

PULSING TEST SET - STEP-BY-STEP OFFICES

1. GENERAL

1.01 This section describes the pulsing test set SD-31481-01 (J34717A) which is designed for applying pulsing tests to step-by-step switches and interoffice repeaters. This test set provides a means of making more accurate tests of the pulsing relays and switch motor mechanism, and for insuring better service margins than is possible with the motor-driven interrupter, commonly known as the "varying machine", which it replaces.

1.02 The pulsing test set has the following principal features:

- (a) It employs a relay interrupter with a condenser-resistance method of timing.
- (b) Combinations of pulsing speed and values of per cent. break, in conjunction with loop and leak tests, simulate more nearly the service conditions imposed on the pulsing mechanism of the switch than is feasible with the "varying machine".
- (c) Provision is made for the following leak tests:
 - (1) Leak A: The approximate equivalent of the worst circuit condition on a minimum loop with one station ringer in series with a capacity of 2 mf.
 - (2) Leak B: The approximate equivalent of the worst circuit condition on a minimum loop with one station ringer in series with a capacity of 1 mf. This corresponds approximately to the conditions imposed by the "varying machine".
 - (3) Leak C: A modified leak condition for use on switches requiring compensated loops (except test distributors compensated for loops of over 750 ohms).
- (d) Provision for varying the resistance in the test circuit loop from 0 to 1400 ohms in 200-ohm steps.
- (e) A magnet pulsing test which permits a check of the switch motor mechanism adjustment independently of the pulsing relays.
- (f) Remote control by means of a No. 36-B test set.
- (g) Arrangement for use in conjunction with other test sets designed for this purpose, such as the connector test wagon.

- (h) A busy-guard feature to prevent interference with busy circuits.
- (i) Means for indicating momentary interruptions in the sleeve circuit when testing switches that return a ground on the sleeve.
- (j) Elimination of "pick-up" delay such as occurs in the "varying machine".
- (k) Convenient means for checking the accuracy of the pulses generated by the test set.

1.03 The pulsing test set furnishes pulses at the rate of 12 per second as compared with 14 per second with the "varying machine". It provides pulses having 68.5 per cent. break on loop tests and 60.5 per cent. break on leak tests against 61 per cent. break on both loop and leak tests with the "varying machine". An indication of the relative severity of the testing conditions provided by the pulsing test set may be had by comparison with the approximate equivalents expressed in terms of the "varying machine" in the following table. These conditions can not, however, be considered identical since substitution of resistances in the "varying machine" would render it inoperative in certain cases or cause alteration of test margins in a different manner than the "equivalent" pulsing test set conditions.

<u>Pulsing Test Set</u>	<u>Varying Machine</u>
Loop (Ohms)	Loop (Ohms)
1200	1580
1000	1350
800	1200
600	*1000
Leak	Leak (Ohms)
"A"	10000
"B"	*15000

* Indicates standard values for the "varying machine".

1.04 The magnet pulsing test is intended primarily for use on switches which have failed on the leak condition on the overall pulsing test, and is used as a means of determining whether or not the trouble is due to the switch motor mechanism. Two magnet pulsing conditions are provided in the test set, one for use where the leak A condition is applied on the overall test and the other for use where the leak B condition is applied.

2. EQUIPMENT FEATURES

2.01 The apparatus of the pulsing test set is mounted in the size "C" (medium ladder size) standard metal portable test set housing. The dimensions of this box are 7-1/2" x 9-1/2" x 14-1/4".

2.02 The principal elements of the test set, consisting of a No. 206 type selector, relays, condensers and resistances, (except a No. 44-A resistance) are mounted within the box. Three locking lever type keys, three locking push button type keys, a lamp, and a No. 44-A resistance and associated cage are located on top of the set. Six jacks are mounted on the end of the box above the handle.

2.03 The apparatus which is exposed to view is shown in Fig. 1.

2.04 The three push button type keys are designated 200, 400 and 800 and are depressed to insert resistance in the pulsing loop.

2.05 One lever type key, designated LKA and LKC, is used in applying the leak A and the leak C test conditions. Another lever type key, designated LKB and CHK PLS, is used in applying the leak B test condition and in delivering continuous pulses for checking the accuracy of the test set. The other lever type key, designated MAG, is used in making the magnet pulsing test.

2.06 The lamp is designated BY. It indicates a busy condition of the circuit under test. Also, it is used when checking the test set pulsing speed.

2.07 The SW jack is used to connect to the circuit under test except for switches which require a ground forward on the sleeve in which case the TL jack is used. The TL jack is also used when checking the per cent. break period of the pulses or to supply pulses through other test sets arranged for this purpose. The MAG jack is used when making the magnet pulsing test.

2.08 Jacks A and B provide for connection with the No. 36-B (remote control) test set, or with other test sets arranged to control the pulses delivered to them by the pulsing test set.

2.09 Jack BAT-G is used for connecting battery and ground to the circuit.

2.10 Condensers within the set designated B and A1 to A6 together with associated terminal punchings are provided as a means of regulating the speed of pulsing.

2.11 Resistances within the set designated Z1 to Z24 are provided as a means of regulating the per cent. break (open) period of the pulses.

2.12 The No. 206 type selector is used for counting the pulses and for performing other control functions.

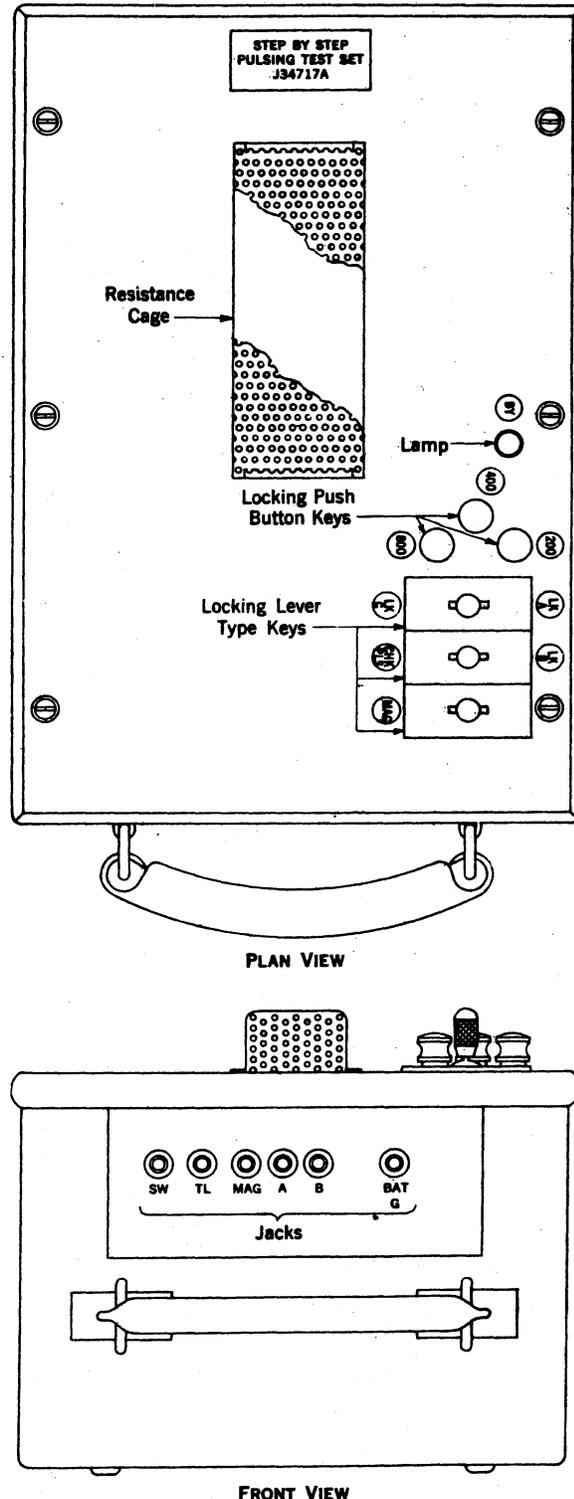


Fig. 1.

2.13 The cords, remote control test set and individual plug used with the pulsing test set are shown in Fig. 2. All of this apparatus, except the W2M and the P3E cords, is furnished with the set.

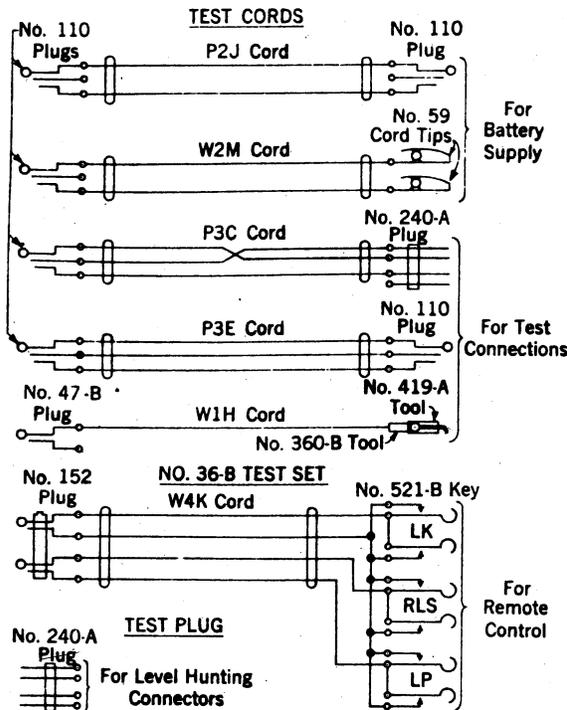


Fig. 2.

3. CIRCUIT FEATURES

General

3.01 The pulsing test set is a device for generating pulses, at a definite rate of 12 pulses per second, the per cent. break period depending upon the type of test being made.

3.02 The pulses may be delivered in one or more groups of nine pulses or in a continuous series of pulses. Nine pulses are generated by momentarily operating the LP or LK key of the No. 36-B remote control set, or the equivalent keys in an associated test set. Two or more groups of nine pulses, such as 99 or 999 etc., are generated by holding the key depressed until the test set starts to pulse the last digit. The continuous pulsing is set up by operating the CHK PLS key and then either the LP or LK key.

Note: Wherever the LP, LK and RLS keys are mentioned in this section it refers to the keys so designated on the remote control set (No.36-B).

3.03 The test set is so designed that if it is connected to a busy circuit the test set pulsing loop can not be closed,

thereby preventing interference to service. The BY lamp lights to indicate a busy condition.

3.04 When conducting tests on circuits which return a sleeve ground, the test circuit is under control of this ground. If the relay which supplies this ground tends to release during pulsing it will be immediately indicated by the opening of the pulsing circuit and the release of the circuit under test.

Pulsing Circuit

3.05 The principle of the pulse generating circuit of the pulsing test set is illustrated by the fundamental circuit shown schematically in Fig. 3.

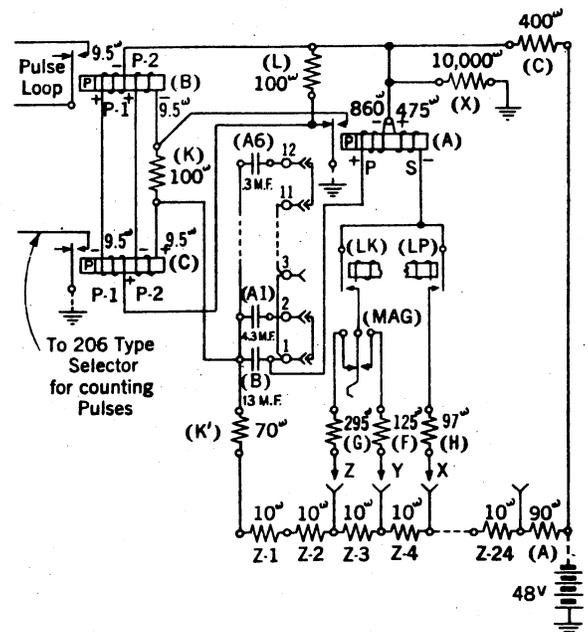


Fig. 3.

3.06 The polar relay A is the primary pulse relay. Two secondary polar relays, B and C, are controlled by the A relay. The B relay opening and closing its front contact interrupts the pulsing loop. Relay C is used to operate a counting device (a No. 206 type selector not shown for measuring the pulses in groups of nine except where the set is put into continuous operation.

3.07 In order to start generating the pulses, ground must be connected to the armature of the A relay and battery to the primary and secondary windings. This is accomplished by the operation of the LP relay for the loop test, and the LK relay for the leak and magnet pulsing tests, through contacts not shown in Fig. 3.

Note: The LK and LP relays are operated by the operation of the LP and LK keys not shown in Fig. 3.

3.08 The A relay has two windings, P and S, wired differentially. The current in the primary P winding results from the charging of the A and B condensers and therefore flows only for a limited time. The current in the secondary S winding is through a resistance path and continues to flow at a definite rate until a circuit change takes place. These two currents, under given conditions, are reversed and may be aiding or opposing in their effect.

3.09 Assuming that the A relay is making its back contact at the start, the B and C relays are operated to their front contacts. (The operating path is from battery through resistance C, in parallel with the series combination of resistances A, part of Z and F, G or H and the S winding of relay A, through the P-1 windings of relays B and C to ground on the back contact of the A relay.) The pulsing loop is closed by the B relay.

3.10 As indicated in 3.09, with the A relay making its back contact, current flows from battery through the S winding to ground at the back contact of the A relay. (This path is through resistances A, part of Z and F, G or H, through the S winding of relay A and through resistance L, in parallel with the series combination of the P-1 windings of relays B and C, to the back contact of relay A.) The charging current in the P winding is opposed to the current in the S winding. (This charging current results from a relatively low potential connected through the P winding of the A relay to one side of the condensers and a relatively high potential connected to the other side of the condensers.) Within a definite time, however, when the current in the P winding becomes sufficiently small due to the condensers becoming charged, the current in the S winding starts to operate the relay to its front contact.

3.11 As the armature leaves the back contact, the condensers start to discharge through the two windings of the A relay in series aiding in a direction which causes the relay to operate to its front contact.

3.12 With the A relay making its front contact, the B and C relays move to their back contacts. (The operating path is from battery through resistance A and part of Z, in parallel with the series combination of resistance C, the S winding of relay A and resistance F, G or H, and through the remaining part of resistance Z, resistance K, and the P-2 windings of relays B and C to ground on the front contact of the A relay.) The pulsing loop is opened by the B relay.

3.13 As indicated in 3.12, with the A relay making its front contact, current now flows from battery through the S winding (in the reverse direction) to ground at the front contact of the A relay. (This path is through resistance C, the S winding

of relay A, resistance F, G or H, part of resistance Z, resistance K, and through resistance K, in parallel with the series combination of the P-2 windings of relays B and C, to the front contact of relay A.) This tends to move the relay to its back contact. The charging current through the P winding (also in the reverse direction) is opposed to the current in the S winding. (This charging current results from a relatively high potential connected through the P winding of relay A to one side of the condensers, and a relatively low potential connected to the other side of the condensers.) As before, within a definite time, when the charging current in the P winding becomes sufficiently small, the current in the S winding starts to move the relay armature, this time to the back contact.

3.14 As the armature leaves the front contact, the condensers start to discharge through the two windings of the A relay in series aiding, this time in a direction which moves the relay armature to the back contact.

3.15 With the A relay making its back contact the B and C relays are again operated to their front contacts and the pulsing loop is again closed by the B relay. This action is continued as long as ground is maintained on the armature and battery on the windings of the A relay.

3.16 It is necessary to have the A relay operated to either its front or back contact in order to start pulsing when the LP or LK relay is operated. Since there is no mechanical bias on the A relay the armature can assume a floating position between the two contacts when the circuit is idle and, therefore, the 10,000 ohm resistance X is connected from ground to the junction of the P and S windings so that the A relay will operate to one of its contacts when the LP or LK relay is operated.

3.17 The less the capacity of the condensers, the shorter the time it takes to charge them and, therefore, the shorter the time that the charging current flows in the P winding of the A relay. As this current is the means of delaying the movement of the armature, the pulsing speed may therefore be increased or decreased, respectively, by decreasing or increasing the capacity.

3.18 When the A relay is making its back contact, the nearer the X, Y and Z leads are electrically to the battery the greater the current there is flowing in the S winding and, therefore, the shorter the time it takes to operate the relay to its front contact. When the A relay is making its front contact, the nearer these leads are to the battery the less current there is flowing in the opposite direction in the S winding and, therefore, the longer the time it takes to operate the relay to its back contact. Therefore the time during which the A relay makes its front contact

may be increased by moving the X, Y and Z leads closer to the battery. This results in increasing the per cent. break period of the pulses delivered by the B relay. Conversely the per cent. break period of the pulses is decreased by moving the X, Y and Z leads farther from the battery. These leads are connected independently of each other at such points that the overall resistances of the X, Y and Z paths result in per cent. break intervals of 68.5, 67 and 60.5, respectively.

3.19 The X path (68.5 per cent. break) is used for the loop test and is closed by operating the LP key.

3.20 The Y path (67 per cent. break) is used for the magnet test where the switches are being maintained to the leak A requirement. This path is closed by operating the MAG and LK keys.

3.21 The Z path (60.5 per cent. break) is used for the leak test, and also for the magnet test where the switches are being maintained to the Leak B requirement. For the leak test the Z path is closed by operating the LK key. For the magnet test it is closed by operating the MAG, LKB and LK keys. The operation of the LKB key (not shown in Fig. 3) has the effect of substituting the Z path for the Y path with the MAG key operated.

Overall Pulsing Tests (Local Type Switches)

3.22 The No. 36-B (remote control) test set is connected to jacks A and B.

3.23 The loop resistance to be employed is inserted by depressing the 200, 400 and 800 keys as required. Each key designation represents the amount of resistance in ohms which is inserted by depressing the corresponding key. The total value inserted is equal to the sum of the values represented by the individual keys depressed. Thus, by the selection of key combinations, the loop resistance can be varied from zero to 1400 ohms in 200-ohm steps.

3.24 Either the LKA or the LKB key is operated depending upon which leak requirement is to be applied.

3.25 The pulsing conditions with the LKA and the LKB keys operated are illustrated in Figs. 4 and 5 respectively. In each case the LK relay is shown operated as when applying the leak test. When the loop test is applied the LP relay is operated and the LK relay is released.

3.26 The SW jack is connected to the test jack of the circuit under test. If the circuit is busy the BY lamp will light, the pulse generating circuit is made inoperative, and the pulsing loop will remain open, thereby preventing interference to service.

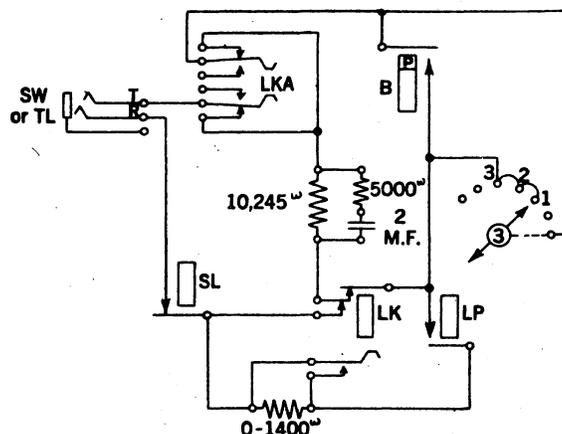


Fig. 4.

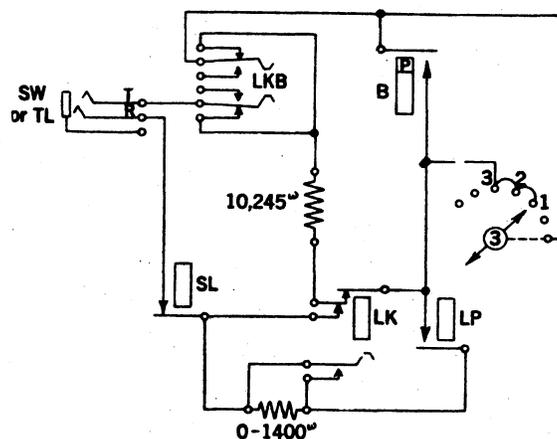


Fig. 5.

3.27 The loop test is applied by momentarily depressing the LP key. During the first three steps of the test set selector the loop is closed. Nine pulses are then transmitted to the switch under test. The per cent. break of these pulses is 68.5. The A relay in the switch is required to operate over the loop resistance during the 31.5 per cent. closed interval and is released on open circuit during the 68.5 per cent. break interval. The loop resistance retards the operation of the A relay. Accordingly, under this test, the switch magnet receives relatively long pulse closures and the B relay receives relatively short pulse closures. At the end of pulsing the loop remains closed thereby holding the switch. If the B relay in the switch does not remain operated during pulsing of the A relay, ground is removed from the sleeve and the test set functions to open the pulsing loop and thereby release the switch.

3.28 The loop is opened, and the switch released by momentarily operating the RLS key.

3.29 The leak test is applied by momentarily depressing the LK key. During the first three steps of the test set selector, a zero loop is closed. Nine pulses are then transmitted to the switch under test. The per cent. break of these pulses is 60.5. The A relay in the switch is operated over a zero loop during the 39.5 per cent. closed interval and is required to release against the leak current during the 60.5 per cent. break interval. The leak conditions retard the release of the A relay. Accordingly, under this test, the switch magnet and the C (or E) relay receive relatively short pulse closures. At the end of pulsing the zero loop remains closed thereby holding the switch.

3.30 Release is accomplished as in 3.28 or by removing the plug from the test jack.

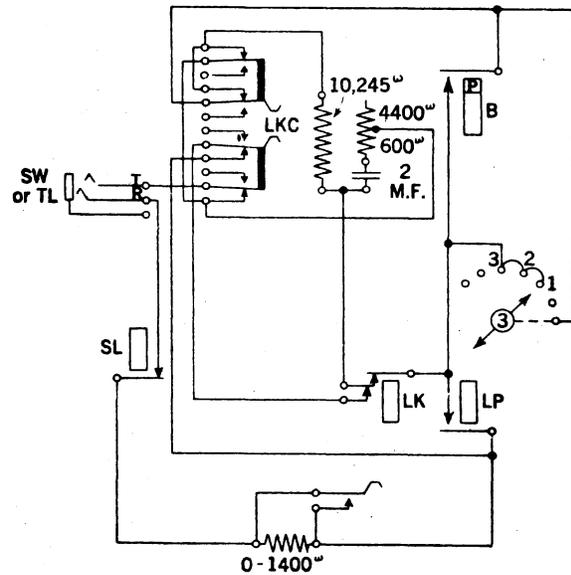


Fig. 6.

Compensated Loop Switches (Toll, etc.)

3.31 In the case of switches having loop compensating resistances the same general procedure as outlined in 3.22 to 3.30 is followed except that the LKC key is operated instead of the LKA or LKB key. The pulsing conditions with the LKC key operated are illustrated in Fig. 6. On the loop test the pulsing relay is required to operate over the loop resistance during the 31.5 per cent. closed interval and is released on open circuit during the 68.5 per cent. break interval. On the leak test the pulsing relay in the switch is again operated over the loop resistance, but this time during the 39.5 per cent. closed interval, and it is required to release against the leak current during the 60.5 per cent. break interval. The operating current on the leak test is limited to the value used on the loop test, since this simulates service conditions with compensated switches and otherwise the leak test would be too severe.

Two Digit Operation

3.32 When it is desired to pulse two digits, as in the case of connectors, the LP or LK key is held operated long enough to start the second set of pulses. The time interval between the two digits is such that a check is made for the release of the C relay.

Switches Requiring Ground Forward on Sleeve

3.33 When testing switches designed to receive a ground over the sleeve from a preceding switch, connection is made to the TL jack instead of to the SW jack. In order for the busy-guard feature to be effective on subsequent tests, it is necessary to depress the remote control RLS key before connecting to the test jack of the switch.

Pulsing Through Other Test Sets

3.34 When pulsing tests are to be combined with operation tests, as in the case of connector tests, or where it is desired to supply pulses through other test sets for other reasons, the TL jack of the pulsing test set is employed for furnishing pulses to the associated test set and the A and B jacks are patched to corresponding jacks of the associated set to permit of controlling pulsing from keys in the associated set.

Repeaters

3.35 Repeaters are tested in the same general manner as switches except that the action of the distant selector or call indicator recorder must be observed in order to judge the repeater performance. Where several digits must be pulsed to complete the test, as in the case of call indicator, the LP or LK key is held operated long enough to pulse the required number of digits in continuous succession.

Magnet Pulsing Tests

3.36 When it is desired to make magnet pulsing tests, the test connections and the position of the resistance and leak keys should be the same as for the overall pulsing tests. This provides a means for establishing the proper per cent. break condition for the magnet test, and also makes it convenient to switch from the magnet test to the overall test as desired.

3.37 In addition the MAG key is operated and the MAG jack is connected to the back contact spring of the pulsing springs on the A relay of the switch under test.

The pulsing conditions under the magnet test are illustrated in Fig. 7.

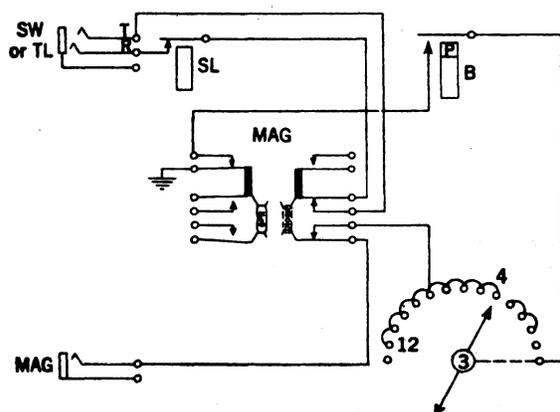


Fig. 7.

3.38 The test is applied by momentarily depressing the LK key. This first places a holding loop across the A relay which, in operating, removes the A relay ground from the pulsing path to permit making the magnet test and causes the switch to be made busy. A series of nine ground pulses are then transmitted to the magnet under test, the distortion of the pulses normally supplied by the A relay being eliminated. The per cent. break of the pulses is 67 if the LKB key is normal and 60.5 if the LKB key is operated. The former corresponds to Leak A in the overall test and the latter corresponds to Leak B. These pulses are intended to represent the worst pulse closures which should be delivered by an A relay in proper adjustment and serve to check the operating time of the switch mechanism or the holding time under pulsing conditions of the C or E relay. At the end of pulsing the magnet pulsing ground is removed but the loop to the A relay remains closed thereby holding the switch.

3.39 The loop may be opened, and the switch released, by momentarily operating the RLS key.

3.40 When it is desired to pulse two digits, as in the case of connectors, the LK key is held depressed long enough to start the second set of pulses.

Test Set Checking and Calibration

3.41 The adjustment of the pulsing test set should remain relatively stable if care is exercised to prevent unnecessary shocks when handling the set.

3.42 Detailed information for use in checking the test set and for making readjustments when required are covered in a section of Division A400. The test set features pertaining to this procedure are outlined in 3.43 to 3.45.

3.43 The No. 36-B (remote control) test set is connected to jacks A and B and the TL jack is connected to a per cent. break meter per KS-7361 used in connection with a No. 35-C or similar test set. (The per cent. break meter is described in a section of Division A700.) The CHK PLS key is operated.

3.44 The test set is put in continuous operation by momentarily operating either the LP or LK key. The LP key is used for checking the 68.5, the LK key for the 60.5, and the MAG and LK keys for the 67 per cent. break condition. The per cent. break can be read directly on the per cent. break meter. The EY lamp on the test set flashes once for each 22 pulses and therefore the speed of pulsing can be checked by counting the flashes.

3.45 Operation of the test set is stopped by depressing the RLS key or by restoring the CHK PLS key.