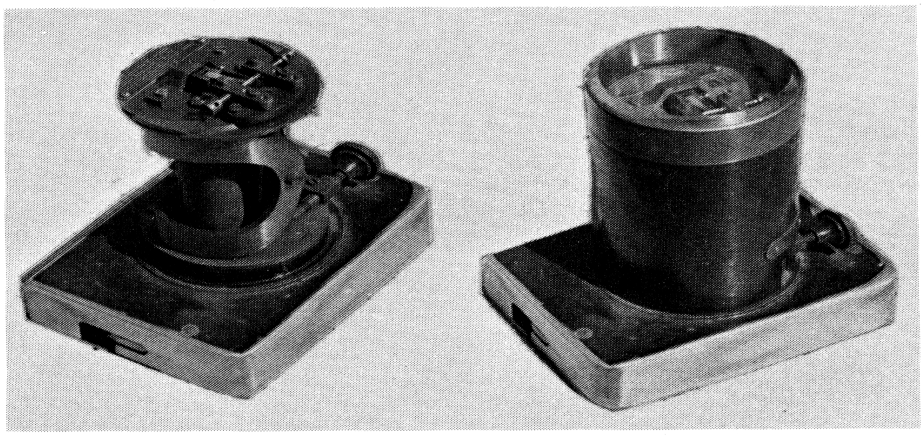


Wheatstone type 1-B polar relay.

wheeling" position for the control lever is provided to facilitate the insertion of tape in the TD by permitting the tape feed wheel to rotate freely. Index lines on the tape guide bars are six characters in front of the sensing pins, indicating the typed character corresponding to the perforated character. The tape is kept flat and under tension by a taut-tape device which stops transmission when the tape goes taut. An extra "tape-out" sensing pin automatically stops transmission when a tape runs out of the TD.

Connections

No effort is made here to show a wiring diagram for the Model 28ASR because of the large number of possibilities in the combinations of the various units described in this section. It should be kept in mind that the wiring and functioning of the page printer is essentially that of the 28KSR, *so reference can be made to information on that unit. Teletype Corporation* drawing numbers are given above with some of the descriptions of the various component units. The wiring diagram for the *LAAC* console cabinet is drawing number 3264WD. Refer also to drawngs 3292WD and 3459WD.

2.4 Polar Relays

a. General

In the early days of radioteletype, when equipment was not as plentiful, the only relays available to RTTYers were those made by Wheatstone. The Wheatstone relays are good relays with carboloy contacts. The types 1-B and 1-F were designed to be used only in the vertical position, while the type 17-B was made to be operated in the horizontal position.

The Wheatstone 1-B relays were made to fit into a finger-type socket such as shown just below in the accompanying photo. Fig. 2.4a1 shows the schematic diagram of the 1-B relay and also indicates that the actual connections, un-numbered on either the relay or the socket, make use of only seven of the available twelve terminals. Electrically both coil pairs are similar and may be used interchangably as operate or as bias windings. For polar operation, or in direct connection to an RTTY converter, terminals 3 and 6 are connected together, and 2 and 7 each go to a plate of the d.c. ampli-

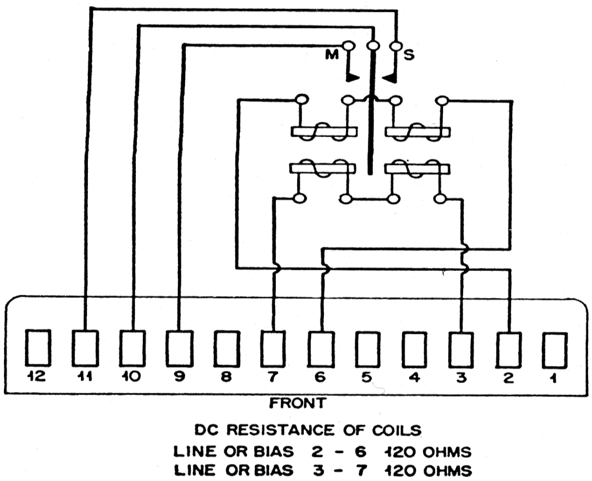


Fig. 2.4a1—Wheatstone polar relay 1-B.

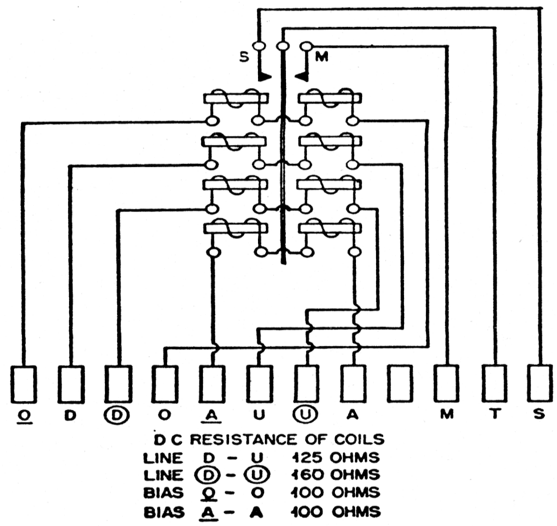


Fig. 2.4a2—Combination Wheatstone relay 1-F.

fier/keyer tube. For neutral loop operation (60 ma) one pair of windings is used as the operate or line coil, and the other pair of windings has in it a bias or continuous current of one-half the line current, or 30 ma.

The Wheatstone 1-F combination polar relay is mechanically similar to the 1-B except for the base mounting. As shown in Fig. 2.4a2, the 1-F relays have four pairs of coils, two line pairs and two auxiliary or bias pairs of coils. The line coil terminals are D-U, and *circled D - circled U.* With these coils in series, U to *circled D,* the relay will operate on polar signals of 30 to 70 ma. For neutral operation, in order to move the armature to the *space* contact when a *space* signal is received, the bias current is passed through the auxiliary coils in such a direction as to oppose the *mark* current in the line windings. The auxiliary coil terminals are designated O - *underlined O,* and A - *underlined A.* For neutral operation, the line coils are connected in series, as described above for polar operation, and the auxiliary coils are also connected in series, O to *underlined A,* and a bias current of one-half the line current is applied, negative to A, to move the armature to the spacing contact in the absence of marking current in the line coils.

Figure 2.4a3 shows the actual circular layout of the base connections. The base is designated MTG. 2-A. The Wheatstone 17-B relay is similar electrically to the 1-F, even to the same base connections. Mechanically, it is constructed in an entirely different manner, although it is somewhat similar in external appearance, in order to permit operation in a horizontal position.

Most of the polar relays in the hands of the amateur RTTYer are now of the Western Electric 215A or 255A types. Mechanically, these two relays look quite similar except for the knurled tension nuts on the 255A. Electrically, they each have two coils; however, the 215A coils are 90 ohms each while the 255A coils are 136 ohms apiece. (By the way, some 255A polar relays with bakelite cases are marked D163119-A.) While both of these

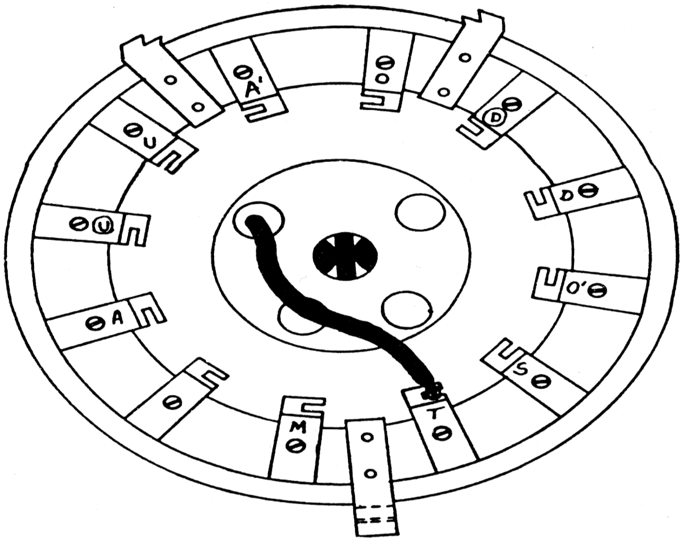
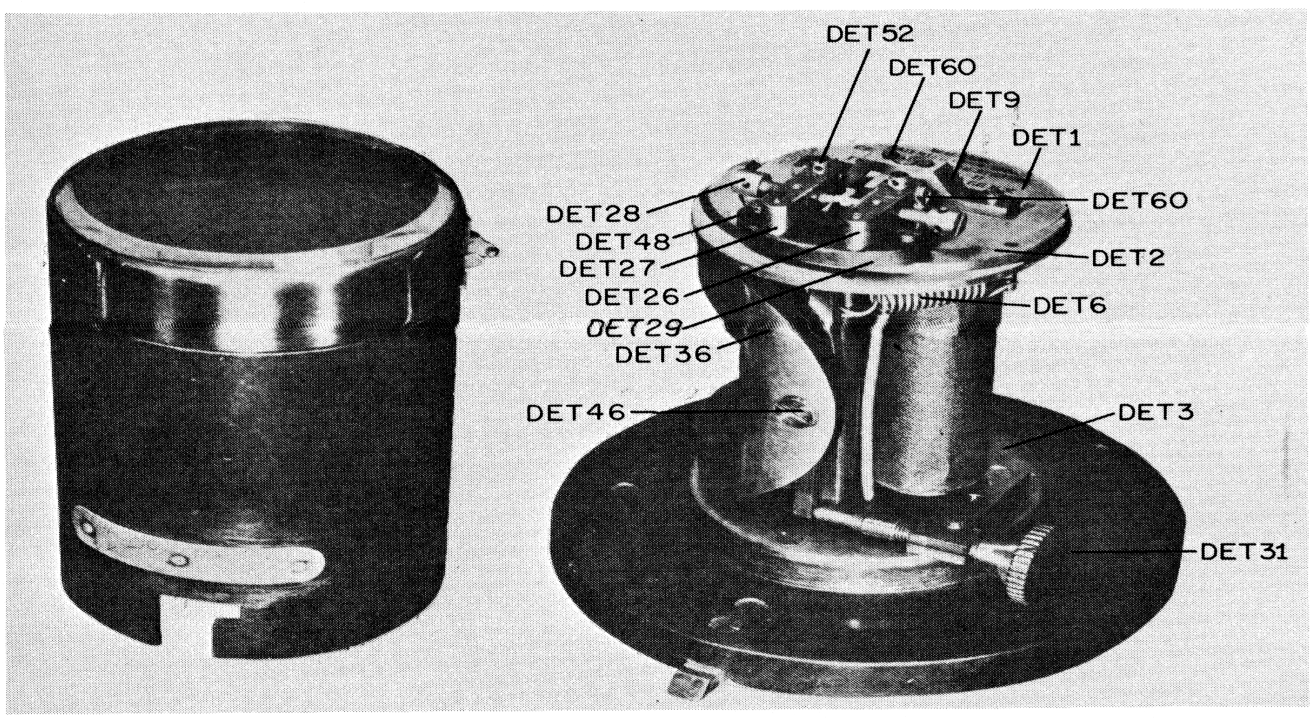


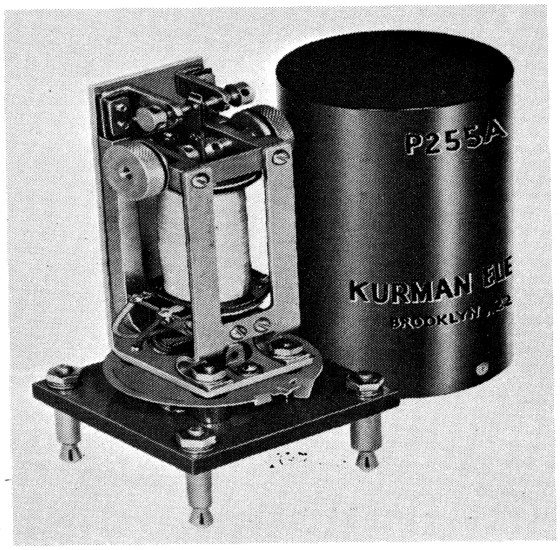
Fig. 2.4a3
Wheatstone polar relay 1-F, base connections.

relays are similar, it should be noted that the 255A is built more accurately than the 215A and as a result it is easier to adjust. Also, when working with small current differentials, the more sensitive 255A is suggested.

When the normal 60 ma local loop is used with a 215A or 255A polar relay, the loop or line current is put through the upper or "operating" winding. Since these relays have no spring, a reversing or bias current must be continuously applied to the lower or biasing winding. Polarity of the current



Combination Wheatstone type 1-F polar relay.



255A polar relay.

in each winding must be observed so that the armature is pulled in the proper direction. When the polar relay is connected in a polar circuit, both windings are connected in series, again observing proper polarity of the windings. Proper loop current is then set at 15 to 30 ma in each direction. The value of the current is not critical, but the currents in each direction must be equal, otherwise the armature will spend more time on one contact than on the other, giving the signal "bias distortion" and thereby increasing the possibility of errors.

b. Polar Relay Test Set

From the above discussion it can be seen that bias distortion could just as easily result if the polar relay were not in correct adjustment. In other words, it must operate equally, in time, to the *mark* and to the *space* contact when equal pulses are received. Now, if a surplus I-193-A Test Set for polar relays can be found, perhaps through MARS, your adjustment problems

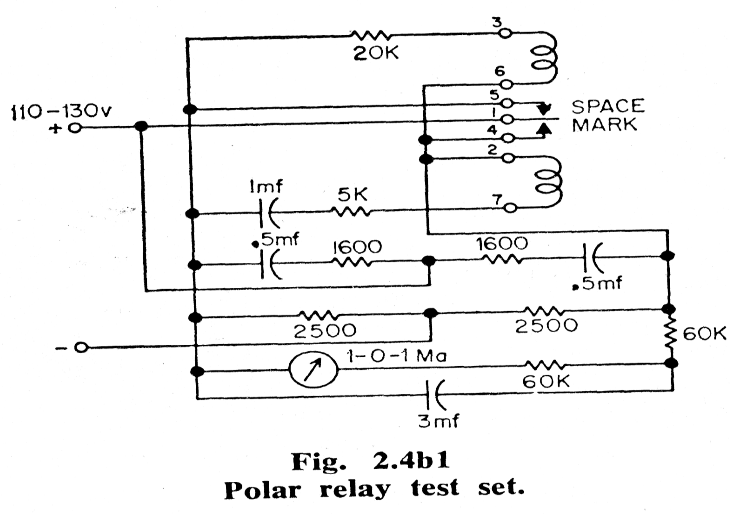


Fig. 2.4b1
Polar relay test set.

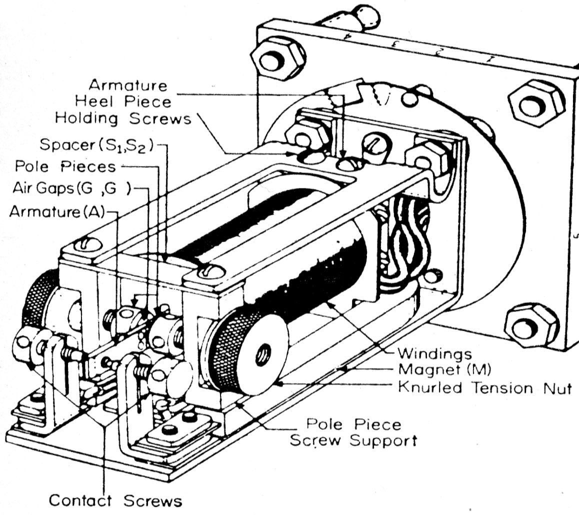


Fig. 2.4c1—255A polar relay, cover removed.

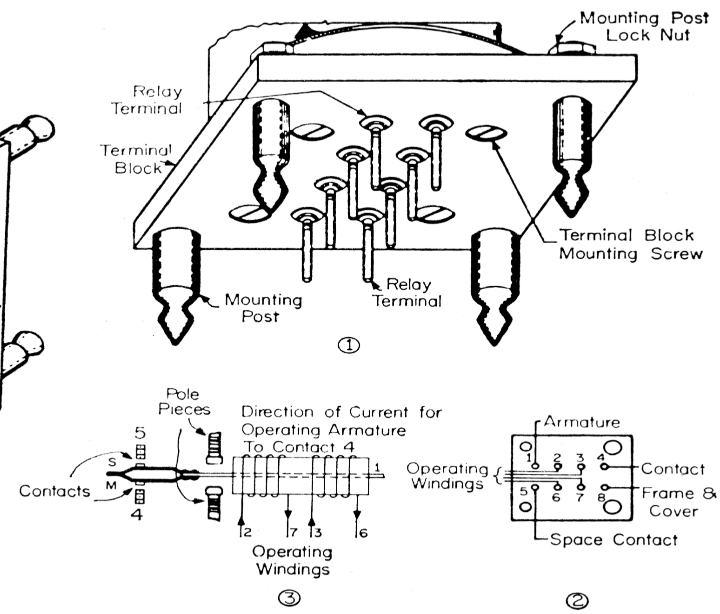


Fig. 2.4c2—255A polar relay connections.

are over as this test set permits setting the internal bias of the polar relay to zero, and in addition, at the correct sensitivity through "operate" and "non-operate" test currents.

Since, in our usual application, sensitivity is considerably less important than bias, we can build a very simple test set which permits us to accurately set the mechanical bias to zero. Fig. 2.4b1 is the schematic diagram of such a test set. The meter is the military surplus IS-180, scrounged from a BD-77A "Line Unit," found with the TG-7B, the military field version of the Model 15. The simple circuit shown causes the armature of the polar relay under test to vibrate at approximately 22 c.p.s. The meter measures the ratio of the armature dwell on each contact. In other words, with voltage applied and the relay vibrating, the meter will jiggle around zero center, providing that the internal mechanical bias of the relay is zero. If it doesn't vibrate (the worst condition), or if the meter jiggles off center, adjustment of the relay is in order.

c. Adjustment of the 255A

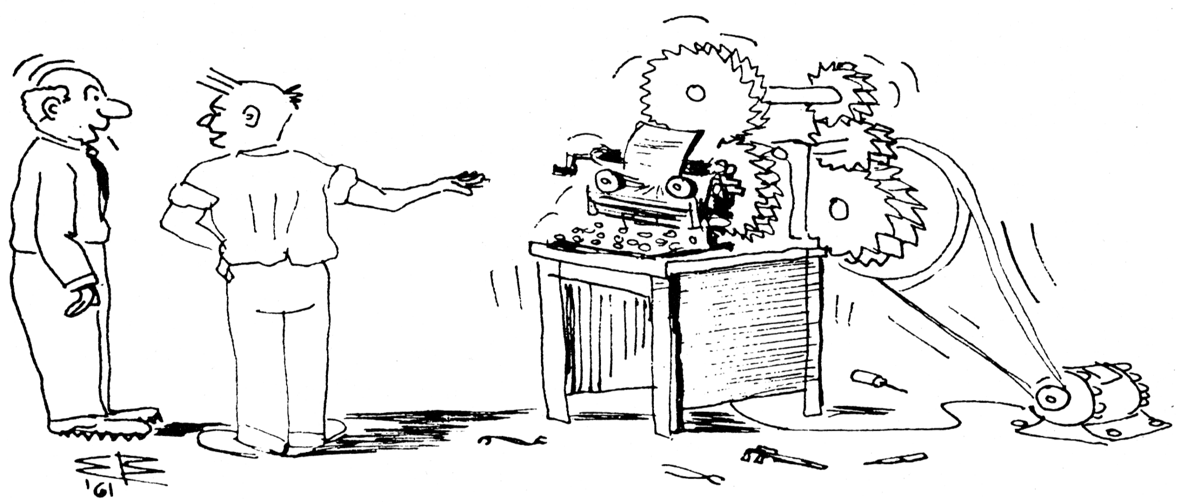
A reasonably good job of adjusting a polar relay can be done by a nail and a simple feeler gauge, but if possible, beg, borrow, etc., *Teletype* tools. The gauge is a 74-D, and the "nail" is a No. 340 tool or adjusting key. Also useful are the KS-2662 file and the No. 265-C contact burnisher.

Carefully inspect the relay visually to make sure that the contacts are unpitted and clean, that the surfaces of the flexible contact springs bear against each other for at least 25% of their width, and that the armature swings freely inside the spool. Check, too, all slotted head screws for tightness.

Begin adjustment by backing off the contact screws and pole pieces with the 340 tool to find the natural mechanical position of the armature. You might find it necessary to center the armature horizontally by loosening the screws holding the front and rear spool heads to the base; then move the coil to the left or to the right to bring the armature into the center of the spool slot. Should it be necessary to center the armature vertically, loosen the heel piece holding screws; then adjust the armature vertically until the contacts are correctly aligned. Check for clearance between the armature and the slot in the spool at both top and bottom; then make doubly sure that all screws are tight.

To set the contacts, begin this phase of the adjustment with both pole pieces backed off and the armature in is natural position. Using the relay test set, or at least an ohmmeter, turn in one contact screw until it just touches the armature, then back it off .002-inch, using the feeler gauge. (One-twelfth of a turn of the contact screw is close to .002-inch.) Go through the same procedure for the other contact, then check, with the feeler gauge, the total contact travel, which, of course, should be .004-inch.

The next step is the pole piece adjustment. This is begun by turning in one pole piece until the armature just rests against the opposite contact screw, as indicated by electrical contact. Then back off the pole piece screw slightly less than one-half turn and tighten the tension nut to hold it there. Now, turn in the other pole piece until the gaps on each side are as equal as can be judged by the eye, and tighten the tension nut. If necessary, readjust the second pole piece until the armature either stands midway between contacts or flips to either contact when moved by hand. Sensitivity is increased, up to a point, by moving the pole pieces away from the armature. So far this has been a "by-hand-and-by-eye" adjustment. Now is the time to plug the relay into a test set and do the fine adjustment for zero bias by moving one or the other of the pole pieces. It should take only a degree or so of movement to set the relay at zero internal bias. Go very slowly at this point or you will find yourself starting the whole procedure over, right from the beginning.



"Some of the boys at the shop helped me out with that speed conversion problem."