This Service Specification provides general instructions for repair and adjustment of Model 12 polarized relays together with calibration values for ordinary-acting relays with low voltage contacts.

1. CORES AND POLE PIECES:

   On these relays the neutral cores are threaded into tapped holes in the pole pieces so that these parts can be dismantled when necessary by clamping the pole pieces and unscrewing the cores. For this purpose a smooth jaw wrench, such as is used for handling pipe and tubing, is desirable. A Walworth-Parmalee wrench with girth for standard 3/8 inch pipe can be used satisfactorily with the cores if liners are used in the girth to take up the excess clearance. In reassembling the cores and pole pieces clamping blocks should be used to hold the two pole pieces in proper alignment when the cores are tightened. After assembly a check should be made with a straightedge that the pole face surfaces are in the same plane, and these filed slightly if necessary.

   The cores can be removed and replaced one at a time without disturbing the pole pieces or armature bracket if these parts are clamped securely while the cores are being changed. A special clamping block 3/8 inch square in cross-section and 2-1/2 inches long with the ends notched out to slip over the dowel pins is useful for clamping the pole pieces. This method of handling is convenient if it is desired only to change the cores since it will not be necessary to reset the armature airgap if care is used.

2. PERMANENT MAGNET AND POLAR ARMATURE BRACKET:

   The permanent magnet is pressed into a threaded bushing, the upper
end of which is in the form of a large nut which bears against the brass plate on the upper side of the top plate, and the lower end of which threads into a tapped hole in the polar armature bracket. To remove the permanent magnet the top plate should be held from turning while this bushing is unscrewed. We can furnish a special wrench for this purpose if desired. Care should be used in handling the polar armature bracket so that the alignment of the lower trunnion support will not be disturbed.

We recommend that the permanent magnet be recharged just before it is reassembled in the relay, and after being charged it should be handled carefully as any hammering, filing or grinding will cause it to lose some of its magnetism. Dwg. B-12731, Shs. 1 to 3, show the construction details, and Dwg. B-12730, Shs. 1 and 2, the assembly and method of using a charging outfit suitable for recharging these permanent magnets as well as those for DP-14 and other polarized relays. These drawings will be furnished on request. If the permanent magnet is handled carefully, it may be satisfactory without being recharged. A weak permanent magnet will show up in that it will be found that the polar armature operation will not meet the requirements outlined later in this specification. The standard polarity of charge is such that the lower end of the magnet attracts the North-seeking end of a compass needle.

3. NEUTRAL ARMATURE:

The armature should have end play of 0.010 to 0.020 inch and the pivots should fit freely with 0.002 to 0.004 inch side clearance in the armature bearings.

Armature brackets of die cast metal as furnished on relays built for a period of several years previous to 1921 should be replaced with the later type nickel plated cast brass brackets. When newer type hex head pivot screws with sheet metal lock washers are assembled in the older style armature brackets which were originally used with round head pivot screws, a flat edge can be filed on the back of each lug on the armature bracket to provide for locking of the sheet metal washer.

The parallel airgap setting for these relays is 0.040 inch for relays with 2N-2R polar contacts, and 0.013 inch for relays with 4N-4R polar contacts. This parallel setting is determined by the adjustment of the armature bracket on the pole pieces.
The armature stop pin should be filed to provide an airgap of 0.013 inch (minimum) at the front edge on either type relay. It is recommended that this airgap be set to 0.014 inch before the pole faces are painted. A special file with spacing strips of phosphor bronze along the edges to raise the cutting surface above the pole faces is convenient for filing the stop pin. For the 2N-2R relays the strip on one edge will be higher than the other so as to give the proper taper to the stop pin to make square contact with the armature. The stop pin should be chamfered slightly to remove burrs after filing.

If it is necessary to repaint the pole faces we recommend that Union pole face treatment per Instruction Pamphlet U-5038 be used. This instruction pamphlet also covers a paint material for touching up armatures and other parts. Care should be used that no paint is left on the surface of the armature where it strikes the stop pin, and if there is any evidence of a powdery surface that sometimes develops on cadmium plating, the plating should be scraped off from the portion of the armature surface that comes in contact with the stop pin with a smooth scraper. This also applies to the polar armature.

The safety stop pins in the armature should not touch the pole faces.

4. POLAR ARMATURE:

Particular attention should be paid to the polar armature. The armature should be removed, the pivots and bushings carefully cleaned and examined, and all particles of dirt or any foreign material removed before the armature is reassembled. It is desirable to clean the pivot holes with a special reaming tool, Pc. 156970, Dwg. A-2586, Sh. 13. Before reassembling the polar armature, the upper pivot hole and the polar armature bracket should be checked for alignment by means of alignment tool Pc. 245637, Dwg. A-2586, Sh. 62, and if necessary, realigned as described on Dwg. A-2586, Sh. 62. When the polar armature is reassembled the lower pivot bearing should be adjusted to provide 0.010 to 0.015 inch vertical play and the lock nut securely tightened. A check should then be made to see that the upper edge of the armature has at least 1/32 inch clearance from the lower end of the bushing on the permanent magnet and the polar armature bracket and that the lower edge of the armature is at least 3/32 inch above the neutral armature. The lower pivot must rest on the steel ball in the lower bearing and the shoulder on the pivot must be free from
the upper end of the bearing. There should be a slight amount of side play in the pivots and the armature should operate freely without any binding.

On the 2N-2R relay the airgap at the tip of the armature when closed against either pole piece, which is determined by the height of the core pin, should be 0.025 inch, and the opening at the other end of the armature should be approximately 0.165 inch from the pole piece. For the 4N-4R relay the airgap at the tip of the armature when closed is 0.008 inch and the opening at the other end of the armature approximately 0.182 inch.

5. ADJUSTMENT OF NEUTRAL CONTACTS:

Neutral contact springs furnished since 1929 have the silver tips bent to provide a rounded contact surface. This change results in better performance, especially with heavier current loads, than was obtained with the straight tips. If the straight tips on the older springs have not been filed too short they can be bent to a radius on the end to match the newer springs.

The front contact carbons should be a snug fit in the holders. When a new carbon is being assembled in a holder, it is recommended that a #6-40 tap be run through so that the clamping screw will not exert side pressure tending to crack the carbon. If the tips of the carbons are pitted, they should be filed with a 12 or 14-inch second cut mill file to remove the pits and leave a flat contact surface.

Silver tips should be carefully cleaned before contacts are adjusted. Best service is obtained from a contact surface polished as highly as possible. Care should be taken to avoid the coarse finish resulting from ordinary fine files. The use of erasers, identified below, is recommended for the final polishing. Eraser, Pce. 101018, Dwg. 12750, Sheet 1, is for use in a drill press, the end of the eraser being rotated over the silver surface of the back anvil. The rotating eraser should touch the silver lightly and should not be held in one place long, as this will overheat the silver contact. Eraser, Pce. 101019, Dwg. 12750, Sheet 1, is a hand eraser for polishing by stroking the silver of the contact spring tips in the direction of contact slide. While polishing, the silver should be held against a solid backing so it does not become twisted to cause beveling of the surfaces. Care should be taken to remove all eraser particles after polishing.
It is advisable to have the carbon (later ones are silver impregnated) made smooth and clean as well as the silver. A #4 equaling file 0.040 inch thick is recommended for finishing the carbon contact surfaces before the contacts are adjusted both on new carbons and old carbons which have had the pits removed.

After carbons are filed, it is advisable to remove the loose carbon particles by pulling a strip of good clean bond paper through the contact space against the carbon. Paper having shiny surface or lint should not be used. Care should be taken to avoid leaving small particles of paper on the contact surfaces as might occur if the edge or end of the paper strip were pulled through the contact with the contact closed. While paper is being moved between the closed contact members it is advisable to keep the edges of the paper from the contact surfaces.

When contact springs are being replaced or adjusted it should be noted that the Bakelite studs are tight in the armature without undue strain, that there is no indication of cracking of any of the studs, and that the two studs for each contact spring will permit the spring to seat squarely so that the studs will not be strained when the nuts holding the springs are tightened. Each spring should be adjusted on the armature so that the tip hits the front contact carbon approximately in the center.

Contact adjustments when needed should be made by adjusting the brass fingers, and bending of the springs should be avoided as far as possible. The silver tips of the springs may be bent slightly if necessary so that the three tips make contact squarely and at the same time. The back contacts should be adjusted by raising or lowering them on the threaded posts, the nuts to be securely tightened and locked after adjustment.

The front contacts should be adjusted to have 1/32 inch slide. This corresponds to adjusting the contacts to just open with a spacer 0.009 inch thick between the armature and the stop pin. If this method of adjustment is used the spacer should be held firmly by pressure applied to the armature between the stop pin and the pivot screws so as to take up the play in the pivots. This pressure may be applied conveniently by energizing the relay at approximately four times the pick up current. This adjustment may have to be changed slightly to meet the calibration values.
The back contacts should be adjusted so that they will have 0.020 inch (minimum) opening when the front contacts are just breaking. With the armature in the fully released position the front contacts must have 0.050 inch (minimum) opening. This adjustment is determined by the stop members on the back contact springs, each of which should have 0.030 inch (minimum) opening from the silver tip of the spring when the back contacts are not made. When the armature is in the fully released position, it is desirable to have all of these stop members closed against the spring tips so as to distribute the armature pressure uniformly.

6. ADJUSTMENT OF POLAR CONTACTS:

The polar contacts should have 1/32 inch minimum slide which corresponds to adjustment of the spring tips to just break contact with a spacer between the armature and the polar stop pin approximately 0.025 inch thick. This adjustment may have to be changed somewhat by bending the springs in order to meet the requirements for polar armature operating values, but if the polar armature does not go to stop pin and compress the contacts properly at the value shown in the calibration table when they are adjusted with the 1/32 inch minimum slide, this is an indication that the permanent magnet is weak and should be recharged.

It is recommended that Cophite polar contacts, which have been furnished to some roads in order to get low contact resistance, be replaced with new silver impregnated contacts which are not subject to fusing as were the Cophite.

7. TOP PLATE:

For touching up the porcelain top plates, black insulating baking varnish, our Spec. 509, Class 269, which will air dry in approximately twelve hours, is satisfactory. This same material is also recommended for sealing around terminal posts when new posts are assembled in the top plate. When used for this purpose the varnish should be allowed to evaporate in a small container to a thick consistency and a fillet of this thick material spun around the joint between the terminal post and the boss on the top plate to seal against the entrance of moisture.

8. BACKSTRAP:

The contacting surfaces of the backstrap and the cores should be clean
and free from burrs or particles that would prevent them from making a good magnetic joint. The tapped plug in the portion of the backstrap at the permanent magnet should be adjusted so that it is in contact with the top of the permanent magnet but not screwed in so far as to keep the neutral cores from making solid contact with the backstrap. This plug should be doweled in the final position after it has been set.

9. **CALIBRATION:**

The calibration data listed in the tables herewith is for new relays where the usual initial charge of four times P.U. is available. Tests should be made in accordance with A.A.R. Signal Section Manual, Part 126, and when checking or shopping old relays allowances should be made for changes in calibration as outlined in the manual: For field test the initial charge available is usually not much in excess of working current, and in such cases the calibration values may be slightly higher than the shop values. We suggest that, in general, calibration readings be checked in current on low resistance relays and in voltage on relays of 100 ohms or higher resistance.

On relays adjusted with 0.090 inch neutral contact opening instead of 0.050 inch, the maximum P.U. values may be 15% higher than those given in the tables.

It is usually recommended that relays be adjusted when the drop-away values fall below 67% of the new relay value. Also, after these relays have been in service for four or five years, the change in calibration due to aging of the iron usually is sufficient to warrant reannealing of the cores, particularly on track relays. Very little is gained by reannealing of the other magnetic parts, but we suggest that the cores be returned to the Factory when reannealing is required and given our standard annealing process and residual tests.

**Polarity:** The standard polarity of permanent magnet charge and coil connections is such that with positive battery connected to the left-hand coil terminal post, which is marked +, the polar contacts marked with the rib will be closed.

10. **CONTACT RESISTANCE:**

Resistance of front and polar contacts should be measured with the armature against the stop pin. The initial cleaned resistance of front or polar contacts should not exceed the values given in the following table:
Silver to Carbon
*Silver to Silver Impregnated Carbon 0.18 Ohm
Back Contacts, Silver to Silver 0.09 Ohm
0.03 Ohm

* Silver impregnated front carbons can be identified by small circular depressions drilled in the front and back faces of the contact near the corners.

11. ASSEMBLY OF BASE TO RELAY:

These relays at one time were furnished with one long continuous felt gasket for the top plate. Later relays have had four straight gaskets similar to those on the bases, cut slightly longer than the grooves in the top plate and forced in tightly to close up the openings at the corners. Ordinarily, it will be possible to cut the old continuous gasket into four pieces and apply them to the top plate in this manner.

After the base has been tightened on the top plate, it should be checked that the space between each corner post and the top plate is securely sealed. On some relays two or more of the small corner gaskets will be required at each corner to fill up this space.

A good grade of orange shellac dissolved in pure denatured alcohol is recommended for attaching gaskets.

Rubber gaskets, together with a special rubber cement for attaching, can be furnished to replace the original felt gaskets. The rubber gasket material is furnished in long strips which should be cut in pieces slightly longer than the grooves in the top plate or base, the same as the felt gaskets. Rubber corner gaskets for the top plate are also furnished.

It is recommended that the thin metal corner linings be used to close the openings in the punched metal corner posts on earlier relays which were not equipped with these linings.

WRITTEN BY: H.E. Schmeltzer, 9-7-45 APPROVED: A.W. Fischer
CHECKED BY: O. Leicht, 9-7-45 DATE: Sept. 7, 1945
Calibration Values for Model 12 Polarized Relays
Ordinary-Acting, Low Voltage Contacts, 2N-2R, or
4N-4R Polar Contacts

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* For relays with 4 back neutral contacts. PU values may be increased 6% above the values given.

** Special 1-ohm coils Pc. 127252