Signal Training Bulletin

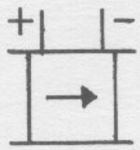
COMMITTEE G: Education & Training
Communication & Signal Division AAR

C-10 Biased Relays

Approved January 1972

Definition: A relay which will operate to its energized position by current of one polarity only, and will return to its de-energized position when current is removed, or the polarity reversed.

Symbol:



Description: A biased neutral relay is a relay equipped with a permanent magnet and a leakage strip between the cores, so arranged that the relay armature will pick up only if current is flowing through the coils in the proper direction.

Purpose and Application: Biased relays are used for both line and track. As track relays, they provide protection against defective insulated joints if the polarity of adjacent track circuits is staggered and are less susceptible to foreign current because of their response to current of only one direction. When the biasing feature is applied to a two-point track relay having a relatively large air gap, a relay having quick drop-away, and high drop-away, with respect to normal working current, is obtained. Improved shunting sensitivity, in addition to the advantages mentioned previously, is also obtained.

They may be used instead of polar line and neutral line relays in polarized signal control circuits. They may be used for switch operating and correspondence or repeating circuits or, in any neutral or polarized line circuit where response to a particular polarity is required. They are particularly useful in neutral line circuits for protection against foreign current and crosses as a battery-checking relay where polarized circuits are fed from one section of a split battery and other loads are connected across the whole battery.

General Information: None.

Detailed Operation: With the polarity of the permanent magnet as shown in Figure 1 and no current flowing through the coils, the major portion of the magnetic flux produced by the permanent magnet goes through the "U" core and leakage strip. Because of the high reluctance of the air gap, very little flux will flow through the armature.

Assume current flows through the coils in such a direction that the resulting magnetism opposes the magnetism of the permanent magnet in the "U" core, Figure 1. This is comparable to a high reluctance in the path of the permanent flux in the "U" core. This

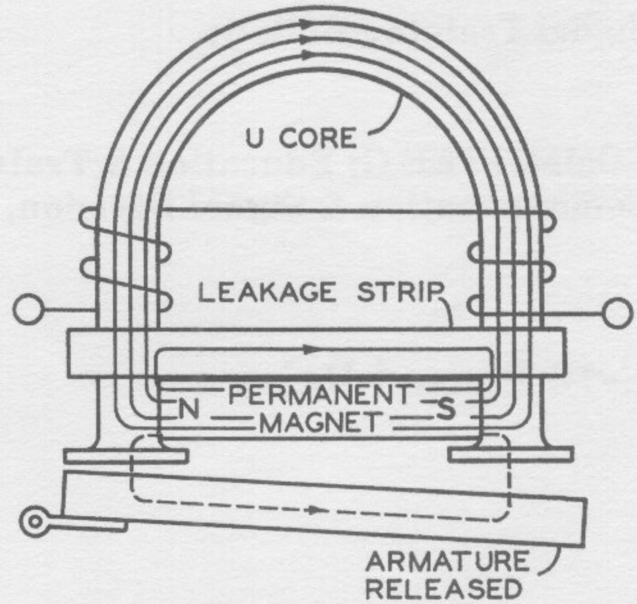


Figure 1: No voltage applied. The biased neutral relay is deenergized. Most of the magnet flux is in the "U" core. A very small amount is in the strip and in the armature.

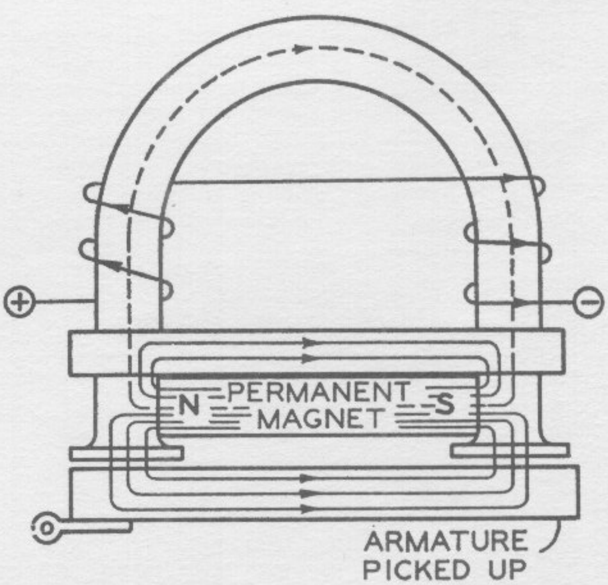


Figure 2: Voltage of correct polarity applied. The relay armature picks up. Most of the magnet flux is diverted through the armature because current through the coils has created a flux in opposition to the permanent magnet flux thus causing an effective high reluctance in the "U" core.

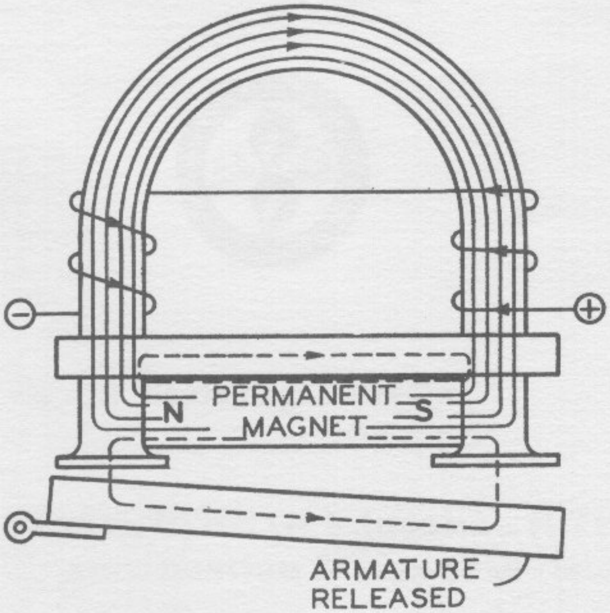


Figure 3: Voltage of wrong polarity applied. The relay armature does not pick up. Practically all the magnet flux is in the "U" core because the current through the coils has created a flux which aids, rather than opposes, the permanent magnet flux thus causing an effective lower reluctance in the "U" core than shown in Figure 1.

causes part of the permanent magnet flux to be diverted through the armature of the relay. Note that the coil flux is in the same direction as the permanent magnet flux through the leakage strip. The combination of permanent magnet flux and coil flux through the leakage strip tends to saturate the leakage strip and causes even more of the permanent magnet flux to seek a path through the armature of the relay. The relay will now assume the energized position, or pick up.

The armature will remain up as long as the coils are energized. See Figure 2. When the circuit is opened, the magnetic force opposing the permanent magnet is destroyed. The flux of the permanent magnet once more resumes the low reluctance path through the "U" core and leakage strip, which have lower reluctance than the path through the armature. Since there is no force to hold the armature up, it falls away from the pole pieces.

Assume voltage of the opposite polarity is applied to the coils. See Figure 3. This would merely create a magnetic force which would aid the magnetic force of the permanent magnet and the flux would remain in the "U" core and the strip. The armature cannot be picked up with voltage of the opposite polarity.

Figures 4 and 5 illustrate a slightly different method to obtain the bias. In Figure 4, with no voltage applied to the coils and the relay in the de-energized position, a part of the permanent magnet flux passes lengthwise through the armature and exerts a torque on the armature which assists gravity in holding the back contacts closed.

When energy of the polarity as shown in Figure 5 is applied to the coils, the flux created in the armature by the current flowing in the coils will be in opposition to the permanent magnet flux. As the coil flux increases, the armature flux increases and opposes the permanent magnet flux. When the coil flux increases to a value such that the hold-down effect is neutralized, the armature will pick up.

If energy of opposite polarity is applied to the coils as shown in Figure 6, the resultant coil flux will pass through the armature in the same direction as the permanent magnet flux and the armature will remain in the de-energized position.

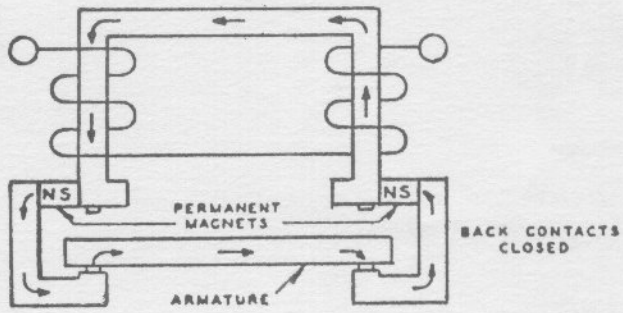


Figure 4

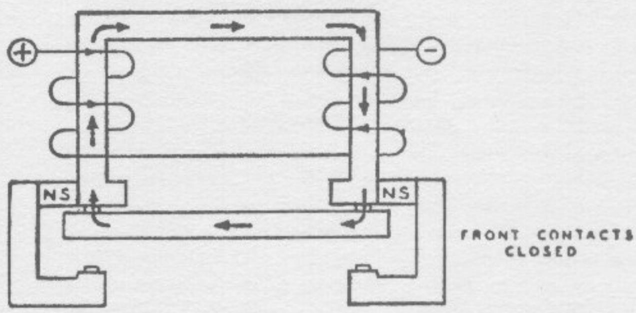


Figure 5

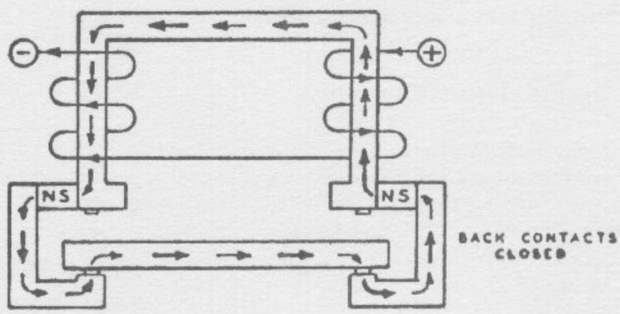


Figure 6