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TOLL SYSTEMS SIGNALING 2B SIGNALING TEST SET AND ASSOCIATED PULSE REPEATING ADAPTER CIRCUIT

CHANGES

B. Changes in Apparatus

B.1 Superseded	Superseded By
(On a Line-Out Basis)	
Resistors	Resistors
R20, 147E, 3.32 meg Fig. 1	R20, 263A, 3.32 meg Fig. 1
R30, 107B, 89,800 ohms Fig. 1	R30, KS-16313,L4F 89,800 ohms, Fig. 1
R32, 106E, 9760 ohms Fig. 1	R32, KS-16313,L4F 9760 ohms, Fig. 1

B.2 Superseded	Superseded By
(On a Line-Out Basis)	
Resistors	Resistors
R101, R102, R124, R126, R130 227A, 600 ohms, Fig. 5	R101, R102, R124, R126, R130 KS-20810,L1A, 600 ohms Fig. 5
R108, 227A, 1200 ohms Fig. 5	R108, KS-20810,L1A 1200 ohms, Fig. 5
R106, R107, 228A 2000 ohms, Fig. 5	R106, R107, KS-20289,L6C 2000 ohms, Fig. 5
R122, 228A, 5050 ohms Fig. 5	R122, KS-20289,L6C 5050 ohms, Fig. 5
R132, R133, 228A 1600 ohms, Fig. 5	R132, R133, KS-20289,L6C 1600 ohms, Fig. 5

D. Description of Changes

D.1 Codes of resistors listed in B.1 and B.2 have been changed on a line-out basis due to manufacture discontinued components.

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DEPT 4161-CDF-LCJR

Printed in U.S.A.

TOLL SYSTEMS
SIGNALING
2B SIGNALING TEST SET
AND ASSOCIATED PULSE REPEATING
ADAPTER CIRCUIT

CHANGES

B. Changes in Apparatus

B.1 Added

R41 Resistor KS-20289-L6 1K ZK option. Fig. 1

B.2

Superseded	Superseded By
Jack 17 M 217E Type, Fig. 1	Jack J7 M 226A ZK Option, Fig. 1

D. Description of changes

D.1 In circuit note 101, added information for ZK and ZM options.

D.2 Added circuit note 115.

D.3 Added options ZK and ZM to option index.

BELL TELEPHONE LABORATORIES, INCORPORATED
DEPT. 4162-LIC-RCC

TOLL SYSTEMS
SIGNALING
2B SIGNALING TEST SET
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ADAPTER CIRCUIT

CHANGES

B. Changes in Apparatus

B.1 Superseded	Superseded By
In Fig. 1 (On a Line-Out Basis)	
Resistor R1 KS-13491, L1, 0.1 MΩ	Resistor, R1 KS-20289, L6C, 0.1 MΩ
Resistors R5,R13,and R24 KS-13491, L1, 5100Ω	Resistors R5,R13,and R24 KS-20289, L6C, 5100Ω
Resistor, R17 KS-13491, L1, 1600Ω	Resistor, R17 KS-20289, L6C, 1620Ω
Resistor, R35 KS-13491, L1, 2000Ω	Resistor, R35 KS-20289, L6C, 2000Ω
Resistor, R3 KS-13490, L2, 12,000Ω	Resistor, R3 KS-13490, L1, 12000Ω
Resistors R4,R14,and R15 KS-13490, L2, 56000Ω	Resistors R4,R14,and R15 KS-13490 L1, 56000Ω
Resistors R9,R12,R18,and R19 KS-13490, L3, 150Ω	Resistors R9,R12,R18,and R19 KS-13490, L1, 150Ω
Resistor R33 KS-13490, L3, 3300Ω	Resistor R33 KS-13490, L1, 3300Ω
Resistor R34 KS-13490, L3, 2.2MΩ	Resistor R34 KS-13490, L1, 2.2MΩ
Resistors R6,R10,and R16 KS-13492, L1, 20000Ω	Resistors R6,R10,and R16 KS-20289, L6C, 19600Ω
Resistor R21 KS-13492, L1, 8200Ω	Resistor R21 KS-20289, L6C, 8250Ω
Resistor R11 147D, 2MΩ	Resistor R11 KS-20289, L6C, 2MΩ

Resistor R22 144E, 6730Ω	Resistor R22 KS-20289, L6C, 6730Ω
Resistor R25 144E, 21300Ω	Resistor R25 KS-20289, L6C, 21300Ω
Resistor R31 144E, 898000Ω	Resistor R31 KS-20289, L6C, 898000Ω
Capacitor C7 402B, 0.01µf	Capacitor C7 KS-16742, L31, 0.01µf
Capacitor C8 KS-14290, L2, 0.003µf	Capacitor C8 KS-16742, L34, 3320pf
Capacitor C20 KS-19668, L1, 300µf	Capacitor C20 KS-19658, L63,300µf
Diode CR1 420G	Diode CR1 446F
Diode CR3 400E	Diode CR3 400J

B.2 Superseded | Superseded By

In Fig. 2 (On a Line-Out Basis)

Capacitors C2,C3,C4,and C5 KS-13810, 125µf	Capacitors C2,C3,C4,and C5 KS-19827, L8, 125µf

B.3 Superseded | Superseded By

In Fig. 5 (On a Line-Out Basis)

Resistors R121 and R123 221A, 10200Ω	Resistors R121 and R123 KS-20810, 10200Ω
Resistor R125 221A, 20300Ω	Resistor R125 KS-20810, 20300Ω
Resistor R129 221A, 15000Ω	Resistor R129 KS-20810, 15000Ω
Resistors R112 and R114 KS-14603, L3C, 100Ω	Resistors R112 and R114 KS-20289, L6C, 100Ω
Resistors R115 and R116 KS-14603, L3C, 200Ω	Resistors R115 and R116 KS-20289, L6C, 200Ω
Resistors R117 and R118 KS-14603, L3C, 402Ω	Resistors R117 and R118 KS-20289, L6C, 402Ω

Resistors R119 and R120 KS-14603, L3C, 796Ω	Resistors R119 and R120 KS-20289, L6C, 796Ω
Resistor R131 KS-19150, L1, 4700Ω	Resistor R131 KS-13490, L1, 4700Ω

D. Description of Changes

D.1 In Figure 1, the apparatus codes of several resistors, capacitors and diodes are changed on a line-out basis.

D.2 In Figure 2, the apparatus codes of several capacitors are changed on a line-out basis.

D.3 In Figure 5, the apparatus codes of several resistors are changed on a line-out basis.

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SIGNALING
2B SIGNALING TEST SET
AND ASSOCIATED PULSE REPEATING
ADAPTER CIRCUIT

TABLE OF CONTENTS

SECTION I - GENERAL DESCRIPTION

1. PURPOSE OF CIRCUIT

1.01 The pulsing circuit of the 2B set (Fig. 1) of SD-56134-02 provides a source of controlled pulses or supervisory signals suitable for application toward line or drop on E or M signaling leads, and a means of measuring the percent break of continuous received pulses or observing received supervisory signals.

1.02 The optional pulse-repeating adapter circuit (Fig. 5) of SD-56134-02 converts the battery and ground pulses of the 2B signaling test (Fig. 1) to a form suitable for testing local and toll pulse-repeating relays, CX, SX, and DX circuits, and in-service E1C and E1S SF units.

SECTION II - DETAILED DESCRIPTION

1. GENERAL

1.01 Throughout this circuit description, the 2B signaling test set (Fig. 1) will be referred to as the 2B set, and the pulse-repeating adapter circuit (Fig. 5) will be called the adapter. The pulsing source of the 2B set consists of two multivibrators (V1 and V2) and a mercury contact relay (P). The repetition rate of multivibrator V1 determines the pulsing speed. It may be arranged for continuous pulsing or as a single-cycle multivibrator controlled by a dial. In either case it triggers a second multivibrator V2 which determines the release time of relay P.

1.02 The pulsing speed and the percent break of the outgoing pulses are independently adjustable during continuous pulsing. When under dial control, only the percent break is adjustable.

1.03 Two meters are provided: one for setting the continuous speed, the other for measuring sent or received percent break of continuously pulsing signals.

1.04 The 2B set can be made to serve several additional testing functions through the use of the adapter circuit. These functions include testing of local and toll pulse-repeating relays, overall

testing of CX, SX, and DX signaling circuits, and in-service testing of E1C and E1S SF signaling units.

1.05 The 2B set transmits controlled pulses to and measures the percent break of pulses received from the adapter. Pulses from the 2B set are repeated, converted, and applied to the circuit under test by means of the adapter circuitry. Pulses from the circuit under test are also converted in the adapter and applied to the 2B set for percent break measurements.

Note: When the 2B set is used as the pulsing source for the adapter, it must be modified with the addition of capacitor C18 (option ZC or D). This must be done to prevent misfiring of the multivibrator tubes of the 2B set when the adapter pulses 221-type relays. When the 2B set is modified with C18 (option ZC or D), it will be designated 2B-1 and will have all the original characteristics plus reliability when working with the adapter.

2. EXTERNAL CONNECTIONS

POWER LEADS

2.01 Connection to the office negative 24-volt filament battery and negative 48-volt and positive 130-volt signaling batteries (V option) or to the office negative 48-volt and positive 130-volt signaling batteries through battery supply filters (W option) is obtained by patching two low-resistance cords to the power supply jacks for No. 2 type signaling test sets. Where a negative 48-volt filtered battery supply is used, the 24-volt filament supply to the test set is obtained from this source. When the 2B set is arranged for bay mounting (option ZE), two low-resistance power cords will not be provided. Power will be obtained directly from the power supply filter by means of hard wiring to a connector which is mounted with the 2B set. When operating the 2B set, the P relay mercury contacts may momentarily bridge battery and ground through the LP1 lamp. This lamp by itself gives adequate steady-state excess current protection. The R33 resistor and L1 inductor are provided to decrease the rate of change of this current sufficiently to prevent an appreciable increase in the office battery noise.

2.02 As an alternate means of providing power for the 2B set, the two low-resistance battery cords can be patched to the appropriate jacks on an optional KS-19653, List 1 power supply, when provided. This power supply is designed for the 2B or 2B-1 signaling test set and will fit into a container alongside the adapter. The adapter obtains its negative 48 volts from the KS-19653, List 1 power supply through an internal connector.

SIGNALING LEADS

2.03 Two sets of jacks, designated TST 1 and TST 2, are provided for obtaining access to the E and M leads of signaling systems using this type of supervision. Either pair of jacks may be used as required by the corresponding jack arrangement at a particular test location. Thus, the E and M jacks of group TST 1 would be patched to corresponding E and M jacks in the vf signaling patch bay. The 2B set controls the line signaling equipment through the tip springs of these jacks while the drop equipment is controlled through the sleeves. This test set may also be used at patch jack boards or at other test locations where the E and M leads appear on the tip and ring springs, respectively, of line and drop jacks designated LINE and DROP or DSL and DSD, respectively. In such cases, the 2B set controls the line signaling equipment E and M leads through tip and ring springs, respectively, of the L jack, and the drop equipment E and M leads through the tip and ring, respectively, of the D jack.

2.04 When the test set is arranged for bay mounting (option ZE), the tip and ring springs of the L and D jacks will be multipled to a connector. When external circuits use these leads via the connector, a 258C dummy plug must be inserted into the D jack. It is recommended that dummy plugs also be inserted into the L, E, and M jacks to provide some deterrent to inadvertent insertion of patch cords.

2.05 In all E and M lead signaling circuits, the drop equipment furnishes a ground as an on-hook signal or -48 volt battery through a 13A lamp as an off-hook signal on the M lead to the line signaling equipment or to this set. Ordinarily, the line signaling equipment or this test set furnishes an open circuit as an on-hook signal or a ground as an off-hook signal on the E lead to the drop equipment. In some instances, it is expected that the on-hook signal to the drop equipment may require -48 volt battery through a 13A lamp. The BG OG key in the OG position provides for the open-circuit ground requirement and when operated to BG provides for the battery-ground requirements.

2.06 Signaling leads for the adapter will be covered in SECTION 7.

3. SUPERVISORY SIGNALS (FIG. 1)

MONITORING

3.01 Typical cord lamp supervision is provided by the L and D lamps on the E and M leads, respectively; when all keys are normal, continuity of these leads is also provided through the test set between line and drop equipment. Either lamp

lighted indicates an on-hook condition and, when subsequently extinguished, indicates that the connected equipment is off-hook. Prior to connection between the test set and equipment E and M leads, both lamps are lighted on internal circuits as an indication of lamp circuit continuity. Either lamp will also follow alternations between off-hook and on-hook signals produced by flashing supervisory signals or dial pulsing.

CONTINUOUS SUPERVISORY SIGNALS

3.02 Control of E and M lead signals is provided in the test set by means of the TWD L and TWD D keys. On-hook or off-hook signals may be applied independently toward line or drop on the tip of the M jack or the sleeve of the E jack, respectively. When either of these keys is operated, the associated signaling lead continuity between line and drop equipment is removed. Drop equipment M lead lamp supervision is retained in the D lamp while E lead lamp supervision from the line equipment is retained in the L lamp.

3.03 Operation of the TWD D key to on-hook substitutes an open circuit or -48 volt battery for the line signal being received at the test set sleeve of the E jack. Operation to off-hook substitutes a ground on the sleeve of the E jack through normally made contacts of the PLS pulsing key.

3.04 Operation of the TWD L key to on-hook substitutes a ground on the tip of the M jack for the drop signal being received at the test set. Operation to off-hook substitutes -48 volt battery through the LP2 lamp and through normally made contacts of the PLS pulsing key to the tip of the M jack.

3.05 The signaling leads are controlled by the TWD D and TWD L keys when either is in the on-hook position, but if in the off-hook or normal position they are superseded by the PLS key. This combination of keys and division of superseding control facilitates the transition from off-hook to dialing or pulsing in either direction and, at the same time, maintains either on-hook or off-hook in the opposite direction.

INTERRUPTER SUPERVISORY SIGNALS

3.06 Typical reorder, all trunks busy, or subscriber busy signals ordinarily are off-hook signals interrupted at 60 ipm or 120 ipm. These may be produced in the 2B set and applied to either line or drop equipment under control of the PLS key. The operation of the PLS key to LINE connects the armature of the P relay to the tip of the M jack and, when operated to DROP, connects the sleeve of the E jack to the armature of the P relay. It also connects the proper potentials to the contacts of the P relay so that, when operated, an off-hook signal is applied in the direction indicated by the position of the PLS key. When the P jack of the 2B set is patched to the 60- or 120-ipm supply jack in a vf signaling bay, the P relay will operate and release on interrupted ground supplied to this jack from the office interrupter.

3.07 Typical dial pulse signals consist of an off-hook signal with momentary return to on-hook. These may be produced in the test set and applied to either line or drop equipment under control of the PLS key with the P jack vacant. Under this condition, the P relay is controlled by an electronic interrupter through a normally closed contact on the P jack. With the CONT PLS key normal, the pulsing signal is continuously interrupted at a rate and for intervals dependent on the setting of the ADJ PPS and ADJ % BK controls.

3.08 Two meters are provided for setting rate of pulsing and duration of the on-hook interval in terms of percent break. A multiscale microammeter is so arranged that it will read pulsing rate in pulses per second (pps) on the 0 to 20 scale with the SCALE SEL switch in the PPS position irrespective of the position of the PLS key. Percent break is read on a milliammeter provided with a black 0 to 100 scale and an inverse 100 to 0 red scale. It is under control of the MEAS % BK key which when normal completes the connection to the contacts of the P relay through the PLS key. The deflection then indicates the percent break (ie, percent on-hook) which will be applied toward the indicated equipment when the PLS key is operated. These meters and the associated pulsing source are described in greater detail below.

3.09 Trains of dial pulse signals with a controlled percent break may be originated within the test set under the control of an accurately adjusted 9.9- to 10.1-pps dial. With conditions set for continuous pulsing, operation of the CONT PLS key to DIAL PLS holds the pulsing source in the off-hook condition under control of the dial. Operation of the dial will thereafter produce a number of momentary off-hook signals corresponding to the digit dialed. The off-on interval of the applied dial pulses can be adjusted by the ADJ % BK control to obtain the desired value on the PERCENT BREAK meter when the pulsing source is running continuously at a speed of 10 pps.

3.10 A single timed pulse of on-hook signal or a train of time pulses of any number up to 10 may be produced in a manner similar to that employed for setting up dial pulse signals. These times may range from approximately 5 to 300 milliseconds. The same range of duration of on-hook

signal is of ccurse also available on a continuously interrupted basis. These duration limits are based upon the range of speed and percent break available, 2.5 to 17 pps and 10 to 75 percent break. The duration of the pulse may be related to speed and percent break as shown below.

Duration in milliseconds

$$= \frac{1000}{\text{PPS reading}} \times \frac{\text{\% BRK reading}}{100}$$

A desired duration of pulse may be set up at any convenient speed and then repeated at a slower rate merely by reducing the rate of pulsing. On the other hand, repetition rate for a given duration can be increased only to the point at which the given duration represents a 75-percent break. Beyond this value there may be insufficient time for the pulsing source to recycle. Failure to recycle will result in unstable pulse length and pulse skipping and can occur only when percent break exceeds 75.

3.11 In addition to the ADJ % BK potentiometer, an ADJ % BK switch is provided as a means of extending the range of adjustment. Ordinarily at 10 pps, the S or M positions are used for the relatively short or medium pulse durations. The L position is useful in obtaining longer pulse durations.

4. PULSING SOURCE

4.01 The pulsing source comprises two multivibrators and a mercury contact relay. One multivibrator controls the repetition rate and the other controls the pulse duration.

REPETITION RATE MULTIVIBRATOR

4.02 In this multivibrator, elements 6 (plate) and 8 (cathode) of electron tube V1 are normally conducting. When conduction ceases because of a drop in the voltage impressed on grid 7 by the C7 condenser, the multivibrator will remain in this state for a fixed time interval determined by R11 and C7. This time is on the order of 0.015 second and is dependent to some extent on the particular tube in use. During this time, elements 4 (plate) and 2 (cathode) are conducting. When C7 has discharged sufficiently, element 7 will reach a potential which causes elements 6 and 8 to conduct again and, in so doing, return elements 4 and 2 to the nonconducting state through the coupling provided by the C6 condenser. Elements 4 and 2 now remain nonconducting until grid 3 returns to firing potential for grid 3. This half of the multivibrator has a variable nonconducting time by virtue of an adjustable (3) bias potential. Thus, the recycling time of the multivibrator may be varied by a ratio of approximately 6:1 under control of the PPS ADJ potentiometer. The minimum pulsing speed will be approximately 3 pps and the maximum about 20 pps.

4.03 The V3 electron tube and the series resistor R26 serve to minimize voltage variations and surges which might interfere with uniform pulsing speed.

4.04 Measurement of pulsing speed is obtained by a specially damped multiscale microammeter and a scale switch, SCALE SEL. With this switch in the PPS position, the microammeter damping is increased by the capacitive and resistive shunts C3-C5 and R7. The average deflection of the meter is now dependent upon the rate of 0.015-second square-wave pulses it receives from the plate current of element 4 (V1). Since this average is also dependent upon the energy in each individual pulse as determined by the current amplitude and pulse width, it will vary slightly for different 407-A electron tubes or for a particular tube as it ages. For this reason, a calibration control CAL PPS is provided so that the meter deflection can be adjusted to read exactly at that speed for any known rate of pulsing speed. Other points on the scale will then be accurate to within ±1 percent between 9 and 11 and within ±2 percent beyond these speeds.

4.05 The actual pulsing rate may be checked conveniently by comparison with commercial 60-cycle power frequency or any other low-frequency standard with the aid of an oscilloscope. This is provided for by the SYNC jack and its associated open-ended cord. The sleeve of this jack provides a ground for the oscilloscope. The tip and ring leads when connected to the vertical amplifier input and 3-volt 60-cycle test frequency of the oscilloscope, respectively, provide a suitable ratio of multivibrator synchronizing pulse and commercial power frequency for frequency comparison. If the oscilloscope horizontal sweep rate is synchronized to 1/6 of the 60-cycle power frequency, a single stationary synchronizing pulse superimposed upon the single-line 6-cycle trace indicates that the test set pulsing rate is 10 pps. The CAL PPS potentiometer is then adjusted to produce a 10-pps deflection. Similarly, other points on the scale may be calibrated by employing other ratios of multivibrator synchronized pulses to sweep speeds which are even submultiples of a standard reference frequency. Ordinarily, power line frequency is accurate to ±0.1 cycle per second. For general use, the test set pulsing speed is calibrated at 10 pps.

4.06 The multivibrator synchronizing pulse is derived by differentiating the abrupt voltage changes which occur at element 6 of V1. The C8, R14, R15, and CR2 varistors are provided for this purpose. This pulse actually consists of two voltage

spikes, one positive and the other negative, separated by approximately 0.015 second. They also have a high ratio of amplitude to duration. A suitable positive triggering pulse for the percent break multivibrator V2 is obtained by the combination of R14, R15, and CR2. These serve to attenuate the negative portion of the synchronizing pulse with respect to the positive portion and thus produce a suitably shapped pulse for triggering the single-cycle multivibrator V2.

4.07 When the CONT PLS key is operated to the DIAL PLS position, pulsing will cease until triggered by the 5LB dial. The dial pulses are shapped by a differentiating circuit so that V1 will be triggered once for each dial contact break. V1 goes through a single cycle and then triggers V2 as during continuous pulsing. R75 and C18 are needed to attenuate transients at the trigger grid of V2 due to chatter in the dial contact when it recloses. Option ZC adds R75,changes the code of CR1,and changes the wiring and code of C18 to make the test set immune to dial transients. C18 serves a double purpose: it allows the test set to be used with the pulse-repeating adapter, and it is part of the dial transient modification. When the test set has option ZC, it will be designated 2B-1.

PULSE DURATION MULTIVIBRATOR

4.08 In this multivibrator, plate current through V2 electron tube elements produces a voltage drop in the cathode bias resistor R17 which prevents elements 2 and 4 from conducting. Each time a positive triggering pulse arrives at grid 3, elements 2 and 4 conduct and produce a sudden voltage drop in plate resistor R16. This drop in voltage is transferred to grid 7 by capacitive coupling controlled by the ADJ % BK switch. Its effect prevents elements 6 and 8 from conducting for a period of time, which is determined by the switch setting and the position of the ADJ % BK potentiometer. Thus, the ratio of conducting to nonconducting time of elements 6 and 8 is variable by means of a coarse adjustment of capacitance and a fine adjustment of grid bias potential. It is desirable in the use of these two controls to use the minimum value of capacitance (S switch position) which will permit adjustment to the desired percent break.

4.09 Percent break output of this test is determined by the ratio of the P relay break contact closure interval to the sum of the make and break contact closure intervals. This in turn is determined by the conduction and nonconduction intervals of multivibrator V2 as determined by the coarse and fine ADJ % BK controls. A meter is included for reading the percent break of the P relay contacts to within ±1 percent on its black scale when keys PLS and MEAS % BK are normal. Thus, any percent break can be readily set up and, when the PLS key is subsequently reoperated to LINE or DROP, an on-hook signal bearing that percent ratio to the pulse cycle will be sent out at a rate determined by the pulse speed control.

4.10 C18 is required to suppress transients or false triggers at grid 7 of the V2 tube. These transients occur when a 2B set is used to pulse the internal A1 relay of the adapter or any 221-type relay. When this capacitor is provided, the 2B set shall be designated 2B-1.

5. PERCENT BREAK MEASUREMENT

5.01 Continuous pulses received from either line or drop equipment may be measured with the percent break meter. The MEAS % BK key operated to either LINE or DROP substitutes the meter for the normally connected D or L lamp and breaks the continuity between line and drop equipment. Dial pulses cannot be measured since 10 pulses, the maximum which a dial can produce, are insufficient for the percent break meter to come to a steady average reading. On continuous pulses received from the drop on an M lead, percent break is read on the black scale. Pulsing signals received from the line on an E lead are read on the red scale. In other words, whichever scale has its zero under the meter pointer during an off-hook signal is the one that should be used to read percent break when the signal is replaced by continuous pulsing from the same direction of signaling.

5.02 The percent break meter itself is fundamentally a percent make type since current flows through the meter upon circuit closures. It is so designed that it will read percent break equally well upon alternations between ground and open circuit or between ground and the same local battery that is used to supply the test set. The only calibration necessary for this meter is to check that the pointer positions are in line with the ends of the scale for zero current and full scale current. The former is the usual mechanical meter pointer adjustment. The latter is a full scale current adjustment by means of the CAL % BK potentiometer.

6. MISCELLANEOUS

6.01 A multiscale microammeter with a medium amount of damping has been furnished as a means of indicating pulsing rate in pulses per second. Its use as a general purpose 0- to 20-ma milliammeter and 0- to 20-volt or 0- to 200-volt 500ω/volt voltmeter preclude providing sufficient inherent damping in the meter movement for satisfactory pulse rate readings. Sufficient damping is therefore obtained in the

PPS position of the scale switch by adding capacitances C3 to C5 inclusive or C20.

6.02 The RR jack is provided to permit use of the 20- or 200-volt voltmeter as an indicator for a release time adjustment of a relay designated RR in the vf signaling circuit SD-55954-01.

7. PULSE REPEATING ADAPTER CIRCUIT (FIG. 5)

CIRCUIT COMPONENTS

7.01 The adapter is comprised of the following components:

(a) One mercury contact relay designated PR used for pulse repetition and pulse conversion.

(b) A rotary-type selector switch, designated FUNCTION, used to select the mode of operation.

(c) Another rotary-type selector switch, designated LEAK, used for selecting leak values.

(d) Six locking-type keys, designated SEND LOOP, used for selecting loop resistance values. Operation of any key will insert a designated amount of resistance in series with the loop circuit.

(e) Six jacks, designated E1, M1, S, R, S/R, and CF, used for connecting the circuit under test to the 2B set, and a current flow relay test set.

(f) One 3-position key, designated CF, used to select the relay to be given a current-flow test by a relay test set when the test set is patched to the CF jack.

(g) One dual potentiometer, designated ADJ RCV LOOP, used to adjust the receive loop resistance.

(h) One connector, designated SF, used to connect to the S socket of an E1C or an E1S SF unit.

(i) One resistance lamp, designated LP100, used in series with the -48 volt battery when performing the overall testing of CX, DX, and SX circuits.

(j) One 221-type relay, designated A1, used for pulse repetition when a cable pair is connected across the contact of the relay under test. The use of the 221-type relay is described in greater detail in BSP Sections for pulse-repeating relays in local systems.

(k) Various resistors and capacitors.

CONNECTING ARRANGEMENTS AND PR RELAY CONTROL

7.02 The 2B-1 set is connected to the adapter by patch cords between the M and E jacks and the M1 and E1 jacks, respectively. External circuits to be tested are patched to the S and R jacks or the S/R jack of the adapter. Signals can be sent to the circuit under test on the springs of the S jack and received on the springs of the R jack, or a combination of both sending and receiving functions can be performed using the springs of the S/R jack. The technique to be used depends on the circuit under test and the test to be performed. The PR relay of the adapter is under direct control of the 2B-1 set via the M lead patch cord from the M jack to the M1 jack. The E lead patch cord from the E1 jack to the E jack permits the adapter to transfer incoming pulses from the circuit under test to the measure percent break circuit of the 2B-1 set where the percent break of these pulses can be measured.

7.03 The PR relay will operate on -48 volts through a 13A resistance lamp and release on ground when these signals are applied by a 2B-1 set. See 3.02 through 3.11 for description of how the battery or ground conditions may be obtained at the M lead of the 2B or 2B-1 set by proper positioning of the control keys. It describes how to position the MEAS % BK key so that percent break measurements may be made on pulses at the E lead.

7.04 The PR relay has one set of transfer contacts whose terminals are connected to common points or poles of the FUNCTION switch. The FUNCTION switch is a rotary selector switch with two poles per section, eleven positions per pole, and a total of seven sections, and is used to choose the different modes of operation. See 7.05 through 7.17 for consideration in greater detail of the various FUNCTION switch positions. The PR relay transfer is a nonbridging or early break-make set of contacts. R127, C100, R128, and C101 are permanently wired across the PR transfer and provide contact protection for this relay under all pulsing modes of operation. The values of these components are chosen so that they will have a negligible effect on the pulsing of the relays under test.

FUNCTION SWITCH POSITIONS (SEE SKETCHES 1, 2, AND 3 FOR SIMPLIFIED SCHEMATICS OF ADAPTER)

A. CX Position

7.05 This position is provided to perform overall pulsing tests on CX, SX, and DX circuits at their equipment locations. When in this position, pulsing of the PR relay causes the voltage at the ring of the S/R jack to alternate between -48 volt battery

and ground. This method of pulsing is similar to that which is produced on the M lead of the 2B-1 set. The differences are that the nonbridging transfer of the PR relay is used in place of the bridging transfer of the P relay, and a 1000-ohm resistor R100 is connected from the ring of the S/R jack to ground. Also, there is no inductor or resistor in series with the M lead battery. R100 substitutes for the 1000-ohm resistance found in most trunk circuits. When the circuit to be tested is patched to the S/R jack, outgoing (battery and ground) pulses from the adapter will appear on the ring, and incoming pulses from the circuit under test (ground and open) will appear on the sleeve. The sleeve of the S/R jack is connected to the tip of the E1 jack internally by means of the FUNCTION switch thereby enabling measurement of the percent break of the incoming pulses.

B. TA Position

7.06 This position as well as the TB-TD-TF, TC, and TE positions are provided to apply the various toll pulsing requirements for pulse-repeating relays. In the TA position, the make contact of the PR relay is shunted by the combination of R101 in series with C102. Outgoing open and closure pulses are applied across the tip and ring of the S/R jack where the relay under test shall be connected. Incoming pulses from the circuit under test appear at the sleeve of the S/R jack and are returned to the percent break meter of the 2B-1 set for measurement.

C. TB-TD-TF Position

7.07 In this positon, the PR relay applies pulses through the network comprised of R102, C102, R103, and R104 to the tip and ring of the S jack, which in turn is patched to the circuit under test. The sleeve of this jack is grounded to busy the circuit under test. Return pulses are received for measurement across the tip and ring of the R jack as opens and closures. In order to convert the received open and closure to open and ground pulses as required by the measure percent break circuit of the 2B-1 set, the tip of this jack is grounded and the ring is connected to the E lead tip.

D. TC Position

7.08 In this position, the make contact of the PR relay is shunted by the combination of R101 in series with C102. Outgoing pulses are applied to the circuit under test on a loop basis through the send loop keys to the tip and ring of the S jack. The sleeve of the S jack is grounded to busy the circuit under test. Returned pulses appear across tip and ring of the R jack or from ring of the R jack to ground. These pulses are converted to the open and ground type and are transmitted to the 2B-1 set measure percent break circuit.

E. TE Position

7.09 In this position, the PR relay pulses the current reversal network made up of R105, R106, C104, R107, C105, R108, R109, and R110. The outputs of this network are connected to the tip and sleeve of the S jack where they are made accessible to the circuit under test. Return pulses are received by the adapter on the sleeve of the R jack which is internally connected to the E lead and therefore to the measure percent break circuit of the 2B-1 set.

F. P/C Position

7.10 This position is provided to self-check the pulsing output of the PR relay. One terminal of the make contact of this relay is returned to the 2B-1 measure percent break circuit via the E1 jack tip; the other terminal is grounded. When adjusting the PR relay, the red scale of the 2B set percent break meter should be used; there should be no external connections to the sleeve of the S/R jack.

G. LP1 Position

7.11 This position is provided for in-service testing of E1C and E1S SF units for applying the local system pulse-repeating requirements A5, D1, E1, E2, F1 to F6, G1, G2, H1, and J1 for pulse-repeating relays.

7.12 In this position, the make contact of the PR relay outpulses on a loop basis through the loop keys across the tip and ring of the S jack. The pulsing contact is shunted by a leak network which is provided by the LEAK switch. The LEAK switch is a rotary-type selector switch which enables various leak conditions to be applied to the relay under test. The LEAK switch is covered in greater detail in 7.18. The sleeve of the S jack is grounded to make the circuit under test busy. Return pulses are of the open and closure type and are converted at the R jack to the open and ground type and transferred to the E lead of the 2B-1 set for measurement. Certain trunk circuits will require that outgoing and incoming pulses be transmitted over a single tip and ring sleeve cord. In this case, the S/R jack should be used. This jack has its tip and ring multipled to the tip and ring of the S jack and its sleeve multipled to the tip of the E1 jack.

7.13 When an E1C or E1S SF unit is to be tested, the SF Jones plug on the adapter should be patched to the S socket

of the SF unit. The pins of this Jones plug are multipled to the tip and ring of the S jack and the tip of the E1 jack.

H. LP2 Position

7.14 This position is useful for applying the local system's pulse repeating requirements A1 to A4, B1 to B6, C1 to C4, and H2 for pulse repeating relays. Outgoing pulses are generated as described in 7.12 for the LP1 position. Incoming open and closure type pulses from the contact of the relay under test appear across the tip and ring of the R jack and are applied to the A1 relay in the adapter. The A1 relay repeats these pulses, and percent break measurements are taken on this relay by returning the opens and grounds generated by its make contact to the E lead of the 2B-1 set. The ADJ RCV LOOP dual potentiometer is in series with the A1 relay windings and allows the receive loop resistance to be varied. The A1 relay and the ADJ RCV LOOP potentiometer are included in the adapter in place they or their equivalents are called for in the ESP section for pulse repeating relays in local systems when the contacts of the relays under test are shunted by trunk conductors. When reading percent break of the A1 relay, use the red scale on the percent break meter of the 2B-1 set.

7.15 When the FUNCTION switch is in the LP2 position, it is possible for the adapter to directly pulse its internal A1 relay so that this relay's pulsing performance may be checked. The S jack must be patched to the R jack, the LOOP and LEAK keys must be adjusted as specified in the circuit requirements table, and the ADJ RCV LOOP potentiometer should be turned to the OUT position.

I. CF Position

7.16 This position is provided so that current flow measurements can be made on both the relay under test and the internal A1 relay. In this position, the terminals of the CF jack are put under control of the locking 3-position CF key. A relay current flow device similar to the 35-type relay test set should be connected to the CF jack. When the CF key is in the S position, the tip and ring of the CF jack are connected to the tip and ring of the S jack, thereby enabling any relay connected to these springs to be given a current flow test. Similarly, when the CF key is in the R position, any relay connected to the springs of the R jack can be current flowed. Finally, the internal A1 relay of the adapter can be current flowed by putting the CF key in the A1 position. When the A1 relay is given a current flow test, it is important that the ADJ RCV LOOP potentiometer be turned to its full counterclockwise or OUT position.

LEAK SWITCH

7.17 The LEAK switch is a rotary-type selector switch with one pole per section, eleven positions per pole, and a total of four sections. The switch positions are designated OUT, A, B, C, D, D1, and SF1. The switch also has four spare positions which are made available for new leak conditions which may be required in the future. The leak network corresponding to the LEAK switch position is connected in shunt with the pulsing make contact of the PR relay of the adapter when the FUNCTION switch is in the LP1 or LP2 position. The individual networks are made up as follows:

Leak A - R121 in parallel with the combination of R122 in series with C106

Leak B - R121

Leak C - R123 in parallel with the combination of R124 in series with C106

Leak D - R125 in parallel with the combination of R126 in series with C106

Leak D1 - R126 in series with C106

Leak SF1 - R129 in parallel with the combination of R130 in series with C106

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 The 2B or 2B-1 signaling test set is designed to function with signaling circuits which require ground on an M lead from the drop equipment as an on-hook signal and -48 volt regulated signaling battery through a 13-A lamp as an off-hook signal; and supply toward the drop equipment on an E lead, a ground as an off-hook signal, and -48 volt regulated signaling battery through a 13-A lamp or an open circuit as an on-hook signal.

1.02 The adapter enables the signaling test set to be used with trunk circuits that require: Loop (open/closure), simplex ground (open/closure), loop (open/closure with variable resistance), battery and ground (reversal of current), or loop (open/closure through variable resistance and leak) as inputs to relay under test; and supply: open ground, loop (open/closure), battery (-48 volts) ground, or open ground with up to 500-ohm resistance as outputs from the relay under test.

2. FUNCTIONAL DESIGNATIONS

None.

3. FUNCTIONS

3.01 Provision is made for typical cord lamp supervision in this test set on E and M signaling leads with or without continuity between line and drop equipment.

3.02 On-hook, off-hook, or controlled dc pulses may be applied on an M lead to a line signaling circuit or an adapter circuit or on an E lead to the associated drop equipment without signaling lead continuity through the test set between line and drop equipment.

3.03 The percent break of continuous pulses received on an E lead from a line signaling circuit, an adapter circuit, or an M lead from the associated drop equipment may be measured by means of a percent break meter without signaling lead continuity through the test set between line and drop equipment.

3.04 Adjustment of pulse speed and percent break is provided for continuous pulsing and adjustment of percent break only on dial controlled trains or pulses.

3.05 Flashing supervisory signals may be produced under control of a connection to the office interrupter ground.

3.06 Single or repeated on-hook and off-hook signals of variable length may be produced and compared with certain time functions of a connected vf signaling circuit.

3.07 A scale switch is provided for converting the pulse speed indicator to a 0- to 20- or 0- to 200-volt voltmeter or 0- to 20-ma milliammeter for voltage measurements.

3.08 Through the use of the pulse repeating adapter circuit, the following functions are provided:

(a) Application of the various pulse-repeating requirements for pulse-repeating relays in toll systems.

(b) Application of the various pulse repeating requirements for pulse repeating relays in local systems.

(c) Means for self-checking its pulsing output.

(d) Means for performing overall pulsing tests on CX, DX, and SX circuits.

(e) Means for applying in-service loop pulsing tests to E1C and E1S single-frequency signaling units at the equipment locations.

(f) Connection to a 35-type test set through operation of its keys so that current flow measurements may be made.

4. CONNECTING CIRCUITS

4.01 When this circuit is listed on a key sheet, connecting information thereon is to be followed:

(a) Patching Jack Circuits - SD-55337-01, SD-62741-01, and SD-64724-01.

(b) 1600- or 200-Cycle Signaling Circuit - SD-55954-01 or SD-56202-01.

(c) Miscellaneous Test Jack Circuit - SD-56137-01.

(d) Testing and Monitoring Circuits for SF Signaling Units - SD-56137-01, SD-56335-01, SD-56339-01, SD-96519-01, SD-96519-02, SD-96533-01, and SD-95874-01.

(e) Circuit Patching Bay Jack Circuit - SD-63317-01.

(f) E1C Signaling Circuit - SD-98086-01 or SD-98086-02.

(g) E1S Signaling Circuit - SD-98138-01 or SD-98138-02.

(h) Circuits similar to SXS Trunk Circuit - SD-31779-01.

(i) Circuits similar to CX Trunk Circuit - SD-95048-01.

(j) Circuits similar to Signal Connector Circuit - SD-95060-01.

5. MANUFACTURING TESTING REQUIREMENTS

None

SECTION IV - REASONS FOR REISSUE

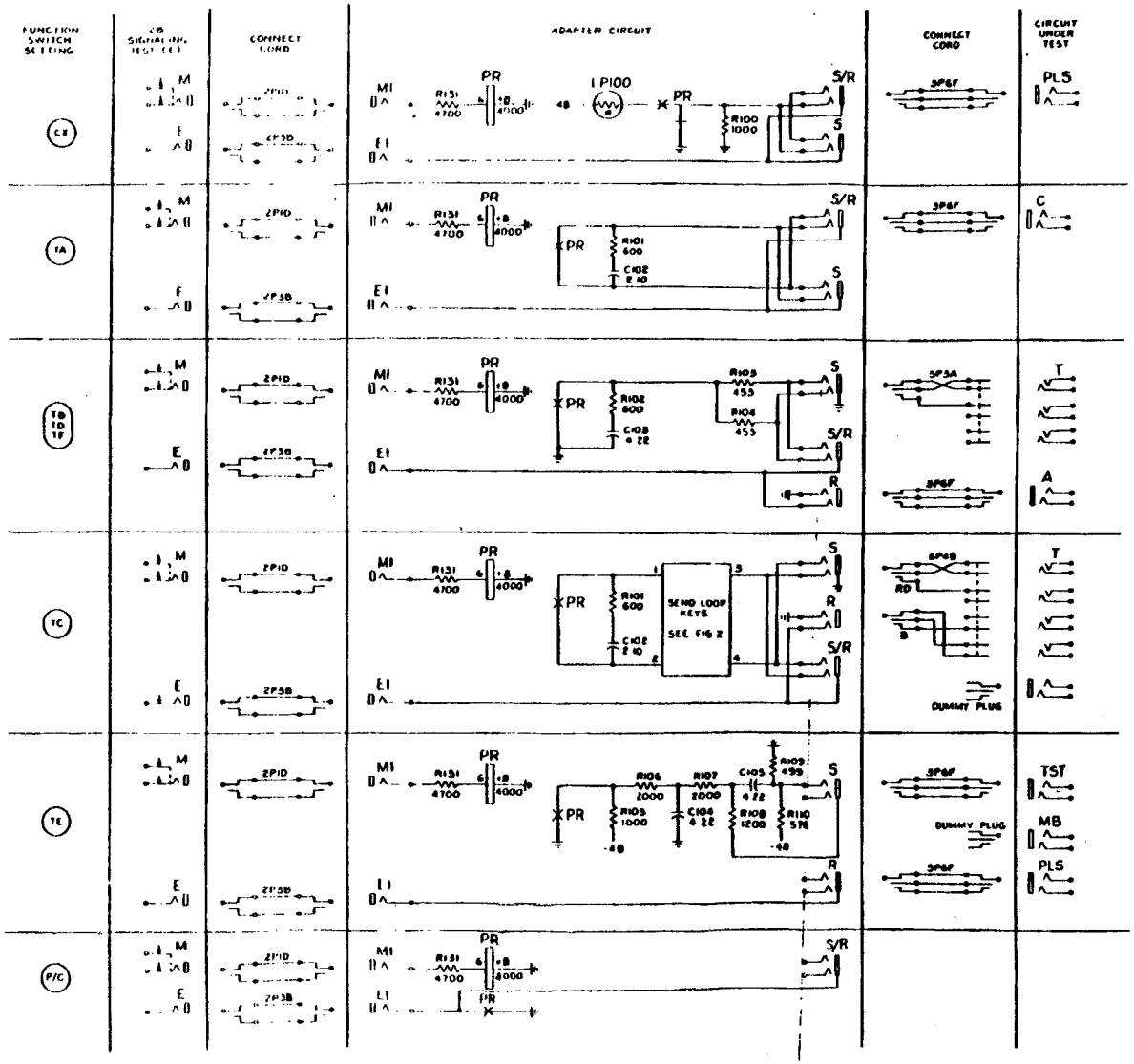
D. Description of Changes

D.1 Option ZH interchanges the wiring on tip and ring of the R jack when the FUNCTION switch is in either the TB or TC positions. This change is made so that toll tests TB, TC, TD, and TF can be performed when the circuit under test provides open-ground pulses to the ring of the R jack.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 1132-TLP-PCC

Attached:
Sketches 1, 2, 3



SIMPLIFIED SCHEMATICS OF PULSE REPEATING ADAPTER CIRCUIT

Sketch 1 - Simplified Schematic of Pulse Repeating Adapter Circuit, Sheet 1 of 2

e: In Sketches 1, 2, and 3, unless erwise specified, resistance values in ohms, capacitance values are in rofarads, values preceded by the bol + (plus) or - (minus) are in ts.