TYPE E SINGLE-FREQUENCY SIGNALING SYSTEM
COMMON SYSTEMS

CONTENTS

1. GENERAL

A. Features

1.01 This section provides general descriptive information on the over-all operation and features of the type E SF signaling system. Succeeding sections bearing the same base number (first six digits) provide similar information on the individual signaling units. These sections are as follows:

987.200.21 E1A SF Signaling and 4-wire Terminating Unit

987.200.22 E1B SF Signaling Unit

987.200.23 E2B SF Signaling Unit

987.200.24 E1C SF Signaling and 4-wire Terminating Unit

987.200.25 E1D SF Signaling and 4-wire Terminating Unit

987.200.26 E1E SF Signaling and 4-wire Terminating Unit

987.200.27 E1F SF Signaling and 4-wire Terminating Unit

1.02 The E series of single-frequency signaling units is designed to work with all classes of trunks arranged for either E and M lead or T and R lead loop signaling. Five units in the series are equipped with a built-in 4-wire terminating circuit. The system provides a means of converting office dc signaling to an ac type using the normal speech transmission path of a carrier channel or 4-wire voice frequency line facility. It employs a single 2600-cycle tone for signaling in each direction without adversely affecting the passage of speech intelligence. Because the same signaling tone is used in both directions of transmission, 4-wire line facilities must be provided. Only the E2B unit is adaptable to 2-wire line operation, in which case one end of the circuit will transmit 2600 cycles and receive 2400 cycles, the latter being transmitted by the SF unit at the distant terminal. The SF unit transmitting 2400 cycles will receive 2600 cycles only. The application or removal of tone at either end of a line facility will cause an associated relay to operate or release at the distant end without interaction between the two directions of transmission. In normal operation, signaling tone and speech will not be on the line facility at the same time except on calls routed to an intercept operator or on a free call.

1.03 These units are plug-in type assemblies and have been miniaturized through the use of transistor circuitry, miniature circuit components, and printed wiring wherever feasible. The relays used are of the wire-spring type. A single −48-volt dc source is the only power needed, thereby removing the need for the +130-volt dc office supply required by the older electron tube version. The use of transistors reduces the amount of heat generated as compared to the older units. Physically, the units occupy only about one third of the mounting area needed for the earlier version.

1.04 The use of 2400- or 2600-cycle tone for this system has a particular advantage in that any amplification of speech intelligence on the line facility will have a like effect on the signaling tone. Thus, the operating range for signaling approximates that of the voice transmission without any intermediate signaling equipment. Normally, a low-level tone is applied to the line facility during the idle condition and is removed during the busy condition. This low-level tone is increased in value for the first 200 milliseconds whenever it is applied to the line. Since dial pulses are less than 200 milliseconds in length, they will be transmitted in their entirety at the higher level. Transmission level points of −16(−13) db and +7(+4) db are required as well as a facility gain of 16 to 23 db depending on which units of this series are employed. Only the E1A unit is adaptable to a 0 receive level for use with P1T carrier.

1.05 Tone at the higher amplitude (which is a result of relay operation in the SF unit's transmitter) is used to insure proper signaling should a higher than normal line noise be present. A guard channel is employed to prevent false receiver operation or "talk-off" due to signal frequencies which might appear as part of the intelligence being received. Band elimination networks centered on the signal frequency are inserted in the voice path to limit the effect of the SF power when this is present in the line. At all other times, these networks are switched out.

B. Applications

1.06 This system is the second in-band 2400- or 2600-cycle SF signaling system developed. The first was described in Section 953.002.01. The plan of operation and basic functions of the two systems are very similar. This later system, as the earlier one, is applicable to most carrier and radio facilities and wide or intermediate band voice frequency facilities. Narrow band facilities such as EB channels, H172 loaded cable, or early type C carrier channels cannot be used. It is adaptable to wire line facilities whose dc paths are already assigned to other services.

1.07 E and M leads on the office or drop side are employed for signaling with three of the units of this series. The E lead represents a one-way dc path out of the signaling unit; the M lead a one-way dc path into the signaling unit. The conditions of the E and M leads for idle (on hook) and busy (off hook) signals are shown in Fig. 1. In the four remaining units, the T and R leads are used for drop signaling and are designed for use on one-way trunk circuits. Tone is either applied or removed from the 4-wire line depending on the condition of the T and R leads on the office or drop side of the circuit.

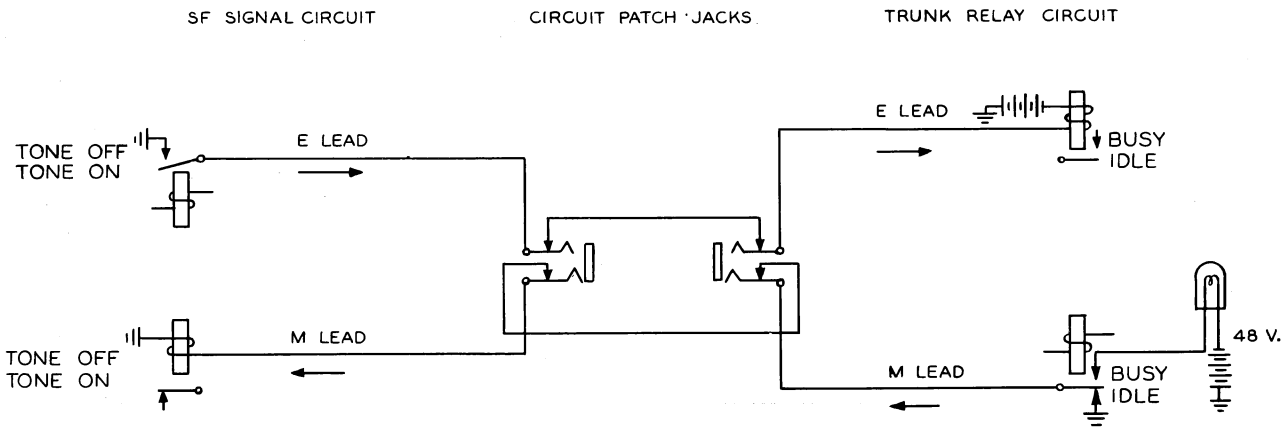


Fig. 1 – E and M Lead Signaling Conditions

1.08 This system is designed for use with multifrequency, dial, revertive pulsing trunks, and, if a proper type signal converter is added, with ringdown-type trunks. Table A shows the relationships of the different units in regard to the type of signaling, 4-wire terminating circuit, levels, etc.

2. SIGNALING CONDITIONS

A. Trunk Signals

2.01 The signals required in telephone trunks are determined by the terminal switching systems and method of operation for the trunks. The two forms of operation for trunks are ringdown and dial. Ringdown operation is suited only to trunks terminating in manual switchboards and needs only one signal, that for ringing, in each direction between the two trunk terminals. Dial operation is used for circuits terminating in dial switching offices and requires two different and alternate signal conditions in each direction between terminals. These two alternate signals are sufficient for supervision; that is, the indication at each trunk terminal of the service conditions, idle or busy, existing at the distant end. By timing in the trunk relay circuits, the same signals used to control supervision are also used to control ringing, dial pulsing, revertive pulsing, and start-stop control of dial or multifrequency pulsing. An additional voice-frequency signal, namely 2000 cycles, is also used for revertive pulsing. The use of the 2000-cycle tone is covered more fully in the sections on the E1E and E1F units listed in 1.01.

2.02 The direction in which connections involving a trunk are established also determines the use made of the signals. For example, the two supervisory signals in the forward direction of a trunk connection serve as a connect (or seizure) and disconnect (or release) signal, while in the opposite direction they serve as the called party's off-hook (or answer) and on-hook (or hang up) signals. Tables B and C show the various conditions for the type of signaling involved.

B. Signal Interference

2.03 The fact that SF signaling relies entirely on the absence or presence of tone in the line permits effective continuous signaling. Its use of the voice path does produce certain conflicting conditions and compromises must be made. A more advantageous situation might appear to be the absence of tone on an idle circuit, but since the major objective is a minimum interference of signal with speech, the tone-on idle condition is used.

2.04 To limit crosstalk into adjacent voice channels and to reduce its additive effect on multichannel amplifier loads, a low-level tone consistent with a usable signal-to-noise ratio is employed. A nominal value of −20 db referred to the ODB 1MW level is normally used for the steady on-hook (idle) tone.

C. Interference on Speech

2.05 The band pass of the voice facility is not altered during conversation on a regular call. SF band elimination networks are switched in when tone is present, but are removed during conversation on most calls. On an intercept or free call, the called end does not return an off-hook (tone off) condition, and the band elimination network at the calling end is left in the line. The network will remove the SF tone as well as speech frequencies in the same range causing a slight impairment of transmission toward the calling end.

D. Protection Against Speech and Noise

2.06 Primary protection is achieved by guard action and by volume limiting in the signal path of the receiver. Guard action is the use of all frequencies outside the narrow signal band to oppose the operating effects of a signal frequency. This increases the power and duration of a signal frequency needed to operate the receiver in the presence of other frequencies. Volume limiting, which aids guard action, sets a limit on the maximum gain obtainable in the signal amplifier. Additional protection is secured by an increase in guard action and in operate time of the receiver when normal talking conditions are established, for it is at this time that the receiver is subjected to the greatest amount of speech energies.

2.07 False operation of the receiver due to signal frequencies being present in the speech transmission or noise emanating from the drop is prevented by inserting a transistor voice amplifier in the receive direction. This creates a very high loss path from the drop, back toward the receiver. This voice amplifier is not provided for line facility gain, but is used only for isolation between the drop and the receiver.

TABLE A

UNIT	USED BY CLASS OF OFFICE	TYPE OF PULSING	DROP SIDE SIGNALING	OPERATES WITH	TRANSMISSION LEVEL REQUIRED AT INSERTION POINT		4-WIRE TERM. CKT BUILT IN
					TRANSMIT	RECEIVE	
E1A	*Class 5	DP or MF	E and M	E1A,E1B,E2B,E1C,E1D	−16 db	+7 db or 0 db†	Yes
E1B	Class 1-4	DP or MF	E and M	E1A,E1B,E2B,E1C,E1D	−16 or −13	+7 or +4	No
E2B	Class 1-4	DP or MF	E and M	√E1A,E1B,E2B,E1C,E1D	−16 or −13	+7 or +4	No
E1C	*Class 5 (Orig End)	DP or MF	T and R	E1A,E1B,E2B,E1D	−16	+7	Yes
E1D	*Class 5 (Term. End)	DP or MF	T and R	E1A,E1B,E2B,E1C	−16	+7	Yes
E1E	*Class 5 (Orig End)	Revertive	T and R	E1F	−16	+7	Yes
E1F	*Class 5 (Term. End)	Revertive	T and R	E1E	−16	+7	Yes

* Acceptable from a transmission standpoint for class 4-5 trunks.

† The 0 receive level is for use with P1T carrier.

√ Designed specifically to work with earlier 2600-cycle electron tube version, but can also be used with other units listed.

TABLE B

Type E1A, E1B, E2B					Type E1A, E1B, E2B		
SIGNAL	M LEAD	E LEAD	SF TONE TOWARD EAST	SF TONE TOWARD WEST	E LEAD	M LEAD	SIGNAL
Idle	Ground	Open	On	On	Open	Ground	Idle
*Connect	Batt	Open	Off	On	Ground	Ground	Connect
Stop Pulsing	Batt	Ground	Off	Off	Ground	Batt	** *Stop Pulsing
Start Pulsing	Batt	Open	Off	On	Ground	Ground	** *Start Pulsing
*†Dial Pulsing	Ground Batt	Open	On Off	On	Open Ground	Ground	Dial Pulsing
Off Hook	Batt	Ground	Off	Off	Ground	Batt	*Off Hook
*††Ring Forward	Ground Batt	Ground	On Off	Off	Open Ground	Batt	Ring Forward
Ring Back	Batt	Open Ground	Off	On Off	Ground	Ground Batt	√*Ring Back
On Hook	Batt	Open	Off	On	Ground	Ground	*On Hook
*Disconnect	Ground	Open	On	On	Open	Ground	Disconnect
Flashing	Batt	Open Ground	Off	On Off	Ground	Ground Batt	√√*Flashing

* Indicates terminal originating signal.

** Stop and start pulsing control signals required only with common control switching equipment.

† Tone on, then off, corresponding to dial break intervals.

†† Tone on, then off, one pulse.

√ Tone on, then off, one pulse for length of the ringing period.

√√ Tone on, then off at the following number of interruptions per minute: Subscriber line busy-60, trunk busy reorder-120, trunks busy, no circuit condition-30, recall by subscriber not over 120.

TABLE C

Type E1C					Type E1D		
SIGNAL	TRUNK CIRCUIT T AND R	SF UNIT T AND R	SF TONE TOWARD EAST	SF TONE TOWARD WEST	SF UNIT T AND R	TRUNK CIRCUIT T AND R	SIGNAL
Idle	Open	Batt	On	On	Open	Batt	Idle
*Connect	Closure	Batt	Off	On	Closure	Batt	Connect
Stop Pulsing	Closure	Rev Batt	Off	Off	Closure	Rev Batt	** *Stop Pulsing
Start Pulsing	Closure	Batt	Off	On	Closure	Batt	** *Start Pulsing
*†Dial Pulsing	Open Closure	Batt	On Off	On	Open Closure	Batt	Dial Pulsing
Off Hook	Closure	Rev Batt	Off	Off	Closure	Rev Batt	*Off Hook
*††Ring Forward	Open Closure	Rev Batt	On Off	Off	Open Closure	Rev Batt	Ring Forward
Ring Back	Closure	Batt Rev Batt	Off	On Off	Closure	Batt Rev Batt	√*Ring Back
On Hook	Closure	Batt	Off	On	Closure	Batt	*On Hook
*Disconnect	Open	Batt	On	On	Open	Batt	Disconnect
Flashing	Closure	Batt Rev Batt	Off	On Off	Closure	Batt Rev Batt	√√*Flashing

* Indicates terminal originating signal.

** Stop and start pulsing control signals required only with common control switching equipment.

† Tone on, then off, corresponding to dial break intervals.

†† Tone on, then off, one pulse.

√ Tone on, then off, one pulse for length of the ringing period.

√√ Tone on, then off at the following number of interruptions per minute: Subscriber line busy-60, trunk busy reorder-120, trunks busy, no circuit condition-30, recall by subscriber not over 120.

E. Protection Against Pulse Distortion

2.08 All models of this series that receive dial pulsing incorporate a pulse correcting circuit. Through the circuit design, the correcting network tends to lengthen short dial pulses, shorten long dial pulses, and maintain a suitable interval between pulses.

3. EQUIPMENT UNITS

A. General

3.01 The individual components of this signaling system consist of a number of equipment units as well as a factory wired frame (or frames). The various equipment units associated with the system are listed below, some of which are always fixed in position on a frame while the others are optional depending on whether they are applicable or not, or whether they are part of the portable testing unit such as would be used in a CDO. The SF units proper are arranged for plug and socket mounting and are secured to the mounting bars with screw-type fasteners. A particular frame will be needed for a given application and the proper local frame cabling will be supplied. The number of frames and the physical appearance of each may vary somewhat from office to office due to the many applications possible with this system.

SF Supply

(1) 2400- or 2600-cycle transistor oscillator.
(2) Alarm circuit (with automatic load transfer circuit).
(3) Tone distributing resistors.

Signaling Circuit

(4) Transmit-receive unit (with 4-wire terminating circuit in some units).
(5) Repeat coil, 120C or 120E (for E1A units only).

Maintenance

(6) Monitoring unit.
(7) Testing unit.
(8) Battery supply.

Mounting Bay

(9) Bay or bays, as required.

B. SF Supply

3.02 An oscillator capable of generating 2400- or 2600-cycle tone is required for each installation of this system. There are three equipment units used for the generation, protection, and distribution of SF tone. They are (1) a transistor oscillator circuit which is the source of tone (2) a load transfer and alarm circuit to guard the output of two oscillators of the same frequency and permit their use as the supply for a maximum of 90 SF signaling units and (3) a pair of mounting plates for a maximum of 94 pairs of resistors for the supply leads to the circuits of one relay rack bay. These resistors are wired in the signal frequency supply distributing leads. One resistor is furnished for each lead of a supply pair to every SF signaling and maintenance circuit. The resistors provide protective separation of the individual circuit supply leads and assist in the provision of the correct power supplied to each circuit. It is intended that every relay rack bay (except those for P1T carrier) will be supplied with a pair of oscillators and automatic transfer circuit in addition to the required number of distributing resistors.

3.03 Two oscillator units are contained on one 2- by 23-inch mounting plate. The sinusoidal oscillations are generated by a Hartley-type oscillator circuit. Coarse frequency (2400 or 2600 cycles) and fine frequency adjustments are made through optional wiring of capacitors. Taps on the output transformer provide either of two output levels as measured at the oscillator test jacks with a 600-ohm load, namely, −9.6 dbm for −16 db office transmission levels, and −6.6 dbm for −13 db office transmission levels. Fine output adjustments are made with a potentiometer control. Once adjusted, the frequency should hold within ±5 cycles and amplitude within ±0.25 db. Input power requirement is −48-volt battery at approximately 0.015 amperes. It is possible the first type E SF equipment bays available will be supplied with the older 2400- 2600-cycle electron tube oscillators and associated transfer circuit. Automatic transfer features, etc, are the same as those described below.

3.04 The automatic load transfer and alarm unit is used with two oscillators of the same frequency and provides individually for (1) oscillator output and load cutoff jacks (2) a

minor alarm in case of one oscillator failure (3) automatic transfer of the load from the oscillator in trouble to the other (4) restore keys and indicating lamps for these trouble conditions and (5) a locking load transfer key. In addition, it provides (6) a frequency checking test circuit, (7) a minor alarm cutoff key and locking circuit which is automatically restored when the trouble condition is cleared and (8) a major alarm in case of failure of both oscillators and also when a plug is inserted in a load jack.

3.05 The third unit in the supply group consists of two 2- by 23-inch mounting plates for 19-type resistors, two cable well terminal strips and supply resistors as needed for the SF signaling and test circuits on one relay rack bay. Since the resistor in each signal circuit supply lead consists of one half of a 19-type resistor and has one terminal in common with another odd- or even-numbered circuit, it is most practical to assign the output of one oscillator to circuits in successive number groups of four.

3.06 An oscillator similar in design to that described in 3.02 but capable of generating 2600 cycles only, will be provided for use with P1T carrier. One oscillator will be associated with each P1T system. It consists of a single equipment unit which is used for the generation, distribution, and monitoring of the SF tone. Included is the oscillator, its tone distributing resistors, oscillator load, and transfer jacks (which allows a single oscillator to serve two P1T systems in an emergency), and a monitor circuit to keep a check on the oscillator output. The seven pairs of distributing resistors are wired in the signal frequency distributing leads. One pair serves one P1T channel, a test or monitor circuit.

3.07 A view of the oscillator is shown in Fig. 2. The complete unit is contained on one 2- by 19-inch mounting plate. Fine frequency adjustments are made through optional wiring of any of five capacitors supplied for that purpose. Output level is controlled by the OSC LEV (oscillator level) potentiometer adjustment, while the level is read with a 13A transmission measuring set (or equivalent) at the OSC TST (oscillator test) jacks. Stability figures and power requirement are the same as those given in 3.03. Should it prove necessary for either maintenance or trouble reasons to transfer the load from one oscillator to another, a patch cord between the LOAD TRNS jacks of the oscillator to be removed from service and the OSC TST jacks of another working oscillator effects the transfer.

3.08 Complete loss of the SF tone supply or a drop in level below a predetermined preset amount will cause an alarm to be brought in and a series of tests to be made by a carrier and SF supply group alarm circuit. This circuit will be furnished whenever SF signaling is used with P1T carrier. Briefly, its operation is as follows should an oscillator failure occur.

3.09 Loss of the SF tone supply at either terminal of a P1T carrier system for more that approximately 1 second will, through the alarm circuit, force a carrier failure in both directions of transmission. The E leads or T and R conductors of the circuits involved are opened for 10 seconds to allow disconnect of the called subscribers, and then the E or sleeve (S) leads are grounded at the outgoing ends of the trunks to make them test busy. After a timed interval, tests are made to determine if the trouble has cleared and, if these tests are successful, the circuits are restored to service while the alarms at both terminals are silenced. If the trouble condition still exists at the time the automatic

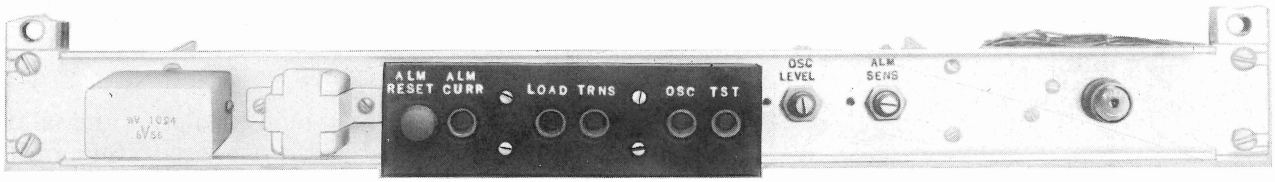


Fig. 2 – Transistor Oscillator Unit

tests are made, the alarms continue to sound at both terminals and the circuits are held out of service until the trouble either clears itself or has been cleared manually. The audible alarms may also be silenced manually while the necessary corrective measures are being taken. When the tone supply is again functioning properly or if a temporary patch is made as described in 3.07, carrier power and tone are re-established in both directions, the associated circuits are released to traffic, and the terminal alarms are retired automatically.

C. Mounting Bays — Five Frames

3.10 A factory wired relay rack bay assembly (or assemblies) provide for mounting the equipment units of this system as applicable for a given installation. Fig. 3 shows three frame configurations for 23-inch by 11-foot, 6-inch relay rack bays. Fig. 4 shows two arrangements for 19-inch relay rack bays with P1T carrier terminals, one bay being 11 feet 6 inches in height, and the other 9 feet. The third frame in Fig. 4 shows a small SF installation on a 23-inch by 11-foot 6-inch relay rack bay.

3.11 In Fig. 3, a testing-monitoring-signaling equipment bay is shown at the left. It provides for a maximum of 70 signaling units except type E1A. Due to heat limitations, no more than 60 E1A units may be placed in any type bay. If it is desired to load a given frame to full capacity (or as close as possible) and still include E1A units, any other signaling unit in this system may be substituted on a 30 to 20 ratio. For example, if in a testing-monitoring-signaling bay 20 of the 60 allowable E1A units were removed, they could be replaced by 30 of any other type resulting in a fully loaded bay of 70 units. This frame contains two tone supply oscillators, automatic transfer and alarm circuit, tone distributing resistors, a monitoring unit, a testing unit, and a folding test bracket (for support of the SF unit). A minimum of one of this type bay will be provided although job requirements may dictate more.

3.12 The monitor and over the line testing-signaling equipment bay (Fig. 3, center) provides for a maximum of 80 type E signaling units except E1A (see above). Included are two tone supply oscillators, automatic transfer and alarm circuit, tone distributing resistors, a monitoring unit, and a folding test bracket. Normally, every fifth bay in a line-up will be of this type except where a testing-monitoring-signaling bay is substituted for it.

3.13 The right-hand bay in Fig. 3 is a signaling equipment bay which provides for a maximum of 90 type E signaling units except E1A (see 3.11). Included are two tone supply oscillators, automatic transfer and alarm circuit, and tone distributing resistors. This bay will not be placed more than two bays distant from either a testing-monitoring-signaling bay, or a monitoring and over-the-line testing-signaling bay.

3.14 Fig. 4 shows two P1T carrier bays equipped with E1A signaling units. The bay to the left contains two systems (eight channels) along with the needed signaling equipment to supply each channel. In addition to the eight SF units, there are two tone supply oscillators, two carrier and SF supply group alarm circuits, and eight repeating coils. Mounted to the right of the SF units is a connector block which feeds power to the portable test stand.

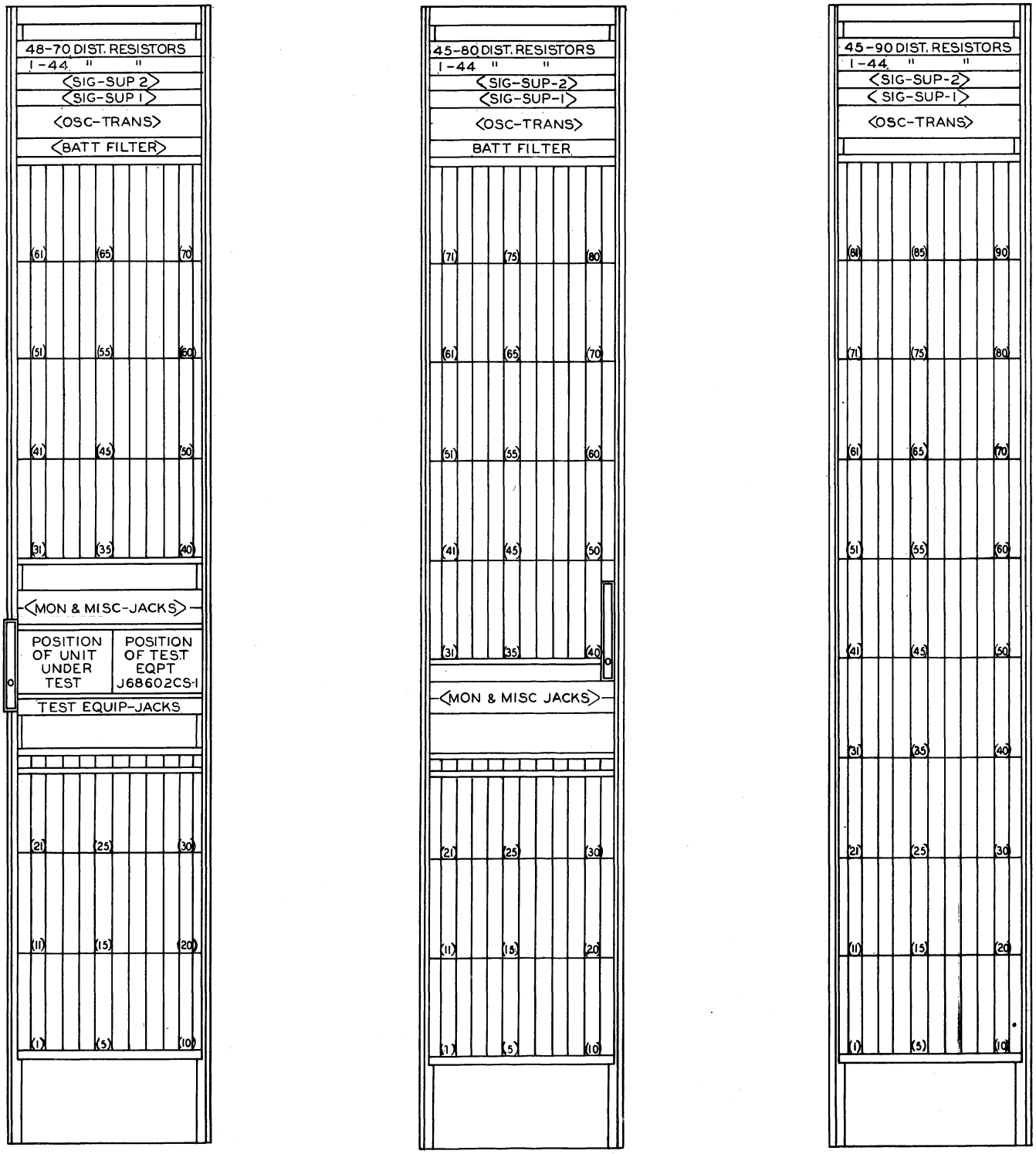
3.15 The center bay in Fig. 4 has the same equipment features as that described in 3.14 except it contains only one complete P1T carrier system and associated signaling equipment.

3.16 In small offices where SF signaling is not associated with P1T carrier the right-hand frame in Fig. 4 may be used. It contains, in addition to the required number of SF units, two tone supply oscillators, automatic transfer and alarm circuit, tone distributing resistors, a monitoring unit, a testing unit, and a folding test bracket.

4. MAINTENANCE

A. General

4.01 The plug- and jack-type mounting of these SF signaling units permits their easy removal for replacement or test and maintenance checks at a test location. Although certain "in-service" checks may be made with the unit mounted in the bay, a test location is provided to facilitate more comprehensive testing procedures. In a small office such as a CDO, the portable testing stand pictured in Fig. 5 may be supplied. This unit is described in 4.06, 4.07, 4.08, 4.14, 4.15, and 4.19.



TESTING-MOUNTING-SIGNALING EQUIPMENT BAY

MONITORING AND OVER THE LINE TESTING-SIGNALING EQUIPMENT BAY

SIGNALING EQUIPMENT BAY

Fig. 3 – Three Relay Rack Bays (23 Inches)

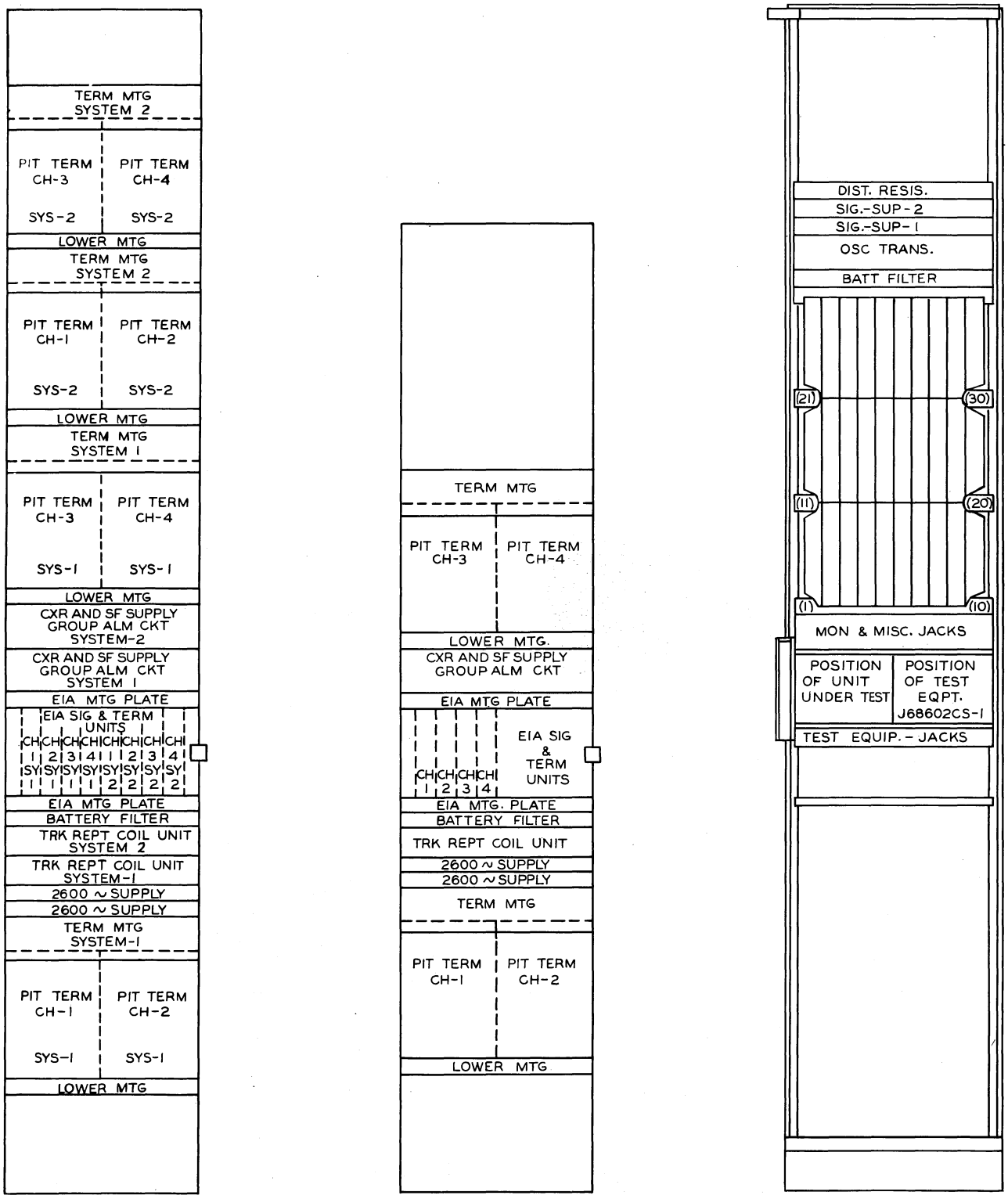


Fig. 4 – Three Relay Rack Bays (19 Inches and 23 Inches)

Fig. 5 – Portable Test Stand

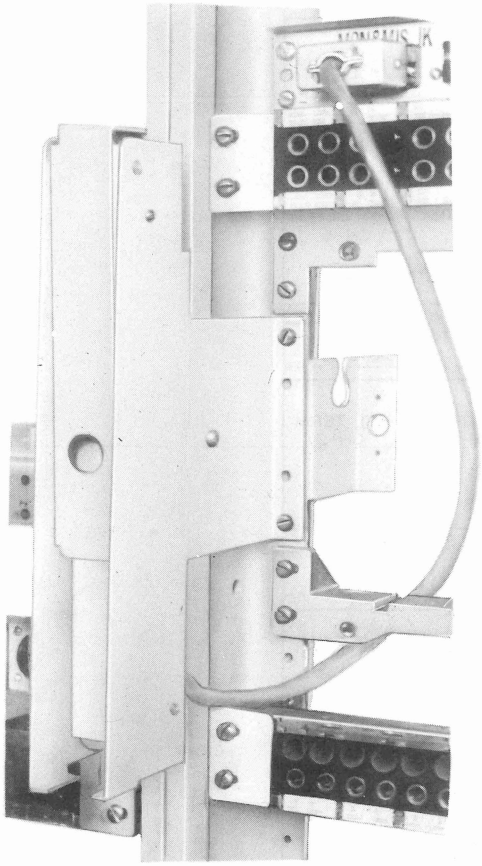


Fig. 6 – Folding Test Bracket (Closed)

4.02 When rack mounted test equipment is supplied, a frame-mounted folding-type test bracket, Fig. 6 and 7, will be furnished. In addition to the test bracket, two test panel facilities will be included. The first, shown in Fig. 8, is a monitor and miscellaneous jack assembly, and the second, shown in Fig. 9, is a test set and test jack assembly. In offices already equipped with a test set, test jack assembly, and signal monitoring unit (for use with the 2600-cycle electron tube SF units), only the two new jack assemblies and the folding test bracket need be added to allow complete testing of most of the E series SF units. The newer monitor and test jack assemblies will provide all the necessary jack facilities for testing the older 2400- or 2600-cycle electron tube SF units as well, and can be used as direct replacements. Provision is also made to allow the electron tube units to be plugged into a frame-mounted socket at the test panel location.

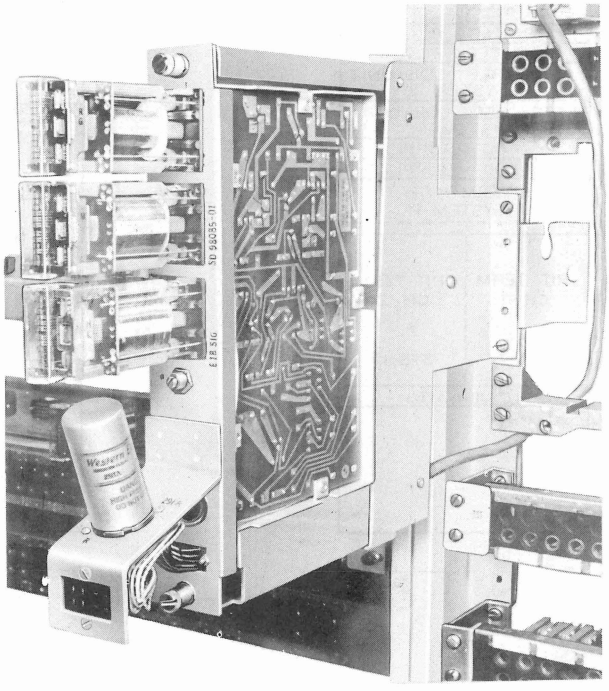


Fig. 7 – Folding Test Bracket

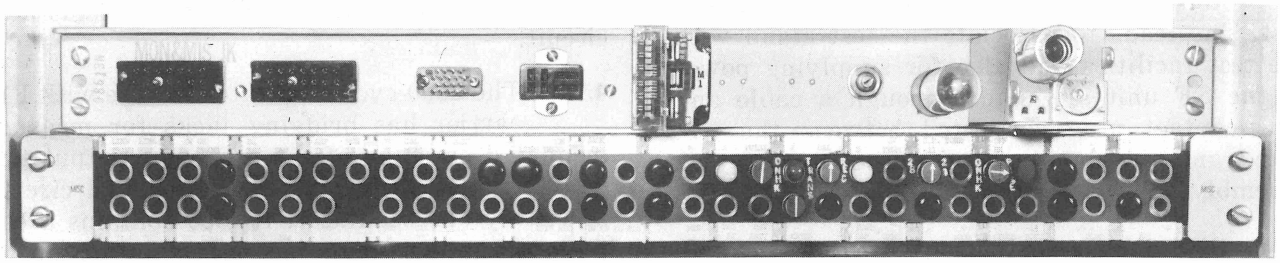


Fig. 8 – Monitoring and Miscellaneous Jack Assembly

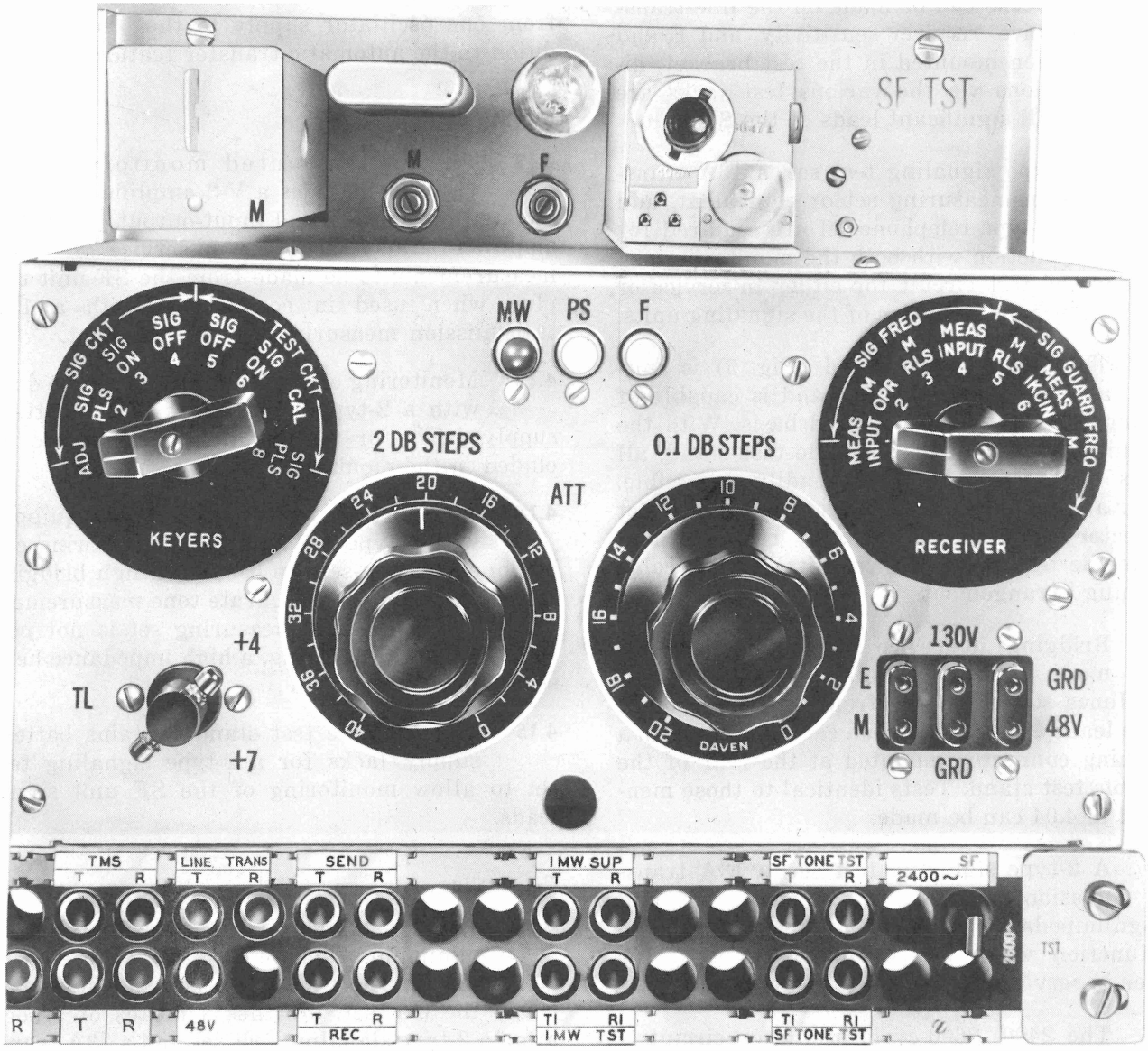


Fig. 9 – Test Set and Test Jack Assembly

4.03 The folding test bracket permits access to the required points of the unit under test. The leads to associate the test stand with the test facilities and also for supplying power to the SF unit are made through a cable and multicontact plug connected between the test stand and the monitor and miscellaneous jack assembly.

4.04 Bridging connections are provided through an 8-contact Jones socket on the front of the SF unit to allow certain checks to be made while the signaling unit is in service. These contacts are extended into the monitor and miscellaneous jack circuit via a suitable connecting cable, and checks can be made on the line transmit, line receive, receiver sensitivity, and E and M leads. When mounted in the test bracket, direct connections via the various test jacks are afforded to all significant leads of the SF unit.

4.05 A 2-type signaling test set, a 13A transmission measuring set or equivalent, and an operators-type telephone set are required for use in conjunction with both the monitoring circuit and the test circuit for either in-service or out-of-service maintenance of the signaling units.

4.06 The portable test stand (Fig. 5) is suitable for use in a CDO, and is capable of making tests on a more limited basis. With the SF unit mounted in the portable test stand, all points of the SF unit are readily accessible. Power and tone are obtained from a multicontact connector mounted on the relay rack bay and fed to the test stand with a suitable type cable and plug arrangement.

4.07 Bridging in-service connections can be made to the SF unit using the 8-contact Jones socket on the front of the SF unit. These leads are brought via a cable and plug to a matching connector mounted at the rear of the portable test stand. Tests identical to those mentioned in 4.04 can be made.

4.08 A 2-type signaling test set, a 13A transmission measuring set or equivalent, and a high-impedance receiver unit may be used in conjunction with the portable test stand for either in-service or out-of-service testing.

4.09 The 2400- 2600-cycle oscillator circuit is provided with bridging jacks for measuring the oscillator output and a current jack and potentiometer for establishing the proper sensitivity level of the automatic transfer and alarm circuit.

4.10 The 2600-cycle oscillator for use with P1T carrier has bridging jacks for measurement and patching of the oscillator output, and cutoff-type jacks for patching the load circuits served by one oscillator. It also contains a current jack and potentiometer for setting up the proper sensitivity level of the carrier and SF signaling group alarm circuit.

4.11 The automatic transfer and alarm circuit (for use with 2400- 2600-cycle oscillators) has provision for manually transferring the load from one oscillator supply to the other in addition to the automatic transfer feature.

B. Monitoring

4.12 The rack-mounted monitoring unit (Fig. 8) includes a V-3 amplifier with associated monitoring and input-output jacks. The amplifier allows accurate in-service SF tone measurements to be made from the SF unit test plug when used in conjunction with a 13A transmission measuring set or equivalent.

4.13 Monitoring of the signal leads can be done with a 2-type signaling test set. Battery supply jacks for the signaling test set are included in the monitoring unit.

4.14 The portable test stand is not equipped with a type V-3 amplifier. Monitoring can be done on an in-service basis but high bridging losses will occur and accurate tone measurement using a transmission measuring set is not possible. For aural checking, a high impedance head set is required.

4.15 The portable test stand contains battery supply jacks for a 2-type signaling test set to allow monitoring of the SF unit signal leads.

C. Testing

4.16 With rack-mounted test equipment, a minimum of one testing unit (Fig. 9) will be furnished. The test jack strip, shown in part below the test set, provides a means of associating a 2-type signaling test set and a 13A transmission test set or equivalent with the test circuit.

4.17 The test set employs two multisection, multiposition wafer-type switches by which various test and adjusting conditions required can be applied to the SF unit without the need for changes in patching connections.

4.18 A battery supply unit consisting of one mounting plate provides filtered −24- and +130-volt power for the 2-type signaling test set. One such supply unit is required for the supply jacks associated with each test or monitoring jack assembly. This battery supply unit should be located as near to the test or monitor panel as is practicable in order to minimize induced interference in the leads to the supply jacks.

4.19 A 2-type signaling test set may be used with the portable test stand to check pulsing requirements if a +130-volt supply and a battery supply filter unit as described in 4.18 is installed.

4.20 In a CDO when complete tests are required on an SF unit (involving the use of the signal testing unit, Fig. 9), it will be necessary to remove the unit from service and have it checked at a maintenance center having full testing facilities.