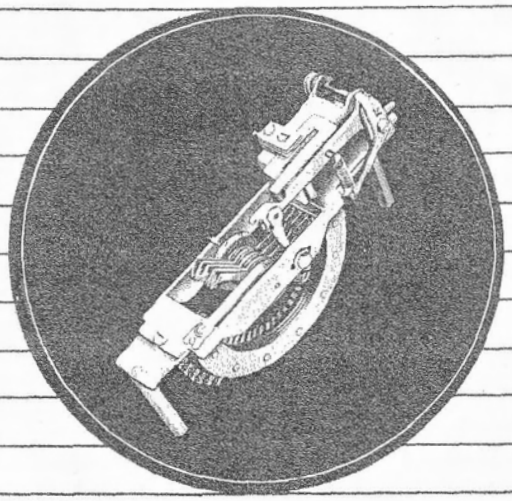
The Rotary Lines\ h 806

AUTOMATIC ELECTRIC TRAINING SERIES | Bulletin **806**

The ROTARY LINESWITCH

STROWGER AUTOMATIC TELEPHONE SYSTEMS



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THE ROTARY LINESWITCH

1. GENERAL

The rotary lineswitch, instead of the plunger lineswitch, may be used in Strowger dial systems as individual line equipment. It is well adapted for certain traffic and service conditions.

The rotary lineswitch is a single-motion (rotary) "non-numerical" switching device; its operation requires no digit in the call number nor any movement of the dial.

A rotary lineswitch is associated with each telephone line and, in operation, is independent of all other lineswitches. It requires no master switching mechanism. This lineswitch automatically connects the associated telephone line, at the initiation of a call, to an idle trunk terminating in a connector (100-line system) or a selector (in a larger system).

With respect to circuit operation, rotary lineswitches are divided into two general types: homing and nonhoming.

A homing-type rotary lineswitch is one which normally rests in an off-trunk position. At the termination of a connection, the wipers rotate to this home position (generally the first position of bank contacts). The homing-type lineswitch is "post-selecting"--the selection of the idle trunk occurs after the call is initiated.

This rotary lineswitch is used with a "graded" trunk arrangement. Trunk selection starts with the first position, permitting the use of individual trunks, if desired. Graded multiple is a method of trunking where a small number of trunks of a group are individual to a number of lines, and the remaining trunks are common to a number of groups of lines.

In the nonhoming-type lineswitch, the position of the selecting wipers does not depend on the condition of the trunk (whether idle or engaged). The wipers remain in the position of the trunk previously used by them. Another call from the same line engages the same trunk, if idle. When another lineswitch occupies the trunk, the wipers rotate to the next idle trunk. In theory, the nonhoming-type rotary lineswitch is post-selecting; in practice, the lineswitch engages the trunk with which its wipers are in contact for a large percentage of initiated calls.

The nonhoming-type rotary lineswitch is available in four different trunk capacities: 11, 16, 25, and 50 trunks, known as the 11-point, 16-point, 25-point, and 50-point rotary lineswitch. The latter has been used only under special conditions. When the 25-point rotary lineswitch is used as individual line equipment (primary lineswitches), the outgoing trunks generally terminate directly in connectors or selectors. A common group of twenty-five trunks is very efficient with respect to the traffic which can be handled by the group during the busy periods.

The homing-type rotary lineswitch is available only in the 10-trunk and 16-trunk capacities.

2. 25-POINT LINESWITCH MECHANISM

The rotary lineswitch, shown in figure 1, consists of two major parts: the relay assembly and the rotary switching mechanism with associated bank. The line and the cut-off relays, composing the relay assembly, are built into a compact group which may be either directly associated with or disassociated from the rotary switch mechanism. The rotary switch is a simple but sturdily-constructed selecting mechanism, comprising essentially a semi-cylindrical bank of contacts over which a set of wipers rotate by means of a ratchet mechanism actuated by a motor magnet.

2.1 Relay assembly. The relay assembly consists of two relays: the line relay (slow-acting), and the cut-off, or B.C.O., relay (quick-acting). A mechanical interlocking device, shown in figure 2, interconnects the armatures of the two relays.

On incoming calls, with the line relay at normal, a finger on the cut-off relay armature strikes the end of the interlocking spring. The cut-off relay armature will move only enough to open all break contacts but not sufficiently to close any of its make contacts. When the line relay is energized on an outgoing call, a finger on the line relay engages

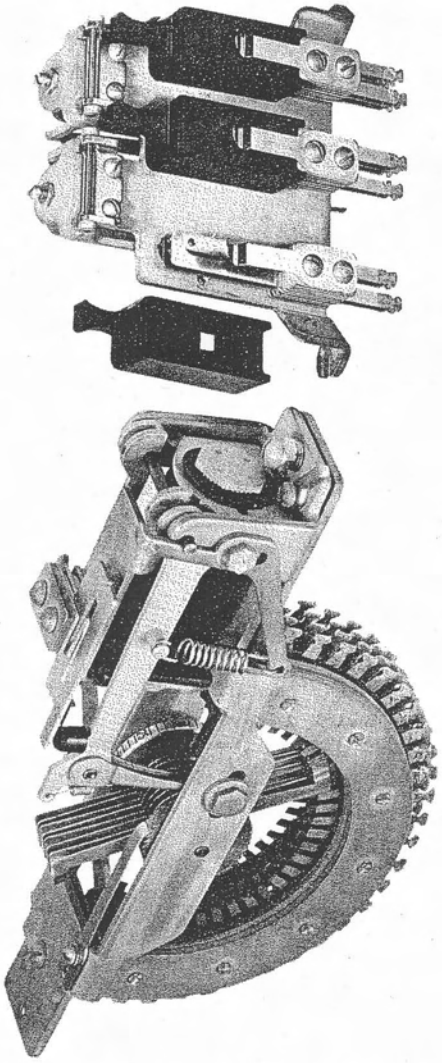

Figure 1. 25-point lineswitch.

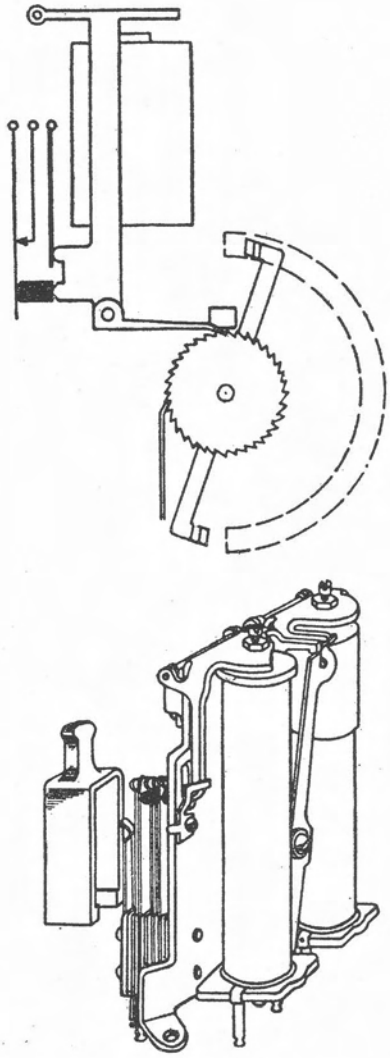

Figure 2. Construction details.

an inclined plane at the end of the interlocking spring, moving the end of this spring out of engagement with the finger of the cut-off relay armature. In this case, when energized, the cut-off relay armature operates completely, closing all make contacts.

2.2 Rotary switch mechanism. The rotary switch mechanism uses a semi-cylindrical bank having three or four levels, each containing twenty-five contacts. A pair of double-ended wipers rotates over each level of contacts. When one end of a wiper is on the bank contacts, the other end is free from the bank. This arrangement and the unidirectional motion of the switch maintain a set of wipers in contact with the bank terminals at all times. When one end of the wipers is leaving contact twenty-five, the other end is approaching contact number one. By rotating through a half circle, the wipers successively step over all contacts. The electrical circuit to each wiper is maintained through a brush spring which makes contact with the wiper, at the hub of the assembly. The control wipers, which test for an idle trunk, have more wiping surface than the others, so that while rotating from one trunk to the other they are always in contact with at least one control bank contact. This preserves the continuity of the circuit if successive contacts are grounded (busy trunks).

Figure 2 shows the driving mechanism of the rotary switch. A ratchet wheel mounted on the wiper shaft is engaged by a pawl pivoted to the arm of the motor-magnet armature. When the motor magnet is energized, this pawl is withdrawn from the ratchet wheel. It engages the next tooth when the motor magnet is de-energized. A drive spring causes the pawl to engage the ratchet tooth, stepping the wipers one step ahead when the motor magnet releases. At the end of the driving stroke, the pawl strikes a stationary stop which presses the pawl against the ratchet wheel, locking the latter to prevent "overthrow." A stationary detent also engages the ratchet wheel, preventing any backward movement of the wipers when the pawl is released.

3. 11-POINT AND 16-POINT LINESWITCH MECHANISM

Figure 3 is a view of the 11-point, homing-type rotary lineswitch showing the relative positions in which the relays and the mechanism are mounted. The 16-point rotary lineswitch is similar to the 11-point lineswitch except for the trunk capacity.

3.1 Relay assembly. The relay assembly except for the mounting bracket is similar to that used with the 25-point rotary lineswitch. The bracket of the 11-point and the 16-point switch permits mounting the relay assembly directly on the rotary switch frame.

The homing-type rotary lineswitch requires no mechanical interlocking device since the line can be seized only when the wipers are on the home position.

3.2 Rotary switch mechanism. While the 11-point and 16-point rotary switch mechanisms are smaller and different in construction, the mechanical functions are similar to those of the 25-point rotary switch and, therefore, will not be repeated.

As shown in figure 3, the pawl, a flat flexible spring, is fastened directly to the arm of the motor magnet armature. The spiral drive spring, secured to the armature proper, is used for restoring the pawl.

A set of cam (off-normal) springs, normally open when the wipers are in the home position, is required with this type of rotary lineswitch.

4. ROTARY LINESWITCH FUNCTIONS

4.1 Outgoing calls. On calls originating from the telephone, the functions of the lineswitch are:

(a) To busy the line at the connector bank terminals against intrusion by incoming calls, immediately upon operation of the lineswitch line relay.

(b) To automatically hunt and seize an idle trunk.

(c) To extend the line through to the selected connector or selector.

(d) To clear the line of all bridges or attachments.

(e) To connect the subscriber's meter to the trunk meter lead, when message register service is provided.

(f) To restore to normal when the calling telephone disconnects.

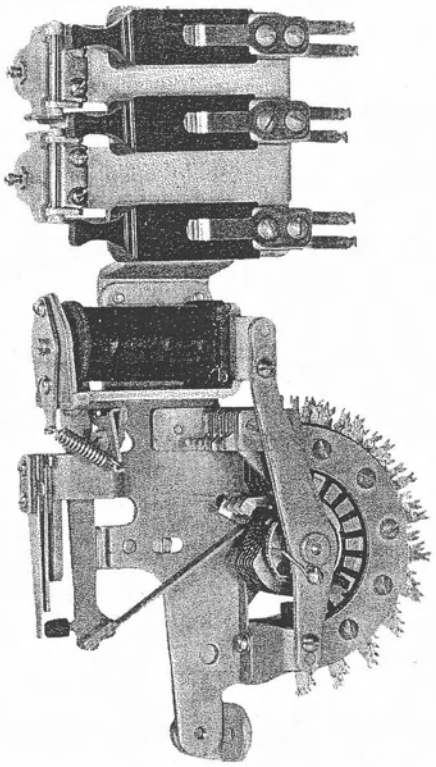

Figure 3. 11-point lineswitch.

4.2 Incoming calls. On calls to the telephone, the functions of the lineswitch are:

(a) To prevent the lineswitch from engaging a connector or selector trunk.

(b) To free the line of all bridges or attachments.

5. NONHOMING LINESWITCH CIRCUIT

A schematic circuit for the nonhoming-type primary rotary lineswitch (in this case, 25-point) is shown in figure 4. The 16-point and 11-point switches use the same circuit. The only difference is in the number of trunks accessed.

5.1 Outgoing calls.

5.1.1 Seizure. When the handset of the calling telephone is removed from the cradle, a circuit is established from ground through the winding of the common supervisory-ground relay, a break contact on the B.C.O. relay B, over the (+) line, through the telephone, back over the (-) line, through another break contact of relay B, and the 800Ω winding of relay A to battery. Relay A operates.

5.1.2 Seeking an idle trunk. Relay A operates and closes its "X" contacts. If the wipers are resting on a busy trunk, ground from the control bank contact is connected to the 95Ω winding of the motor magnet through

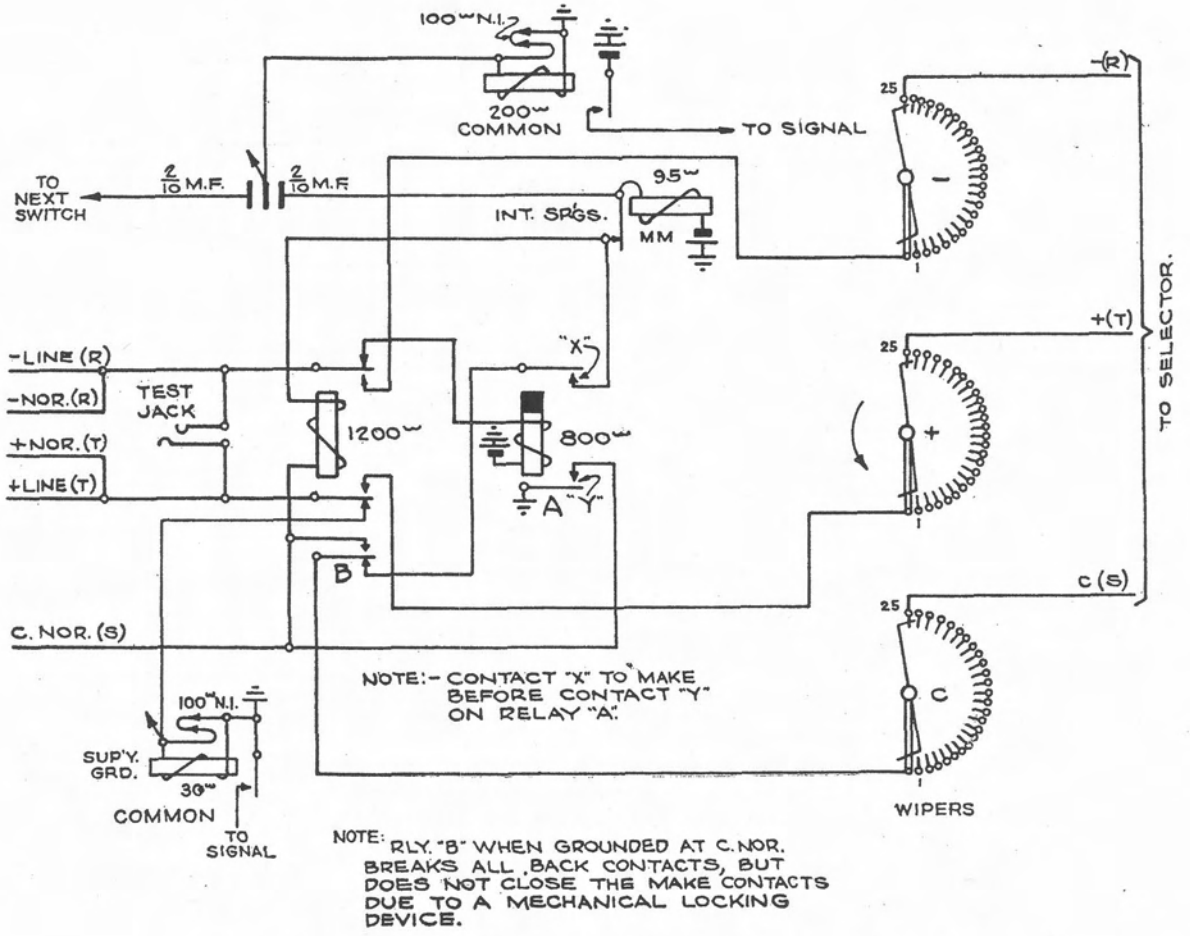

Figure 4. Rotary lineswitch circuit, nonhoming type.

the control wiper, a break contact on relay B, the "X" contacts on relay A and the interrupter springs, causing the motor magnet to operate. Ground from the control lead is also connected to one terminal of the 1200Ω winding of relay B through the "X" contacts of relay A. Ground is also connected to the other terminal of this winding when the "Y" contacts of relay A close. This shunting of the relay B coil prevents it from operating when the wipers engage a busy trunk. Ground is also connected to the control normal, through the "Y" contacts of relay A to busy this line to incoming calls.

The operation of relay A moves the locking spring out of alignment with the locking finger, on the armature of the cut-off relay. Relay B operates fully. When the motor magnet operates, its circuit is opened at the interrupter springs. The motor magnet de-energizes and its armature and pawl, restoring to normal under the power of the drive spring, step the wipers ahead one step. This is repeated as long as the control wiper encounters busy (grounded) control bank contacts. When an idle trunk is found, the control wiper will not encounter ground and, therefore, the shunt around the 1200Ω winding of the cut-off relay B is removed.

5.1.3 Engaging an idle trunk. When an idle trunk is found, a circuit is established from ground, through the "Y" contacts of relay A, the 1200Ω winding of relay B, the interrupter springs, the 95Ω motor magnet coil to (-) battery operating relay B. The high resistance of relay B coil prevents the motor magnet from operating in series with it.

5.1.4 Switching through. Relay B operates and extends the telephone line and the control lead through the wipers and bank contacts to the switch ahead. The operation of relay B also opens the operating circuit for relay A and clears the line of attachments.

Relay A is slow-acting, keeping the ground circuit connected to relay B until ground is returned over the control lead from the succeeding switch. Relay B is held operated until the connection is released.

No stepping occurs when the rotary switch is seized, if its wipers are resting on an idle trunk.

5.1.5 Releasing. When the handset is replaced, the loop to the telephone is opened and the

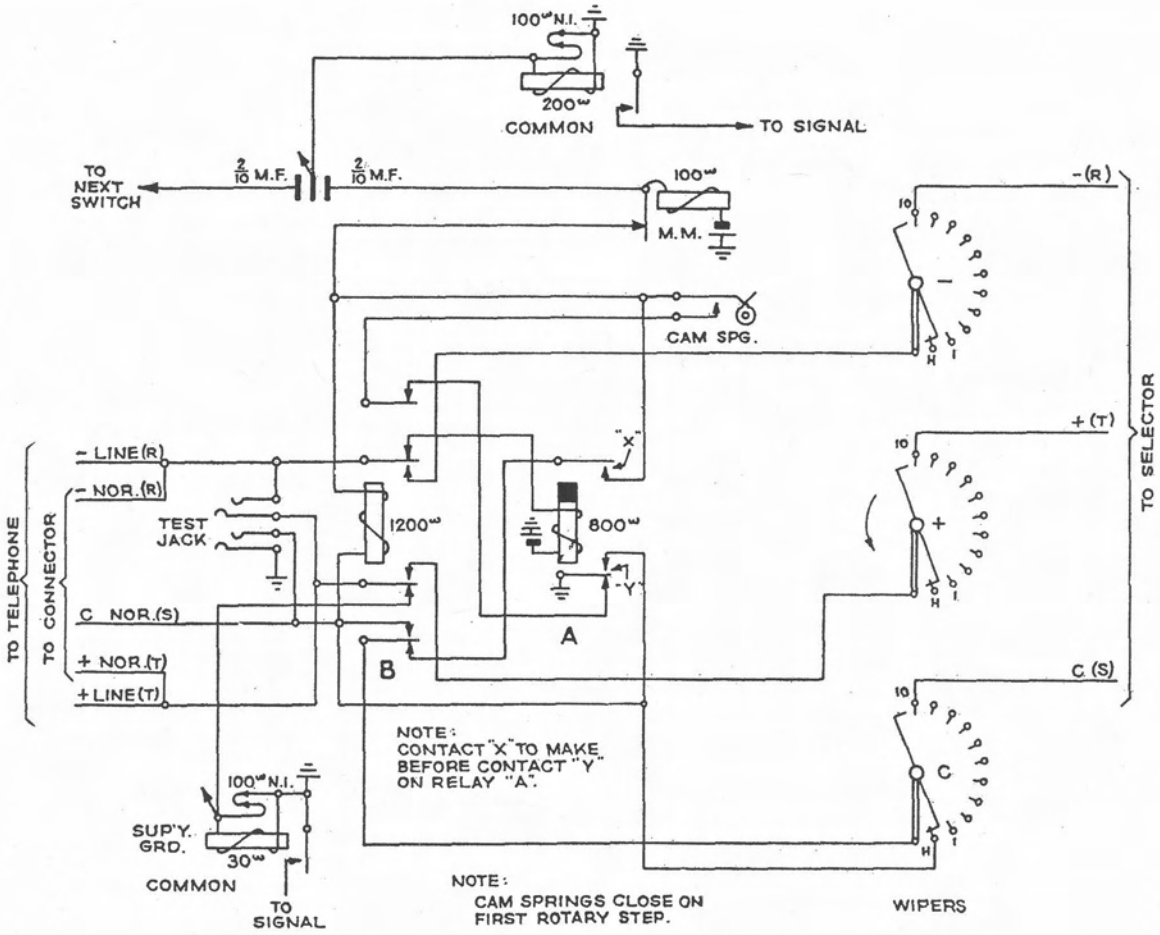

Figure 5. Rotary lineswitch circuit, homing type.

switch ahead disconnects ground from the control lead. Relay B restores, disconnects the line and control leads from the trunk, and re-establishes the circuit for relay A. The switch is now normal ready for another call.

5.2 Incoming calls. On incoming calls the connector places ground on the control normal lead. A circuit from this ground through the 1200Ω winding of cut-off relay B, the interrupter springs and the 95Ω winding of the motor magnet to (-) battery operates relay B. When relay B operates, the locking finger on its armature engages the end of the locking spring. This prevents full operation of its armature.

The movement of the armature, however, is sufficient to open the circuit to relay A and clear the line of attachments. This mechanical interlocking device prevents the armature of relay B from closing its make contacts and the telephone line is not extended through to a primary trunk.

5.3 Supervision. In figure 4 a relay, having its 30Ω winding shunted by a 100Ω N.I. resistance, is connected in the common lead supplying ground to the (+) line through a make contact on relay B. This relay operates and sounds an alarm when any rotary switch in the group fails to extend the telephone line to the switch ahead within a reasonable length of time after it is seized.

The N.I. resistance, connected in parallel with the winding of this supervised ground relay, prevents excessive sparking at the break contact of relay B. Spark suppression for the motor-magnet interrupter springs is shown in figure 4. A .2 M.F. condenser is supplied for each lineswitch. One terminal is connected to the motor-magnet winding. The other (center) terminal is connected to ground through a common relay, having its 200Ω winding shunted by a 100Ω N.I. resistance. This relay causes an alarm to sound should any condenser become short-circuited.

6. HOMING LINESWITCH CIRCUIT.

A homing-type primary lineswitch circuit is shown in figure 5. The line bank contacts, in the home position, are unwired. Therefore, a mechanical interlocking device is not used since the cut-off relay B may be fully operated on the incoming calls.

6.1 Outgoing calls.

6.1.1 Seizure. When the handset is removed from the cradle, relay A is operated over the calling party's loop. A circuit to the motor magnet is closed from ground at the "Y" contacts of relay A, the control bank contact and wiper, at the home position, a break contact of relay B, the "X" contacts of relay A, and the interrupter springs, to the 100Ω winding of the motor magnet and (-) battery. Ground is also connected to the control normal lead to prevent intrusion by incoming calls.

The motor magnet operates, interrupts its own circuit and releases. This causes the drive spring to act upon the armature and pawl to step the wipers off the home position and onto the first set of bank contacts. When the control wiper leaves the home bank contact, it disconnects ground from the winding of the motor magnet. If the first trunk is busy, ground on the control bank contact will re-operate the motor magnet to step the wipers to the next set of contacts. This stepping action will continue as long as busy trunks are encountered. When the wipers step from the home position, a part of an incomplete restoring circuit for the motor magnet is closed through the cam springs.

The ground on the control lead of a busy trunk also shunts the B.C.O. relay B. This prevents it from operating when the wipers are engaging a busy trunk.

6.1.2 Engaging an idle trunk. When the switch wipers find an idle trunk no ground is encountered on the control bank contact. Therefore, the motor magnet does not reoperate and the shunt is removed from the winding of the relay B coil. Relay B now operates from ground at the "Y" contacts of relay A in series with the motor magnet. The high resistance of relay B prevents the motor magnet from functioning at this time.

6.1.3 Switching through. The operation of relay B extends the telephone line and the control lead to the switch ahead. It also opens the circuit to relay A and clears the line of attachments. Relay A is slow acting and does not release before ground is returned over the control lead, from the switch ahead. Relay B is held operated by this ground until the connection is released.

6.1.4 Releasing. When the handset is returned to the cradle, the switch ahead releases and removes ground from the control lead, causing relay B to restore. This completes a circuit from ground through the break contacts of relay A and B, the cam springs (which closed when the switch stepped off the home position), the interrupter springs, and the motor magnet to (-) battery. The motor magnet will step the switch wipers to the home position. At this point the cam springs open the motor magnet circuit to prevent further rotary stepping. The switch has now restored to its normal position ready for another call.

6.2 Incoming calls. On incoming calls the connector places ground on the control normal lead operating B.C.O. relay B.

Relay B operates, opens the relay A circuit and, clears the line of attachments.

When the handset is returned to the cradle, relay B releases and recloses the relay A operating circuit. The switch has now restored to normal ready for another call.

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