PANEL SYSTEMS
INCOMING SELECTOR CIRCUIT
FROM
PANEL LOCAL OR TANDEM OFFICE
NO. 1 CROSSBAR OFFICE
NO. 5 CROSSBAR OFFICE
CROSSBAR TANDEM OFFICE
4 PARTY SEMI-SELECTIVE RINGING
ARRANGED TO REPEAT PULSES FROM FINALS

CHANGES

A. CHANGED AND ADDED FUNCTIONS

A.1 3.25 Provision is made to permit this Ckt. to function satisfactorily with the (EIF) signaling unit.

B. CHANGES IN APPARATUS

Added

(Q) 12F Transistor - Fig. H
(CR1) 1N91 Diode - Fig. H
(F) 215Ω KS-14603 L1A Resistor - Fig. H - 5W
(G) 287Ω KS-14603 L2A Resistor - Fig. H - 10W
(H) 383Ω KS-14603 L2A Resistor - Fig. H - 10W
(J) 1000Ω KS-13491-L1 Resistor - Fig. H - 1W
(K) 3900Ω KS-13491-L1 Resistor - Fig. H - 1W
(A) 552A Key - Fig. H

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Fig. "H" is added to permit the removal of the (C) relay and its associated operate time and allow a faster release of the (L) relay when this Ckt. is used in conjunction with the (EIF) signaling unit.

D.2 Ckt. Notes 135 and 136 have been added and the Figs. and Options Used table has been revised.

D.3' The (EIF) signaling unit has been added to the Connecting Ckts.

2. WORKING LIMITS

2.1 Working Limits:

	Trunk Selections			Calling Sub. Trunk Supv.	Called Sub. Supv.		
	Fig. F	Fig. G			21-26V	45-50V	
	45V	45V	48V		Fig. B	Fig. A	Fig. B,C
Max. Ext. Ckt. Loop	2200Ω	2200Ω	2390Ω	7540Ω	750Ω	1200Ω	1500Ω
Max. Cond. Loop Res.	See paragraph 2.2						
Min. Ins. Res.	70,000Ω	70,000Ω	70,000Ω	30,000Ω	10,000Ω	10,000Ω	10,000Ω
Max. Cable Length	20 miles	23 miles	25 miles				

2.2 The maximum conductor loop resistance shall be controlled by the induced a-c voltage, the options, figures and cable conditions as shown in the following tables. When the conditions are made up of more than one gauge of cable, the limits shown for the type of cable which is predominant in length shall be used.

FIG. F:

A. C. Induced Voltage	Option	Conductor Loop Resistance 19 GA. Min. Ohms	19 GA. Max. Ohms	22 GA. Min. Ohms	22 GA. Max. Ohms	24 GA. Min. Ohms	24 GA. Max. Ohms
0.2 or less	"ZC"	0	1760	0	2010	0	2010
0.0	"ZD"	0	1450	0	1900	0	2010
0.2	"	50	1425	100	1890	70	2000
0.5	"	130	1400	260	1800	220	2000
1.0	"	270	1350	515	1680	520	2000
1.5	"	415	1300	810	1550	850	2000
2.0	"	580	1250	1135	1400	1290	1920
2.3	"			1310	1310		
2.5	"	740	1200			1580	1580
3.0	"	900	1150				
3.5	"	1080	1080				

FIG. G:

AC Induced Voltage	Maximum Conductor or Loop Resistance 19 GA. Min Volt 45	48	22 GA. Min Volt 45	48	24 GA. Min Volt 45	48
0.2 of less	2010	2200	2010	2200	2010	2200
0.5	2010	2010	2010	2200	2010	2200
1.0	1850	1850	2010	2200	1890	2010
1.5	1760	1760	2010	2200	1590	1780
2.0	1670	1670	1930	2160	1400	1590
2.5	1580	1580	1580	1830	1230	1400
3.0	1490	1490	1300	1550	1090	1260
3.5	1320	1320	1020	1320	980	1120
4.0	1050	1050	-	1140	-	980
4.5	-	-	-	980	-	-

The above AC induced voltage measurements are obtained with an M9B meter across a 500 ohm noninductive resistance, one terminal of which is connected to ground and the other connected to the joined ends of the cable pair under test. The distant ends of the cable pair may be either open or joined. The leak resistance shall not be less than 70,000 ohms.

2.3 Tripping Ranges

(R) Relay	Max. Sub. Set Cap.	Adj.	Ringing 20~ AC Voltage	DC Voltage	Silent Interval Voltage	Ext. Ckt. Loop For Trip. Ringing Interval	Silent Interval
114AK	(4M.F	AC	95-103	16-19	46-52	800ω	730ω
	"	"	95-110	-	"	450ω	"
	("	"	84-88	46-52	"	1350ω	800ω
	("	"	"	"	"	"	1000ω
114KA	("	DC-1	"	"	"	1000ω	"
	(2M.F	DC-2	"	"	"	1500ω	1500ω

3. FUNCTIONS

3.01 Recognizes selection.

3.02 Makes brush selection

3.03 Trips the selected brush.

3.04 Makes group selection.

3.05 Selects, and centers the multiple brushes, on the terminals of the first idle trunk.

3.06 Grounds the sleeve terminal of the selected trunk as soon as it is selected and until the switch advances from the talking position, so that the trunk tests busy to other selectors.

3.07 Prepares for, and controls, final selections.

3.08 Recognizes the completion of final selections and signals the sender that all selections have been completed.

3.09 Recognizes trunk closure in the district selector.

3.10 Closes the ringing circuit at the proper time for signalling the called station with the correct ringing code.

3.11 Transmits "ringing induction" to the calling subscriber while either of the ringing circuits is closed.

3.12 Opens the ringing circuit when the receiver is removed from the switchhook at the called station.

3.13 Furnishes talking battery to the called station as soon as the ringing circuit is opened and until the connection is released.

3.14 Signals the district selector when the called subscriber removes the receiver from the switchhook.

3.15 Signals the district selector when the called subscriber replaces the receiver on the switchhook.

3.16 Furnishes repeating coil and condenser transmission during the time the calling and called stations are connected.

3.17 Returns the elevator to normal, resets the multiple brushes, and advances the sequence switch to normal when released by the district selector.

3.18 Registers each advance of the sequence switch from normal.

3.19 If all of the trunks in the selected group are busy when the selector hunts for an idle trunk, the elevator stops on the top set of terminals in the group (known as the overflow terminals) and functions as follows:

(a) Signals the sender that an overflow condition exists.

(b) Recognizes trunk closure.

(c) Registers the overflow condition.

(d) Returns to normal when released by the district selector.

3.20 When the selector travels to the top of the frame on a trouble condition (tell-tale) the circuit functions as follows:

(a) Releases the UP magnet.

(b) Signals the sender as on "overflow" condition.

(c) Recognizes trunk closure.

(d) Returns to normal when released by the district selector.

3.21 Provides fuse protection against excessive current.

3.22 **Returns to normal if the switch is moved off-normal manually.**

3.23 **Recognizes a "wipe-out" condition as soon as the switch enters the ringing positions, opens the ringing circuit, and returns to normal.**

3.24 Uses the same sequence switch as the corresponding key indicator repeating incoming, thus permitting conversion from one to the other without changing cams.

4. CONNECTING CIRCUITS

When this circuit is listed on a key-sheet the connecting information thereon is to be followed.

4.1 Subscriber Sender Circuits such as SD-21193-01 thru District Circuits.

4.2 District Selector Circuits such as SD-21030-01.

4.3 Three Wire Office Selector Circuits such as SD-21733-01.

4.4 Final Selector Circuits such as ES-239664.

4.5 Blank Incoming Line Circuits such as ES-240037.

4.6 Miscellaneous Registers Circuits such as SD-20141-01.

4.7 Office Link and Connector Circuits such as SD-25033-01.

4.8 OGT in #5 Crossbar Office such as SD-25694-01.

4.9 EIF Signaling Unit - SD-98089-01.

DESCRIPTION OF OPERATION

5. SEIZURE

When the trunk to an incoming selector circuit is seized and the associated sender closes the fundamental circuit for trunk test, the incoming (L) relay does not operate since its P winding is shunted in position 1 by the 284Ω (E) resistance with Fig. F, its S winding current is reversed with Fig. G or its operation is under control of the EIF signaling unit with Fig. H. When the sender closes the fundamental circuit for incoming brush selection (Figs. F, G and H) the incoming (L) and sender (STP) relays operate. The operation of the (L) relay operates the (T) relay, advancing the switch to position 2.

6. BRUSH SELECTION

In position 2 of the (T) relay holds under control of the (L) relay, the A commutator is connected to the tip side of the fundamental circuit, and the UP magnet is energized. During the upward travel of the elevator the A commutator causes the operation of the sender counting relays by alternately connecting and removing ground from the tip side of the trunk. When satisfied the sender opens the fundamental circuit releasing the (L) relay. Release of the (L) relay releases the (T) relay thus releasing the UP magnet and advancing the switch to position 3. The TRIP magnet and advancing the switch to position 3. The TRIP magnet is energized in positions 3/5.

7. GROUP SELECTION

When the sender closes the fundamental circuit for incoming group selection the (L) and (T) relays are operated advancing the switch to position 4, in which position the B commutator is connected to the tip side of the fundamental circuit and the UP magnet is energized. During the upward travel of the elevator the selected brush is tripped and the B commutator causes operation of the

sender counting relays. When satisfied the sender opens the fundamental circuit and the (L) relay releases. The (T) relay holds through its S winding to the C commutator ground until the elevator has traveled high enough to insure proper centering of the multiple brushes on the multiple terminals of the first trunk in the selected group. When the C commutator circuit is opened the (T) relay releases, releasing the UP magnet and advancing the switch to position 5.

8. TRUNK HUNTING

In position 5 the (T) relay is operated through its S winding with Fig. D or through its P winding with Fig. E, advancing the switch to position 6. If the sleeve terminal of the first trunk is not grounded, indicating an idle condition, the (T) relay releases when the switch advances from position 5, causing advance of the switch to position 7. If the first trunk is busy, ground on the sleeve terminal holds the (T) relay operated, and the UP magnet is energized in position 6. Between sleeve terminals the (T) relay is held by ground on the C commutator segments, and the elevator continues to move upward until the sleeve brush makes contact with the sleeve terminal of an idle trunk. The (T) relay then releases, and, when the UP magnet releases, the multiple brushes are centered on the multiple terminals of the selected trunk, and the switch is advanced to position 7. Ground is connected to the sleeve terminal of the selected trunk as soon as the (T) relay releases and until the switch advances beyond position 16-1/4. The G commutator is not connected to ground in position 4 and 6 unless the (T) relay is operated, thus preventing reoperation of the (T) relay to the C commutator ground when the multiple brushes are centering on the trunk terminals.

9. SELECTION BEYOND

FIG. G:

Relay (T), Fig. E, is operated thru its P winding in position 7, advancing the switch to position 8. Relay (T) holds over the ring of the selected trunk to ground in the final selector until final selections have been completed. When the sender closes the fundamental circuit for final brush selection, relay (L) is operated thru its P winding, its T winding being short-circuited as long as the (C) relay is not operated. Relay (L) operated, connect relay (C) over the tip of the selected trunk to relay (L) in the final. The final (L) relay operates, but relay (C) does not operate. The final elevator moves upward and the final A commutator alternately connects and removes ground to the tip, thus alternately operating and releasing relay (C). Each operation of relay (C) removes the short circuit from the T winding of relay (L) and 336Ω ground is applied to the midpoint of the (E) resistor. Under this condition, relay (L) holds, aided by its S winding, but the sender (STP) relay releases, operating the sender counting relays. When the sender is satisfied, the fundamental circuit is opened and relay (L) releases. Relay (L) released releases the final (L) relay, thus releasing the final up-drive magnet. Final tens and units selections are controlled in a similar manner. When final units selection is completed, the final removes ground from the ring of the trunk, releasing relay (T). The switch then advances to position 9. The P winding of relay (T) is shunted thru its own back contacts to make it slow operate. Thus, if relay (L) should operate momentarily in position 9 due to a cable surge instead of fundamental closure, relay (T) will not operate to cause false incoming advance.

FIG. F:

The (T) relay is operated through the S winding in position 7, advancing the switch to position 8. The (T) relay holds over the ring side of the selected trunk to ground in the final selector circuit until final selections have been completed.

"ZC" Option. When the sender closes the fundamental circuit for final brush selection the (L) relay is operated through its P winding, its S winding being short-circuited as long as the (C) relay is not operated. The operation of the (L) relay connects the winding of the (C) relay over the tip of the selected trunk to the winding of the final (L) relay. The final (L) relay operates but the incoming (C) relay does not operate. The final elevator moves upward and the final A commutator alternately connects and removes ground to and from the tip side of the final trunk, thus causing the alternate operation and release of the incoming (C) relay. Each operation of the (C) relay removes the short-circuit from the S winding of the (L) relay. Under this condition the (L) relay holds but the sender (STP) relay releases. Thus the alternate operation and release of the (C) relay, as controlled by the final A commutator, causes operation of the sender counting relays, and when the sender is satisfied, the fundamental circuit is opened and the incoming (L) relay releases. The (L) relay released, releases the final (L) relay, thus releasing the final up-drive magnet. Final tens and units selections are controlled in a similar manner, and when final units selection is completed the final removes ground from the ring side of the trunk, releasing the incoming (T) relay. The switch advances to position 9.

"ZD" Option. When the sender closes the fundamental circuit for final brush selection the (L) relay is operated through its primary winding, its secondary winding being energized in the nonoperate direction. This biasing action is applied to speed the

release of the (L) relay at the completion of each final selection. The operation of the (L) relay connects the winding of the (C) relay, over the tip of the selected trunk, to the winding of the final (L) relay. The final (L) relay operates but the incoming (C) relay does not operate. The final elevator moves upward and the final A commutator alternately connects and removes ground to and from the tip side of the final trunk thus causing the alternate operation and release of the incoming (C) relay. Each operation of the (C) relay grounds the tip side of the fundamental circuit to the sender causing the operation of the sender counting relays. The (L) relay holds under this condition. When the sender is satisfied the fundamental circuit is opened. When the A commutator in the final breaks contact the (C) relay releases which in turn releases the incoming (L) relay which releases the final (L) relay thus releasing the final up-drive magnet. Final tens and units selections are controlled in a similar manner and when final units selection is completed the final removes ground from the ring side of the trunk, releasing the incoming (T) relay. The switch advances to position 9.

FIG. H:

During incoming selections, the revertive ground pulse is applied directly to the 287 ohm resistor in series with the (L) relay winding and the transistor (Q) is not connected to the tip of the line. The current in the (L) relay is reduced to one-third of its former value. The diode (CR1) blocks any circulating currents which would have been provided by the shunt path on the (L) relay winding during the release. The 287 ohm resistor in series with the (L) relay winding maintains the total resistance of the (L) relay configuration to approximately 500 ohms which existed prior to the introduction of this figure. The 12,000 ohm secondary winding is always energized in local circuit and provides a small amount of back bias to aid in the release of the (L) relay.

After incoming selections have been completed, the (L) relay is released and the sequence switch moves to selection beyond. The (L) relay is presented a low resistance loop by the terminating (EIF) signaling unit, which in turn operates the (L) relay. The operation of relay (L) in turn operates the final (L) relay which will result in revertive ground pulses being received from the final and applied to the emitter of (Q) through the D cam at position 8. With the emitter at ground potential and the base at -18 volts to ground (Q) now conducts and the collector goes effectively to ground potential holding the (L) relay operated and effectively shorting the terminating (EIF) tip and ring conductors causing a relay to release in the terminating (EIF) unit which transmits a revertive pulse to the originating end.

When the revertive ground pulse is removed, the emitter is lowered to -27 volts to ground, which in turn back biases (Q) and removes the effective ground pulse from the winding of the (L) relay. The (L) relay remains operated from the low resistance loop of the EIF signaling unit. After transmission of revertive pulses has been completed the originating office opens the tip and ring resulting in 2600 cycle tone being transmitted to the (EIF) which in turn operates the (EIF) 2600 cycle receiver. The operated (EIF) receiver presents a high resistance (effectively open) to the terminating office 2 wire line. This high resistance holds a relay in the (EIF) unit and releases the (L) relay. The release of relay (L) releases the final (L) relay which in turn results in the release of the up-drive magnet to stop the upward travel of the selector rod. The (L) relay in releasing, reduces the back bias on (Q) slightly. After all final selections have been completed, the final selector disconnects ground from the ring side of the trunk releasing the incoming (T) relay which advances the sequence switch to incoming advance position. The advance of the switch to position 9 disconnects the emitter and collector of (Q) from the panel office equipment.

10. INCOMING ADVANCE

In position 9/10 the (L) relay is connected to the ring side, and ground is connected to the tip side, of the fundamental circuit so that with this circuit closed thru the sender, the incoming (L) and sender (STP) and (OFL) relays operate. The operation of the (L) relay operates the (T) relay, advancing the switch to position 11. The fundamental circuit is not opened by the incoming until the switch advances beyond position 10, to insure operation of the sender relays. When the switch advances from position 10 the (L) relay releases, in turn releasing the (T) relay.

11. TRUNK CLOSURE

In position 11 battery and ground are connected through the windings of the (A) relay to the tip and ring sides of the incoming trunk. The (A) relay operates when the district closes the trunk. The (A) relay, operated, operates the (D) relay, which locks in position 11 and operates the (T) relay. The (T) relay, operated, advances the switch to position 12.

12. RINGING CALLED STATION

When Options "X" and "T" or "U" are used, the circuit operation provides for connection of ringing supply to the ring conductor toward the final selector for signaling the called station.

Options "W" and "S" or "R" are provided when ringing supply is to be connected to the

tip conductor toward the final selector for signalling the called station. This arrangement may be used when it is desired to increase the number of subscriber stations on existing lines without the addition of final terminals. This will be accomplished by the use of an additional office code and incoming selectors arranged to connect ringing supply to the tip conductor toward the final selectors, thereby permitting ringing the same final terminal number by dialing either office code but signalling a station on the opposite side of the line. Such an arrangement will permit providing a maximum of 4 stations per line but using the final selectors common to two groups of incoming selectors each of which is associated with a separate office code.

13. FOUR PARTY SEMI-SELECTIVE RINGING

The 1 ring code ringing circuit is closed in position 13 and the 2 ring code circuit is closed in position 14. The (PU) relay controls the closing of the ringing circuit to the subscriber's line in such a manner that for a 1 ring code ringing starts as soon as the switch enters position 13, but for a 2 ring code the switch is advanced to position 14 and the ringing circuit is closed at such a time that both rings of the 2 ring code are always given.

13.1 One or Two Ring Ringing Code (Options "X" and "T" or "U")

The two parties which are signaled by the same ringing code are selected by reversing the leads from the final multiple to the line at the distributing frame.

If the selected trunk is in either 0 or 2 group with 50% party line ringing control (with 2 ring code) or in groups 0, 1 or 2 with 25% party line ringing control (with 2 ring code) the (T) relay releases when the switch advances from position 11 and the (PU) relay operates as soon as the switch enters position 12, advancing the switch to position 13. In position 13 the 1 ring code ringing circuit is connected through the winding of the (R) relay to the called subscriber's line. If the selected trunk is in either the 1 or 3 group with 50% party line ringing control or in group 3 with 25% party line ringing control the (T) relay holds in position 11/13 after operating in position 11, and the (PU) relay operates in position 12 under control of the (PU) interrupter. Operation of the (PU) relay advances the switch to position 13 and the (T) relay, operated, advances the switch to position 14. The (T) relay releases when the switch advances from position 13. In position 14 the 2 ring code ringing circuit is connected through the winding of the (R) relay to the called subscriber's line. In either case the (PU) relay holds in positions 13/14 under control of the (R) and (D) relays. Ringing tone is inductively transmitted through the (A) condenser and windings of the repeating coil to the calling subscriber during the time either of the ringing circuits is closed. When the receiver is removed from the switchhook at the called station the (R) relay operates, releasing the (PU) relay. The release of the (PU) relay opens the ringing circuit, and if Option "V" is provided, connects temporary talking battery through the winding of the (S) relay to the called subscriber's line, and advances the switch to position 15.

13.2 One or Two Ring Ringing Code (Options "W" and "S" or "R")

The circuit operates as described in paragraph 13.1 except that the wiring of the F and G cams is reversed so that in position 13 of the sequence switch 1 ring ringing current is connected to the tip of the line for subscribers served by final groups 0 and 2 and in position 14 of the sequence switch 2 ring ringing current is connected to the tip of the line for subscribers served by final groups 1 and 3.

14. TALKING

If Option "V" is provided, the (S) relay operates as soon as the (PU) relay releases, in a circuit through the subscriber's loop to generator ground. The (T) relay operates in position 15 advancing the switch to position 16, the TALKING position. With the (S) relay holding through the subscriber's loop in position 16 the (PU) relay reoperates under control of the (S) relay. The (PU) relay, operated, reverses battery and ground through the windings of the (A) relay with respect to the tip and ring sides of the incoming trunk thereby causing operation of the polarized supervisory relay in the district selector circuit. The (T) relay holds in positions 15/17 under control of the (D) relay. When the receiver is replace on the switchhook at the called station the (S) and (PU) relays release causing battery and ground through the windings of the (A) relay to be again reversed with respect to the tip and ring sides of the incoming trunk, thereby causing release of the district selector supervisory relay.

15. RELEASE AND RETURN TO NORMAL

When the district selector is released by the calling subscriber the trunk is opened and the incoming (A) relay releases, in turn releasing the (D) relay. The (D) relay, released, releases the (T) relay advancing the switch to position 18. In position 18 the DOWN magnet is energized, the elevator is returned to normal, and the brushes are reset. The TRIP magnet is energized in positions 17-3/4/18, to prevent snagging the brushes as this elevator returns to normal. Ground on the Y commutator advances the switch to normal.

16. PREMATURE DISCONNECT

If the call is abondoned and the district selector opens the trunk while the switch is in any of the ringing positions, 13/14, the (A), (D) and (PU) relays release, opening the ringing circuit and advancing the wsitch to position 15. The (T) relay operates to position 15 advancing the switch to position 16. The (T) relay releases when the switch advances. Return to normal is completed as described in the preceding paragraph.

17. OVERFLOW

If all of the trunks in the selected group test busy while the UP magnet is energized in position 6, the elevator stops on the top set of terminals in the group. These terminals are known as the overflow terminals and ground is never connected to the overflow sleeve terminal. The (T) relay releases when this terminal is reached, the UP magnet releases, the brushes are centered on the overflow terminals, and the switch is advanced to position 7. Operation of the (T) relay advance the switch to position 8, and since the ring overflow terminal is not connected to a final, the (T) relay releases, advancing the switch to position 9. In position 9 the incoming (L) and sender (STP) and (OFL) relays operate as described for "incoming advance". The sender has not completed selections and recognizes this as an overflow condition, advancing the district to the overflow position. The (L) relay, operated, operates the (T) relay and the switch is advanced to position 11. As the district advances through the talking position to the overflow position a temporary trunk closure operates the incoming (A) relay. The (A) relay, operated, operates the (D) relay which locks in position 11 and operates the (T) relay. The (T) relay, operated, advances the switch to position 12. Ground on the Z commutator advances the switch to position 15. Operation of the (T) relay in position 15, advances the switch to position 16. Since trunk closure is temporary the (A), (D) and (T) relays release and return to normal is effected as on a completed call. As the switch passes through position 13/16, ground is connected to the tip overflow terminal, operating the overflow register which is connected thereto.

18. TELL-TALE

If the elevator is driven to the top of the frame in any of the up-drive positions ground on the X commutator advances the switch to position 9. When the sender closes the fundamental circuit the switch is advanced to position 12 as described for "overflow" condition. Ground on the X commutator advances the switch to position 17, and return to normal is completed as described for "overflow" condition.

19. SELECTOR GROUP REGISTER

Each time the switch advances through position 10 ground is connected to the "GR" lead, to "Selector Group Register", thus operating the register.

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