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TECHNICAL NOTE

Subject: Step by step relay coil terminal identification

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ABSTRACT

In elctromechanical telephone switching circuits, relays with two coil windings are commonly used. In general we need to be conscious of the relative "poling" of the two windings. In schematic circuit drawings, there is a graphic convention for showing that poling, and for relating it to the identification of the coil terminals.

When we get to the physical apparatus, we need to be able to relate this notation to the physical terminals. These are almost never marked with identification; rather, we must determine their identification from the physical locations of the terminals, under some established convention.

In the step by step switching system, that convention is a little "tricky". In this note, I will describe and explain this convention.

1. THE RELAYS

The relays to be discussed here are often discussed as "221 family" relays. since their Western Electric apparatus codes have numeric parts in the range 221-222-223, etc.

2. TWO-WINDING RELAYS

When a relay has two windings, we must keep track of which end of each is "corresponding" with respect to the electromagnetic effect of the windings. That is because, in the most common case, we must assure that the currents through the two windings have electromagnetic effects in the same direction (and thus will be additive in their effect on the armature). Or, in some special cases, we must be sure that the current through the two windings will have electromagnetic effects in opposing directions.

At the circuit schematic drawing level, we recognize this by this symbology:

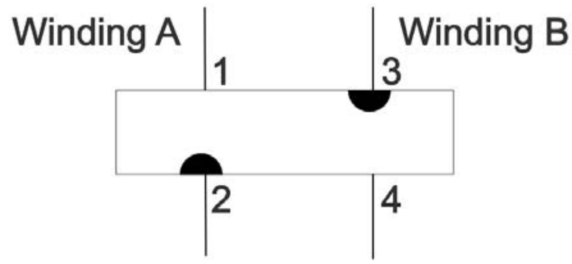

Figure 1.

Here, the little black half-moons tell us that terminal 2 (of winding A) and terminal 3 (of winding B) are said to be the inner ends of the respective windings. But of course, knowing which is the inner end of a winding does not of itself tell us the electromagnetic "poling" of the winding. That is because we do not know in which direction the two windings are wound.

But we do know—the convention for this symbology assumes that both windings are wound in the same direction (from their "inner" ends). Thus we know that a current entering winding A at terminal 2, and a current entering winding B at terminal 3, will have electromagnetic effects in the same direction.

Let me point out that the matter of the "inner" ends of the windings is a relative one. We are concerned with the relative directions of the electromagnetic effect of the two windings, not their absolute directions. Thus if, imprecisely, on the circuit schematic drawing, the two terminals with the half-moon mark were both the outer, rather than inner, ends of the respective windings, there would be no harm. The relay will operate as intended.

And in fact, for a schematic circuit drawing of a circuit that has not yet been physically implemented, the engineer will draw the half-moon symbols to show the needed effect, having no idea how the terminals on the relay to actually be used will be identified.

3. ON THE PHYSICAL RELAYS

When we actually encounter the physical relays, the issue arises of how to relate the physical terminals on the relay with the winding terminals on the circuit schematic drawing. For relays of the types commonly used in step by step switches, the convention is as we see here:

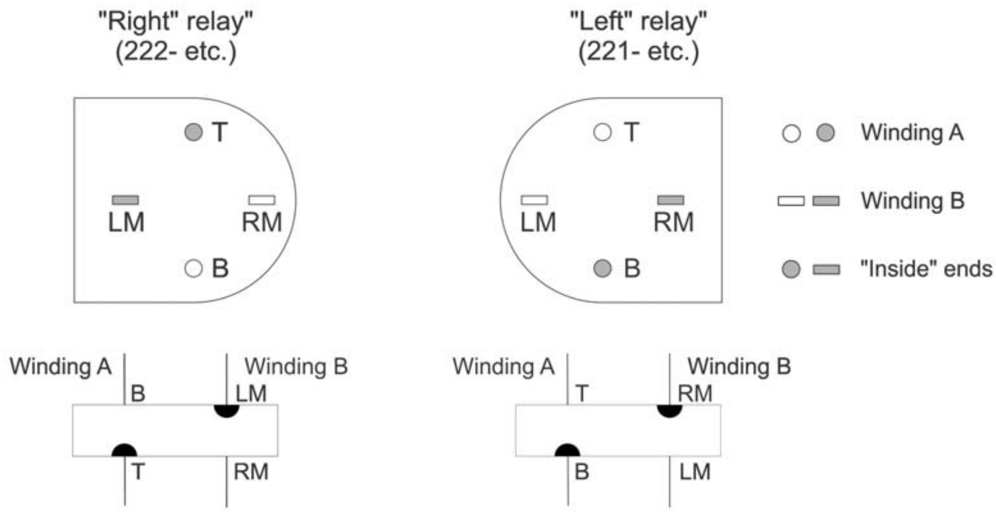

Figure 2.

We note that there are relays of two subtypes in this type, called "left" and "right" relays, named for the side of a step by step switch on which they are intended to be mounted (as seen from the front). The numeric parts of their Western Electric apparatus codes are odd (221, 223) for "left" relays and even (222, 224) for “right” relays.

The terminals of what I will arbitrarily call "winding A" are labeled T (for top) and B (for bottom). The terminals of what we will arbitrarily call "winding B" are labeled LM (for left middle) and RM (for right middle); left and right here again are as would be seen from the front of the switch.

The rectangles and circles used for the terminals in the figure do not represent a different physical shape of the actual terminal, but are just a graphic convention showing which terminals go with which windings. Similarly, the terminals that are shaded in the figure are not in any way specially marked in reality; this is just a graphic convention showing which terminals are for the "inner" ends of the respective windings.

4. AN INCONSISTENCY

We see an inconsistency between the two relay types: in "left" relays, the inner end of, for example, winding B is on terminal RM; in "left" relays, that winding end is on terminal LM.

To understand this very real inconsistency, we will take a relay of each type and hold them both in a consistent orientation—with the frame and contact stacks uppermost, as we see here:

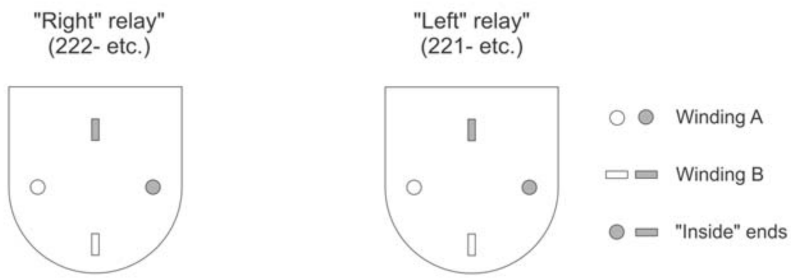

Figure 3.

Now we see that the two ends of the two windings are identically disposed in the two relays. In fact the coil itself could be the same item for both relays, if the coil properties were specified to be the same.

What produces the inconsistency seen in figure 2 is the practice of designating the winding terminals based on their arrangement as seen with the relay oriented the way it is intended to be mounted in a switch, which orientation is different for the two relay subtypes.

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