MAGNETIC LATCHING RELAY
TIMING TEST SET J94735A OPERATION

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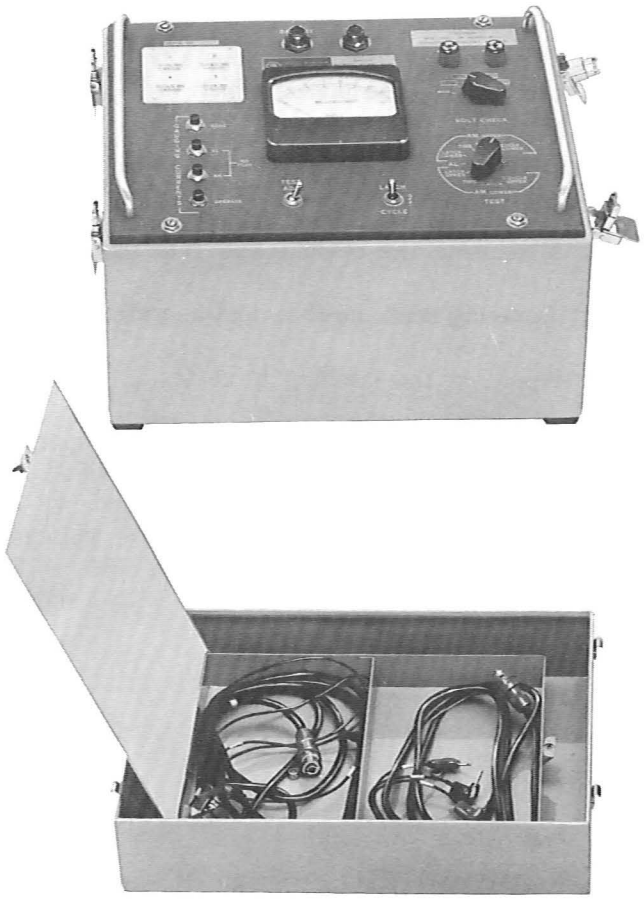

Fig. 1—194735A Magnetic Latching Relay Timing Test

1. GENERAL

1.01 This section describes the operation of the J94735A Magnetic Latching (ML) Relay Timing Test Set (Fig. 1) called for in Section 040-505-501.

1.02 This section is reissued to change the positions of the TEST ADV switch from left to right and right to left where referenced in 6.10 through 6.15. The block diagrams, Fig. 3 and Fig. 5, are also changed to show the correct switch position and lamp sequence.

1.03 The timing test set is portable and consists of voltage regulators, a delay unit, a pulse timer, a relay operate and release detector, and a moving coil meter calibrated in milliseconds. This meter is used to check input internal voltages and to show the operate and the release times for the ML relay under test.

1.04 The ML relay differs from the more familiar types. The ML relays have a core material

which retains enough residual magnetism to hold it operated after the operating current is removed. The ML relay releases when the residual magnetism is reduced by a current pulse in the direction opposite to that of the current which operated the relay. This characteristic makes possible use of a single lead for operating and releasing this type of relay.

1.05 The timing test set develops a train of operate and release pulses which are applied to the relay under test by means of a test cable.

1.06 The timing test set provides means for:

(1) Measuring the operate and release time

(2) Applying soak, no-flux, and operate currents

(3) Applying the latching force tests.

1.07 The timing test set is designed to operate from the +24 and -48 volts provided on central office frames. Since the performance of the timing test set depends upon these voltages being within limits, +25.5 ±0.8 and -51 ±1.75 volts, the timing test set is provided with a means to check these voltages.

If these voltage levels are not available, it is necessary to provide a method for obtaining them. Maximum current drawn by the timing test set is 0.350 amperes from each power source.

1.08 This timing test set is equipped with a safety circuit in the power input circuit which makes it possible to cause a short in the system supplying the voltages. The safety circuit consists of one AK-24 relay which prevents an electrical connection to the system unless the battery is attached correctly.

1.09 Two cables (W3BC and W3BD) are provided with the timing test set and are stored in a compartment of the timing test set cover (Fig. 1). The W3BC cord is used to connect the timing test set to a power source; the W3BD cord connects the timing test set to the relay to be tested.

2. CONTROLS FOR TESTING

2.01 The controls for the timing test set (Fig. 2) and the purpose of each setting are listed in Tables A, B, and C as follows:

Fig. 2—194735A Timing Test Set, Front Panel

TABLE A
CONTROLS

CONTROL	POSITION	PURPOSE
TEST	AL	For checking the timing of the AL-type ML relays.
AM UPPER	LATCH LOWER	For latching lower relay during the testing of the upper relay.
	TIME	For connecting all portions of the timing test set used in determining the operate and release time of the relay under test.
	LATCH	For latching the relay under test during the latching force tests made in Section 040-505-501.
	CYCLE LOWER	For cycling the lower relay during the latching force tests.
AM LOWER	LATCH UPPER	For latching upper relay during the testing of the lower relay.
	TIME	For connecting all portions of the timing test set used in determining the operate and release time of the relay under test.
	LATCH	For latching the relay under test during the latching force tests made in Section 040-505-501.
	CYCLE UPPER	For cycling the upper relay during the latching force tests.
VOLT CHECK	NOR	For changing the voltmeter part of the timing test set from voltage measurements to timing measurements.
	+21 −43 +26 −52	For connecting the metering circuit in the timing test set to check the listed voltages.
GAUGING CURRENTS	SOAK	For providing a soak current for either AL- or AM-type relays.
	AL NO-FLUX	For providing a no-flux current for AL-type relays.
	AM NO-FLUX	For providing a no-flux current for AM-type relays.
	OPERATE	For maintaining an operate current of approximately 200 milliamperes through the relay under test.
TEST ADV	Right (R) or Left (L)	For controlling the steering relay circuit internal to the timing test set which provides a method for changing the voltages being applied to the relay under test.

TABLE A

CONTROLS (Cont)

CONTROL	POSITION	PURPOSE
LATCH OFF CYCLE	LATCH	For providing a positive latch on the relay under test used with both AM- and AL-type relays.
	OFF	For breaking the clock circuit path so that no cycling or latching of the relay is possible while the switch is in this position. This position does not remove power from the timing test set.
	CYCLE	For providing an electrical path for the operation of the clock internal to the timing test set during the timing tests.

TABLE B

INDICATORS

INDICATOR	PURPOSE
Meter (center of timing test set)	Indicates operate or lease time in milliseconds when VOLT CHECK switch is in NOR position. When VOLT CHECK switch is off NOR, meter is connected to check indicated voltages.
Timing Panel (upper left corner of timing test set)	Indicates which of four test modes the timing test set is in (see Section 040-505-501). The timing panel will be completely lighted as a warning when the OPERATE pushbutton is left in the operated condition.

TABLE C

CONNECTORS

CONNECTOR	PURPOSE
BATTERY	For attaching timing test set to a power cord.
TEST	For connecting timing test set to the test cord.

3. PURPOSE

TIMING TEST SET

3.01 The purpose of the timing test set is to determine if ML relays are in adjustment. The timing test set checks these adjustments by:

(a) Measuring the operate and the release times of ML relays under two specific supply voltage conditions.

(b) Applying soak and no-flux currents to these relays.

(c) Operating one half and cycling the other half of an AM-type relay as required in latching force measurements.

(d) Cycling an ML relay to permit visual observations.

(e) Automatically cycling an ML relay at either 2 or 20 complete cps.

(f) Providing pulse path parameters (operating conditions) similar to those used in operating equipment.

(g) Performing a check of both supply voltages and both internally regulated voltages.

4. OPERATION

CONDITIONING EQUIPMENT TO BE TESTED

4.01 Prior to checking an ML relay, the circuit requirement table of the associated circuit should be consulted.

Timing Test Set

4.02 The timing test set must be set up in the following manner:

(1) Connect the timing test set to a power source (1.06) using the W3BC cord.

Caution: When the W3BC power cord for the timing test set is attached to the power sources, the ground lead should be attached first. On disconnection, remove the ground lead last.

(2) Perform a voltage check prior to making any test by turning the VOLT CHECK switch clockwise from NOR (normal) to each of the four positions (+21, -43, +26, and -52). If these voltages are at nominal values, the meter will deflect into a red region for +26 and -52 volts and into the blue region for +21 and -43 volts. If either the +26 or -52 volt checks read below the red region, it is an indication that the voltage source is too low to make the tests. If these two voltages are at the prescribed value as indicated by the red region on the meter but the +21 or -43 volt checks read above or below the blue region, the regulator circuits in the timing test set will require adjustment or other service. Section 100-136-701 describes the calibration adjustments for the timing test set. After the voltage check is completed, the switch must be returned to NOR.

5. TESTS

5.01 The timing test set performs tests on ML relays which are described in the following paragraphs.

RELAY TESTS

A. AL-Type Relays

5.02 ***Relay Timing***

(a) Connect the W3BD cord as follows:

(1) The GRD lead to terminal 1L.

(2) The UPPER lead to terminal 1U.

(3) Do not connect LOWER lead.

(b) Set TEST switch to AL.

(c) Set VOLT CHECK switch to NOR.

(d) Set LATCH/CYCLE switch to CYCLE.

(e) For each operation of the TEST ADV switch, read time on the meter located on the control panel until all four timing tests are completed.

The limits for each test are covered in Section 040-505-501.

B. AM-Type Relays

5.03 ***Relay Timing—AM UPPER***

(a) Connect the W3BD cord as follows:

(1) The GRD lead to the ground side of the relay coil to be tested found at terminal 2L or 2U.

(2) The UPPER lead to terminal 1U.

(3) The LOWER lead to terminal 1L.

(b) Set VOLT CHECK switch to NOR.

(c) Set LATCH/CYCLE switch to OFF.

(d) Set TEST switch to LATCH LOWER (AM UPPER section).

(e) Set LATCH/CYCLE switch to LATCH momentarily to operate the lower relay.

(f) Set TEST switch to TIME (AM UPPER section).

(g) Set LATCH/CYCLE switch to CYCLE.

(h) For each operation of the TEST ADV switch, read time on the meter located on the control panel until all four timing tests are completed. The limits for each test are covered in Section 040-505-501.

(i) After the tests in (h) are completed, set LATCH/CYCLE switch to OFF.

(j) If this portion of the check is within the tolerance specified in Section 040-505-501, proceed to the next check of AM-type relays.

5.04 ***Latching Force—AM UPPER:*** With the relay still connected from the above test and the timing test set in test mode 1 or 4 (as indicated on the illuminated panel), proceed as follows:

(a) Set TEST switch to LATCH (AM UPPER section).

(b) Set LATCH/CYCLE switch to LATCH momentarily.

(c) Set TEST switch to CYCLE LOWER (AM UPPER section), and then operate the LATCH/CYCLE switch to the CYCLE position for 5 seconds to allow approximately 100 cycles of the lower relay.

(d) Measure the latching force of the upper section of the relay using the prescribed gauges and the procedures covered in Section 040-505-501.

5.05 ***Relay Timing—AM LOWER:*** For timing tests for the lower section of the relay, it is only necessary to change TEST switch to AM LOWER section and proceed as covered in 5.03.

5.06 ***Latching Force—AM LOWER:*** For the lower section of the relay, it is only necessary to change the TEST switch to the AM LOWER manner as covered in 5.04.

5.07 ***GAUGING CURRENTS***

(a) Connect relay test leads as covered in 5.02 (AL-type relays) or 5.03 (AM-type relays).

(b) Apply the SOAK current to the relay under test.

(c) Apply the appropriate NO-FLUX current (AL or AM) to release the relay from SOAK.

(d) Remove the power cable from the timing test set.

6. DESCRIPTION

TIMING TESTS

6.01 Fig. 3 is a block diagram of the relay timing test showing the electrical connections to the AM-type relay. With the LATCH/CYCLE switch in the CYCLE position, an interval of time (operate or release) can be read on the meter. Section 040-505-501 specifies the requirements for each timing test.

6.02 The heart of the relay test is the clock circuit which initiates pulses to begin the operation for checking operate and release time (Waveform 1, Fig. 4). When the LATCH/CYCLE switch is placed in the CYCLE position, the clock circuit will deliver a pulsed output.

6.03 Steps to operate the relay under test will start when the clock pulse causes S relay to energize (Waveform 2). At this time, contacts from S relay (Waveform 3) trigger the pulse timer and the path for the application of a regulated -43 volts is made available for the operation of the relay under test. No application of the voltage is made, however, until the pulse timer triggered by S relay operates the T relay (Waveforms 4 and 5). With the operation of the T relay, a path for the operate or release pulse is actually made available to the relay under test causing it to operate. The operation of the T relay triggers the 4-millisecond delay circuit (Fig. 5).

6.04 The trigger for the 4-millisecond delay is achieved by the discharge of a capacitor at its input which started charging at the start of the clock. This capacitor is discharged when T relay switches the connection of the capacitor from its charging path to a discharging path through a resistor at the input of the 4-millisecond delay circuit.

6.05 When the 4-millisecond delay is triggered, it provides a pulse (Waveform 6, Fig. 4) which sets the detector flip-flop. The setting of the detector flip-flop provides a potential of +15 volts at its output. C_t is prevented from charging to this +15 volts until the 4-millisecond delay times out (Waveform 7). At the end of 4 milliseconds, C_t starts to charge.

6.06 At this point in checking the operate and release time of an ML relay, only the check pulse (covered in Section 040-505-501) is necessary to bring the cycle to completion.

6.07 As soon as the operate pulse causes the ML relay under test to energize, the superimposed operate check pulse is available (Waveform 8). When the detector sees this check pulse, it will deliver a negative output pulse (Waveform 9) which will reset the detector flip-flop (Waveforms 10 and 11). The resetting of the detector flip-flop will remove the +15 volts toward which C_t was charging . The level to which C_t was allowed to charge is shown on the meter in the center of the timing test set.

6.08 The meter on the front panel of the timing test set (Fig. 2) is calibrated in milliseconds; the range being from 4 to 12 milliseconds. Four milliseconds after the operation of the T relay, C_t will begin to charge toward the +15 volts available at the output of the detector flip-flop. Ct will continue to charge until the returned superimposed check pulse is detected and the flip-flop has a change of state. The extent to which C_t charged in this circuit is measurable by the meter circuit. The amount of charge is directly dependent on the amount of time that it was allowed to charge. Therefore, for less time, less charge; for more time, more charge.

6.09 The maximum reading of 12 milliseconds is used since the T relay changes state approximately every 12 milliseconds. If the check pulse arrives later than 12 milliseconds or earlier than 4 milliseconds after the operation of the T relay, the time indicated on the meter will always be greater than 12 milliseconds. The timing test has four parts which are selected by the TEST ADV switch.

STEERING CIRCUIT FOR CHECKING OPERATE AND RELEASE TIME

6.10 There are two voltage combinations used for checking both the operate time and release time of AL- and AM-type ML relays. To begin the cycle of the checks, A and B relays located in the steering circuit are de-energized (Fig. 5). The TEST ADV switch (S4) is in the ▶right position◀ and will illuminate lamp No. 1. (Fig. 2 shows the lamps on the front panel; Fig. 5 shows a block diagram.) Lamp No. 1 is lighted by +24 volts through TEST ADV switch (S4) and normally closed contacts of B relay to ground.

6.11 In the test of operate and release timing, A relay selects the voltage combination (-52 and +21 or -43 and +26) which is switched intermittently by S and T relays to the relay under test. These voltages arrive at the relay under test as negative and positive pulses with widths and frequency determined by the pulse timer and clock. The time required for the operate or release is read on the meter. In this present state (timing test 1), only the operate time is checked since the input to the 4-millisecond delay circuit is inhibited when the release pulse is applied to the relay under test.

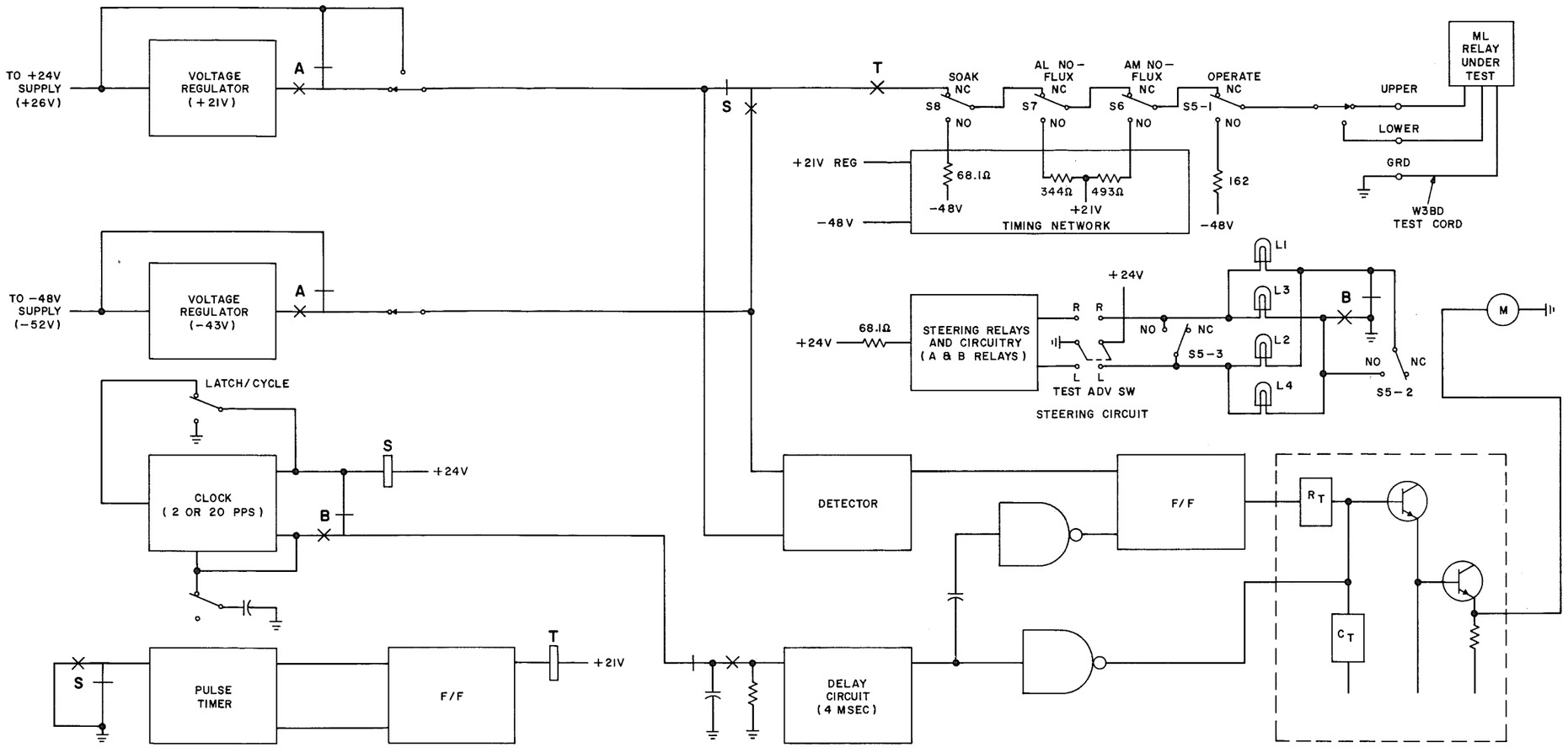

Fig. 3—Relay Timing Test for AM-Type Relay, Simplified Block Diagram

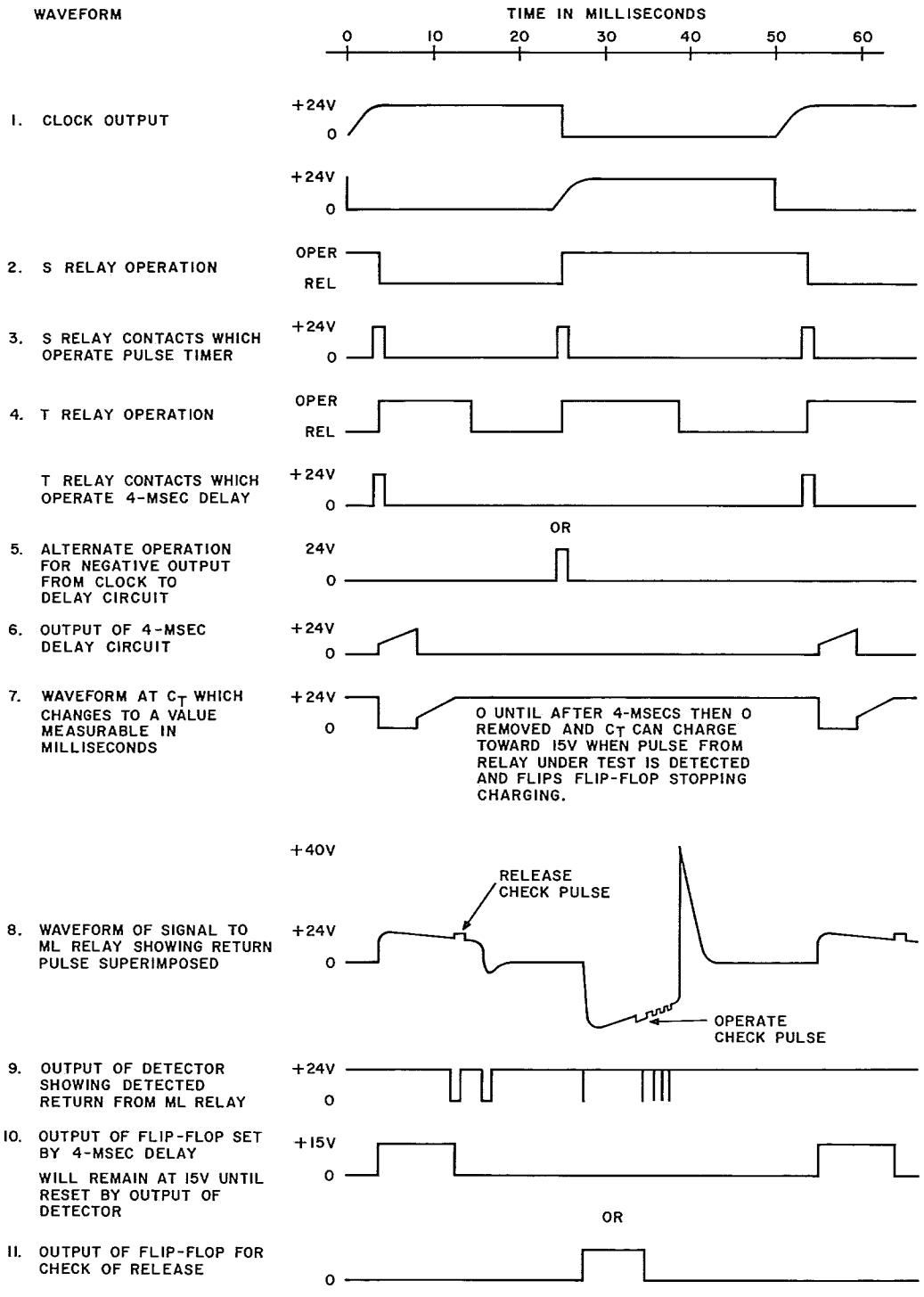

Fig. 4—Operation of Timing Test Set at 2 Pulses Per Second

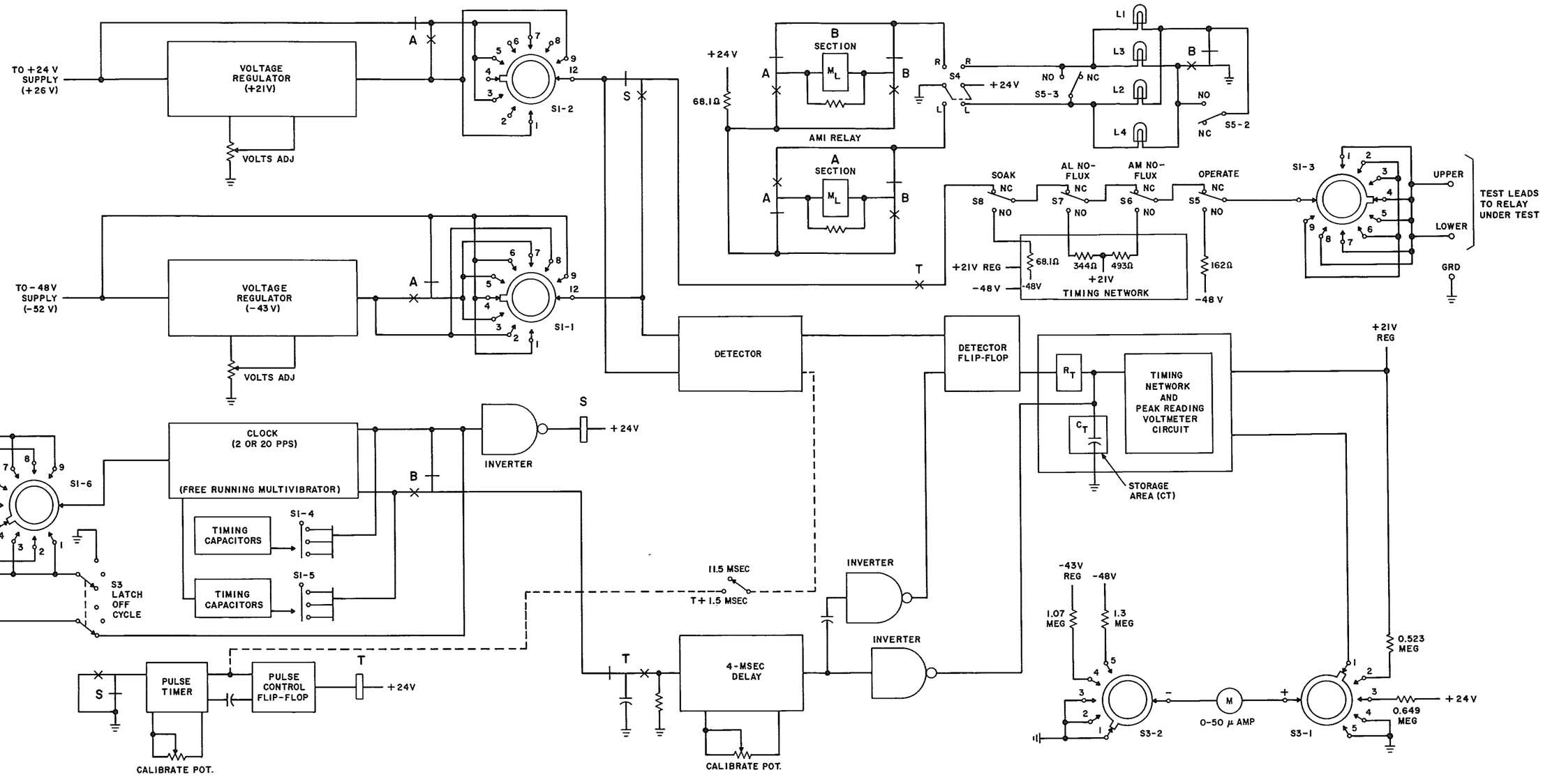

Fig. 5—194735A Magnetic Latching Relay Timing Test Set, Block Diagram

6.12 Three additional steps are now made to check the ML relays by changing the position of the TEST ADV switch three times. When the TEST ADV switch is changed from its initial position (right) to left, +26 volts is applied to operate A relay through a 68.1-ohm resistor, a normally closed contact of A relay, a normally closed contact of B relay, and a ground provided by the TEST ADV switch. At this time the state of the test is indicated by lamp No. 2 which is lighted by a normally closed contact in the de-energized B relay. Other contacts of A relay have now changed the voltage being applied to the relay under test from +26 volts unregulated and -43 volts of regulated voltage to +21 volts regulated and -52 volts unregulated.

6.13 The next condition for checking the ML relay comes when the TEST ADV switch is changed from the left position to the right position. At this time B relay is operated through the 68.1-ohm resistor. Relay A remains latched by the residual magnetism in its core. The operate path for the B relay is through its own normally closed contact and a contact on A relay (closed when A relay was energized). The same voltage is still being applied to the relay under test except that the test is now for release time since the input pulses to the 4-millisecond delay circuit is inhibited when the operate pulse is applied to the relay under test. At this time the condition of the test is indicated by lamp No. 3 which is lighted by +24 volts and a ground picked up through closed contacts of B relay.

6.14 The next condition comes when the TEST ADV switch is again set to the left position. Relay A picks up +24 volts for release through the same resistor and closed contacts of both A and B relays. Release is accomplished by applying the same +24 volts used for operate but in an opposite direction. The test at this time is one of release time since the B relay is still energized and the 4-millisecond delay circuit is only triggered at the start of the release pulse. Lamp No. 4 is lighted at this time picking up a ground through contacts of the B relay which were made when it was operated.

6.15 When the TEST ADV switch is again placed in the right position, the B relay picks up the +24 volts release voltage through the 68.1-ohm resistor and closed contacts which were made when B relay was made and A relay was released. Both A and B relays will be in the released condition and all four timing tests will have been completed. This condition is indicated by lamp No. 1 which is illuminated by picking up a ground through a normally closed contact of the B relay as covered in 6.10.

6.16 In addition to the timing tests, the timing test set affords the operator the facility for applying gauging currents (SOAK and NO-FLUX). The gauging currents are used in checking for mechanical adjustments and are selected by pushbuttons. The pushbuttons will apply the correct current to the output lead for whichever relay is to be tested. The operation of any one of these pushbuttons will override the other controls in the timing test set as well as the test pushbutton preceding it. Gauging currents are made available with resistors to adjust the current for either the AL-type or the AM-type ML relays. For adjustments of these relays, refer to the gauging checks for the ML relays covered in Section 040-505-701.