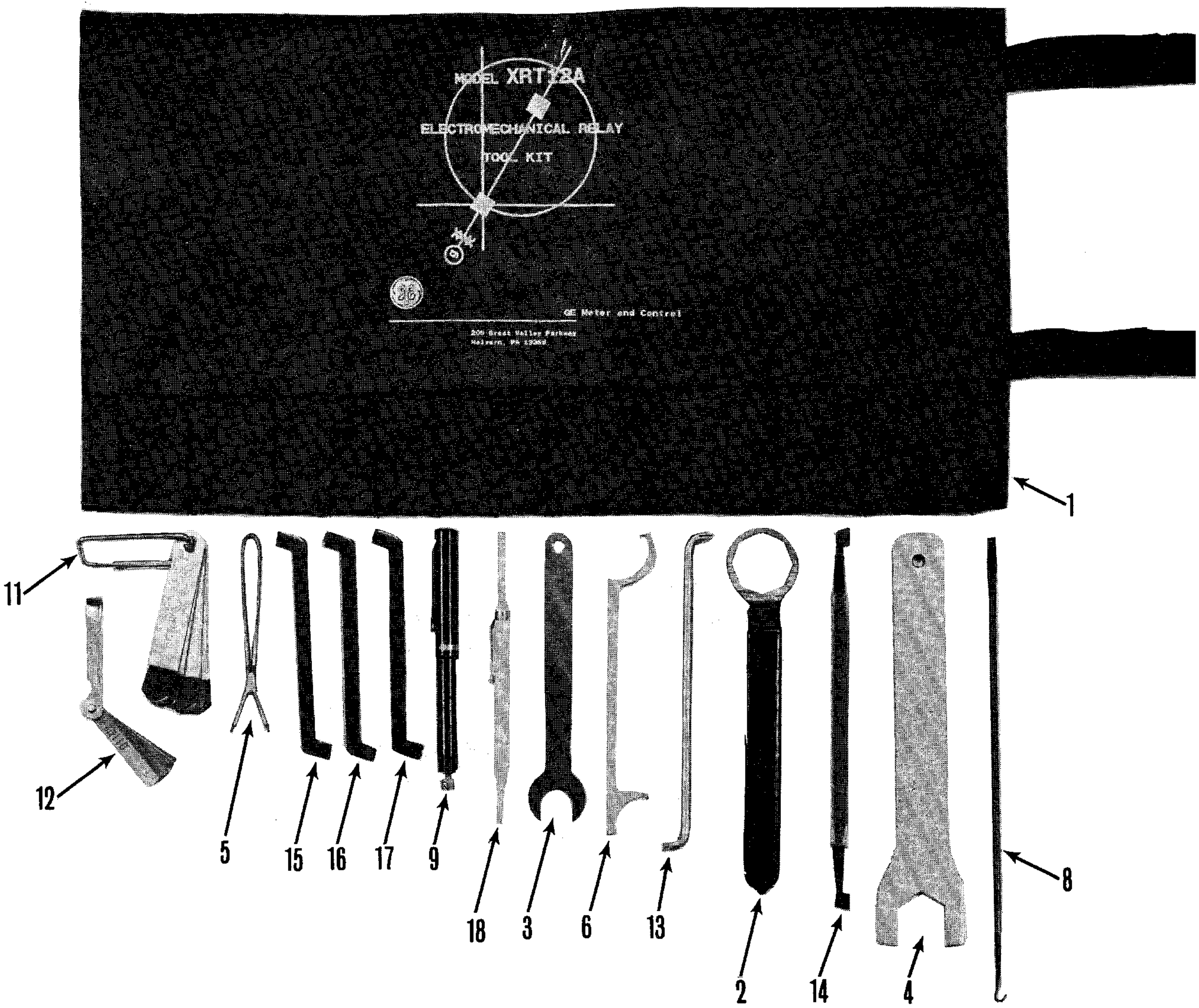


Figure 18 (8012106) Telephone Type Relay



1	Heavy Gauge Vinyl Pouch	10	Extra Blades for Burnisher*
2	Spec. 15/16" Box Wrench	11	Angle Feeler Gauge Set
3	Spec. 1/2" Open-end Wrench	12	Straight Feeler Gauge Set
4	Spec. 13/16" Open-end Wrench	13	Contact Leaf Adjuster
5	Spec. 5/8" Spanner Wrench	14	Contact Leaf Adjuster
6	Spec. Spanner Wrench	15	Armature Adjuster
7	Contact Leaf Adjuster*	16	Armature Adjuster
8	Push/Pull Spring Hook	17	Armature Adjuster
9	Contact Burnisher	18	0.085" wide Pot. Adjuster

* (not shown)

Figure 19 (8919363) XRT12A Relay Adjustment Tool Kit

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