

STATION SYSTEMS  
4-WIRE SUBSCRIBER LINE CIRCUITS  
ARRANGED FOR COMMON  
BATTERY OPERATION

0. CHANGES

0.1 CHANGED AND ADDED FUNCTIONS

None.

0.2 CHANGES IN APPARATUS

Added:

- 1 - KS-13490, List 1 82,000-ohm Resistor (T), App Fig 1 and 4
- 1 - KS-13490, List 1 51-ohm Resistor (R), App Fig 1 and 4

0.3 CHANGES IN CIRCUIT REQUIREMENTS  
(Not Associated with 0.2 Above)

- (a) Test Note 5 is deleted.

0.4 DESCRIPTION OF CIRCUIT CHANGES

- (a) Resistor (R) is added in FS1.
- (b) Resistor (T) is added in FS1.
- (c) Wiring of the "L" lead is changed in FS6.
- (d) Optional station ringer connections are added in FS6.
- (e) Wiring of the receiving pad is changed in FS1.
- (f) The crosstalk shield of the (H) relay is removed.
- (g) Wiring of the exclusion feature is changed to show correct multiple connections for control stations and excluded stations in FS1.
- (h) Contact 7 of the (A-EX) relay is corrected to show make instead of break in FS1.
- (i) Line connections in FS1 are changed to agree with various connecting drawings.
- (j) Nomenclature of the (R) varistor in App Fig 1 and 4 is changed to diode.
- (k) Connecting information to PBX Systems - Auxiliary Line Circuit is added in FS1.

1. PURPOSE OF CIRCUIT

This circuit provides means for signaling a subscriber station on a 4-wire common battery line from a central office or PBX, for holding the line, and for indicating by visual signals whenever the line is held or busy. It provides pickup relays and the common circuits necessary for the proper functioning of lines for a key telephone system. It also provides a manual exclusion circuit for a 4-wire line.

2. WORKING LIMITS

- (a) Maximum external conductor loop resistance - 1200 ohms
- (b) Minimum insulation resistance - 10,000 ohms

3. FUNCTIONS

On 4-wire common battery central office lines or 4-wire PBX lines, this circuit provides for:

- (a) Flashing visual signals for incoming calls.
- (b) Common audible signals for incoming calls.
- (c) Steady visual signals while a station of the key telephone system makes a line busy.
- (d) Holding lines.
- (e) Winking visual signals to indicate a held line.
- (f) Removing the hold when a station of the key telephone system again seizes the line, or when the line is opened momentarily at the central office or PBX.
- (g) Transmission pads to adjust the transmitting and receiving levels.
- (h) Stations which can cut off other stations and cannot be cut off.
- (i) Stations which cannot cut off other stations and can be cut off at any time.
- (j) Sidetone from the transmitting path to the receiver.
- (k) Impedance matching of the receiver to the line.

4. CONNECTING CIRCUITS

When this circuit is listed on the key sheet, the connecting information thereon is to be followed. The following are typical connecting circuits:

- (a) Crossbar Systems No. 5, Line Link and Marker Connector Control Circuit for Use with 4-Wire Lines - SD-26036-01.
- (b) Auxiliary Service Transfer Circuit - SD-69422-01.
- (c) Crossbar Systems No. 5, Auxiliary Line Unit - SD-27517-01.

- (d) PBX Systems - Auxiliary Line Circuit - SD-65864-01.
- (e) Continuous Ringing Supply.
- (f) Key Telephone System No. 1A1 - Visual and Audible Signal Circuit - SD-69294-01.
- (g) Key and Telephone Circuit Arranged for Touch-Tone Calling on 2- and 4-Wire Common Battery Lines - SD-69423-01.
- (h) Key and Telephone Circuit for 2- and 4-Wire Common Battery Dial Lines - SD-69425-01.

"A2" lead operating the (A) relay of the line circuit; (f) in FS2, extends the "P4" lead to the (ON) relay for rotary dial systems ("4" option) or for touch-tone dial systems, extends the "SP" lead to the Auxiliary Service Transfer Circuit ("V" option); (g) in FS3, extends the operating path of the exclusion (A-EX) relay ("3" option) over the "ET" lead; (h) in FS7, extends a signal "S" lead to the "D" or "E" lead of the Auxiliary Service Transfer Circuit, if provided; and (i) in FS8, extends a second "S" lead to the second "D" or "E" lead of the Auxiliary Service Transfer Circuit, if provided.

In FS4, operation of the (A) relay in the line circuit performs the following functions:

- (a) In FS5, operates the auxiliary hold (AH) relay.
- (b) In FS6, transfers the lamp "L" lead from flashing battery to steady battery.
- (c) In FS1, opens the operating path of the hold (H) relay, preventing it from operating falsely.

In FS5, operation of the (AH) relay (a) prepares a circuit from the "LW" lead to the "L" lead in FS6; (b) grounds the "CO" lead to the Visual and Audible Signal Circuit ("T" option) or to the Auxiliary Service Transfer Circuit ("S" option), if provided; and (c) in FS1, opens the locking path of the (R) relay, allowing it to release.

## 5.2 OUTGOING CALL

The relay sequence for an outgoing call is the same as for an incoming call except that the (R) relay will be in a released condition. Dialing is accomplished over the transmitting pair.

### 5.21 Touch-Tone Dialing (242A KTU)

Dial frequencies generated in the key telephone set are transmitted to the line via the "T1" and "R1" leads of FS1 and the transmitting pad composed of resistors (A), (B), (E), (F), (L), (M), and (T) and capacitor (A).

### 5.22 Rotary Dialing (243A KTU)

Dial pulses generated in the key telephone set are transmitted to the line via the "T" and "R" leads of FS1 and through the (A) and (E) resistors in parallel, and the (B) and (F) resistors in parallel. During dialing, the off normal (ON) relay of FS2 is operated from ground on the "P4" lead ("4" option). The (ON) relay operated removes all shunt paths from the transmitting pair during pulsing.

In FS1, the shunt paths consist of the (A) capacitor and (L), (M), and (T) resistors in the shunt leg of the transmitting pad and the (ST) and (SR) capacitors and the (ST) and (SR) resistors of the sidetone bridge. After pulsing, the (ON) relay releases and restores all bridges to the line.

## 5. DESCRIPTION OF OPERATION

### 5.1 INCOMING CALL

#### 5.11 Signaling

When ringing current is applied to the ring R1 of the receiving pair of the 4-wire line on an incoming call, the ac component flows through the secondary of relay (R), thermistor (R), capacitor (R), and resistor (R) to the tip T of the receiving pair on one half of the cycle, and through diode (R), thermistor (R), and capacitor (R) to the tip T on the other half cycle. The 317A varistor (R1) protects diode (R) and thermistor (R) from transient currents. Resistor (R) protects the (R) varistor from damage by surge currents. The thermistor has a cold resistance in the order of 50,000 ohms which prevents relay (R) from operating when ringing current is first applied, preventing false operation on disconnect or other transients. Power absorbed from the ringing current increases the temperature of the thermistor and reduces its resistance to the order of 3000 ohms in about 1/2 second, permitting sufficient current to flow to operate the (R) relay on the half-wave rectified current due to diode (R). Relay (R) locks operated on its primary winding under control of relay (AH) and the "LK" lead. Operation of relay (R) connects ground to the "TO" lead to start the time-out and lamp flashing functions in the Visual and Audible Signal Circuit, connects the signal lamp lead to the flashing circuit, and closes the "CA" or "CA1" lead to the common audible signal circuit and to the Auxiliary Service Transfer Circuit, if provided. When neither the common audible signal circuit nor the Auxiliary Service Transfer Circuit is provided, "J" wiring provides for directly controlling an audible signal.

#### 5.12 Answering an Incoming Call

When an incoming call is answered, ground is placed on the "A" lead, operating the auxiliary pickup (A-PU) relay of FS4 associated with the line and the station. The (A-PU) pickup relay (a) places battery on the 4-wire class "FW" lead toward the key and telephone circuit; (b) in FS1, closes the line side of repeating coil (R); (c) connects the telephone receiver leads "RT" and "RR" to the station side of the repeating coil (R); (d) connects the sidetone network composed of capacitors (ST) and (SR) and resistors (ST) and (SR) between the transmitting pair and the receiving pair; (e) in FS4 connects ground to the

### 5.3 HOLDING

An incoming or outgoing call can be held by removing the ground from the "A" lead while retaining the station shunt on the "T" and "R" leads. Removing ground from the "A" lead releases the (A-PU) relay of FS4, in turn releasing the (A) relay which (a) in FS1, closes the operating path of the (H) relay, allowing it to operate on line current through the telephone set; (b) prepares a holding path for the slow-release relay (AH) in FS5; and (c) transfers the lamp lead "L" in FS6 from steady to winking over the path previously prepared by operation of relay (AH).

Operation of relay (H) (a) closes its M8 contact, connecting its winding across the line as the holding bridge; (b) in FS5, closes a holding path for the slow release (AH) in time to prevent its release; and (c) in FS6, grounds the "HA" lead to the Visual and Audible Signal Circuit to start the interrupter for lamp winking.

The varistor (H) in FS1 is in parallel with the winding of relay (H) to stabilize the sensitivity of the (H) relay when subjected to varying voltages.

#### 5.31 Release of the Holding Bridge When the Call is Again Picked Up

When the line is re seized, ground on the "A" lead operates the (A-PU) relay in FS4, in turn operating the (A) relay, which opens the locking path of the (H) relay in FS1 and removes the holding bridge. This restores the circuit to the talking condition.

#### 5.32 Release of the Holding Bridge from the Central Office or PBX

A permanent signal, caused by the hold

circuit's not being released by a station, can be released from the central office or PBX by opening the line momentarily and allowing relay (H) to release and restore the circuit to normal.

### 5.4 EXCLUSION

When manual cutoff (exclusion) is furnished, the control station connects ground from the "ER" lead to the "ET" lead, operating the (A-EX) relay in FS3, which performs the following functions:

- (a) Opens the following leads between the line circuit and the (A-PU) relays associated with stations that can be cut off: "RT" and "RR" in FS1, "SP" or "P4" in FS2, "A2" in FS4, "D" or "E" in FS7, and FS8.
- (b) Opens the "T" and "R" leads in FS1 between the line circuit and the cutoff stations.
- (c) Short circuits the "RT" and "RR" leads in FS1 toward the cutoff stations.

### 5.5 DISCONNECTION

When the station disconnects on either incoming or outgoing calls, ground is removed from the "A" lead in FS4, releasing the (A-PU) relay, which in turn releases the (A) relay, which releases the (AH) relay in FS5, and the circuit is restored to normal.

### 5.6 TRANSMISSION PADS

Transmission pads are provided in FS1 in both the transmitting circuit and the receiving circuit. Optional strapping permits a choice of four fixed amounts of loss in steps of approximately 2 db.

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