TYPE TD-2 RADIO SYSTEM

GENERAL REQUIREMENTS

TOLL SYSTEMS

CONTENTS

LIST OF ILLUSTRATIONS

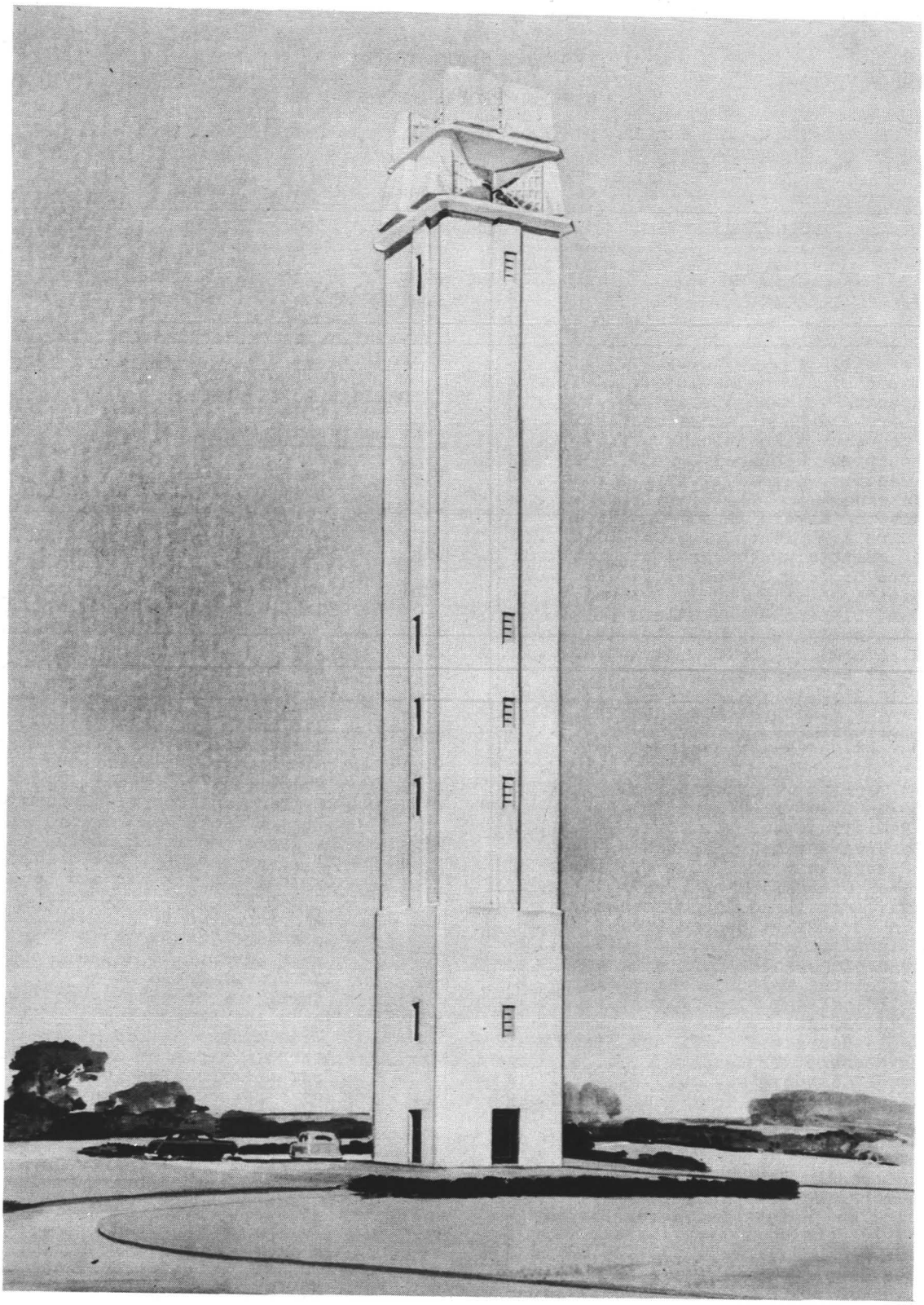

Fig. 1 - Type 4 Microwave Repeater Building

1. GENERAL

Scope

1.01 This specification, together with the supplementary information listed herein, covers the equipment design requirements to be used in engineering, manufacture and installation of equipment for a type TD-2 radio system.

Description

1.02 Type TD-2 radio is designed to provide a long-haul microwave radio system suitable for handling television, multichannel telephone, voice-frequency telegraph or other wide band communication signals. The system operates in the common carrier band between 3700 and 4200 megacycles. Radio waves at these frequencies have propagation characteristics similar to those of light, therefore, it is essential to have line-of-sight paths between radio stations. Sharply beamed high-gain antennas are used for transmitting and receiving the radio waves and are installed on the top decks of radio station buildings or towers. These buildings or towers may vary from 60' to 200' in height and are located on elevated sites where possible. Fig. 1 illustrates the high or type 4 building and Fig. 2 shows the low or type 1 building. Type 1

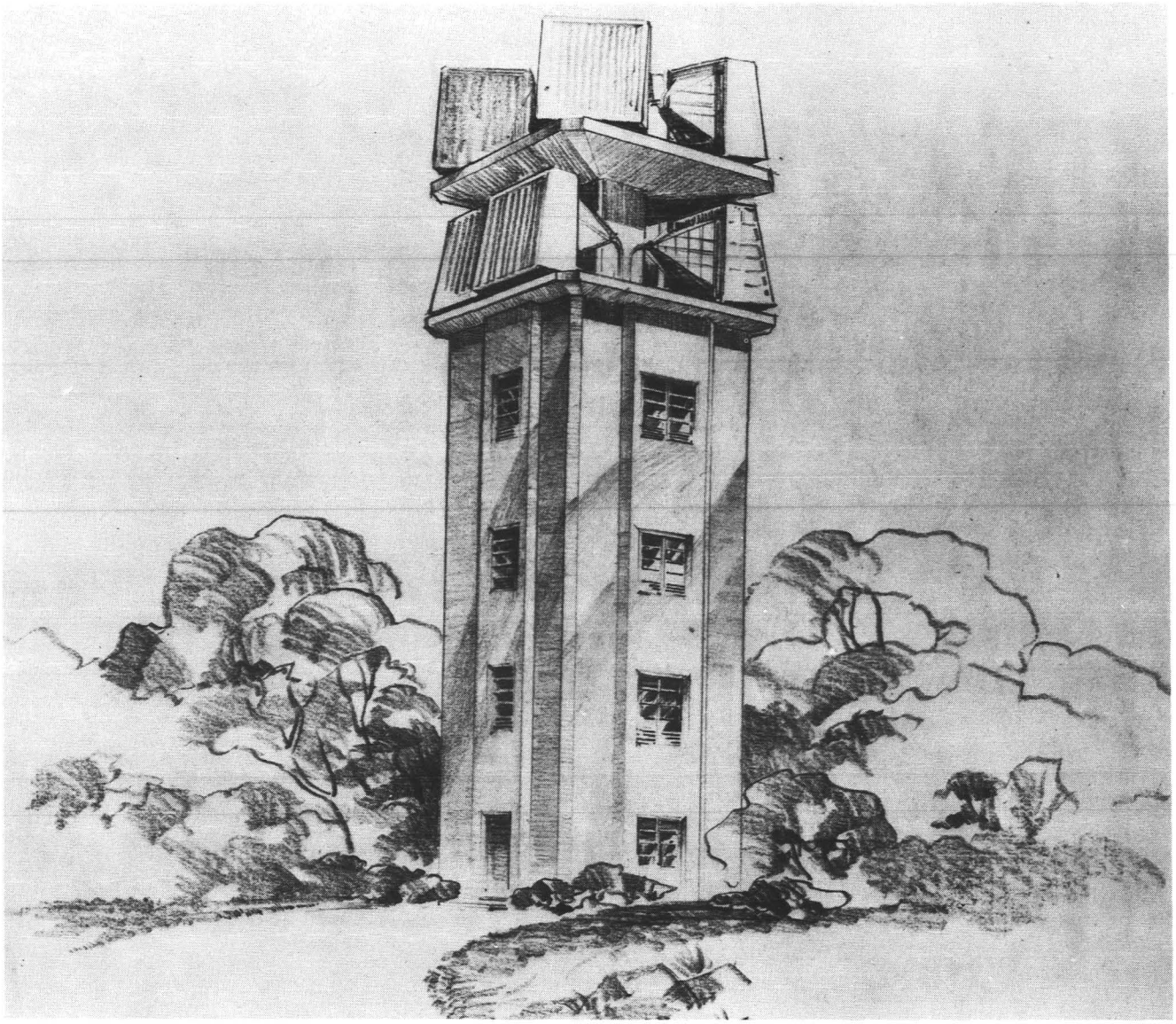

Fig. 2 - Type 1 Microwave Repeater Building

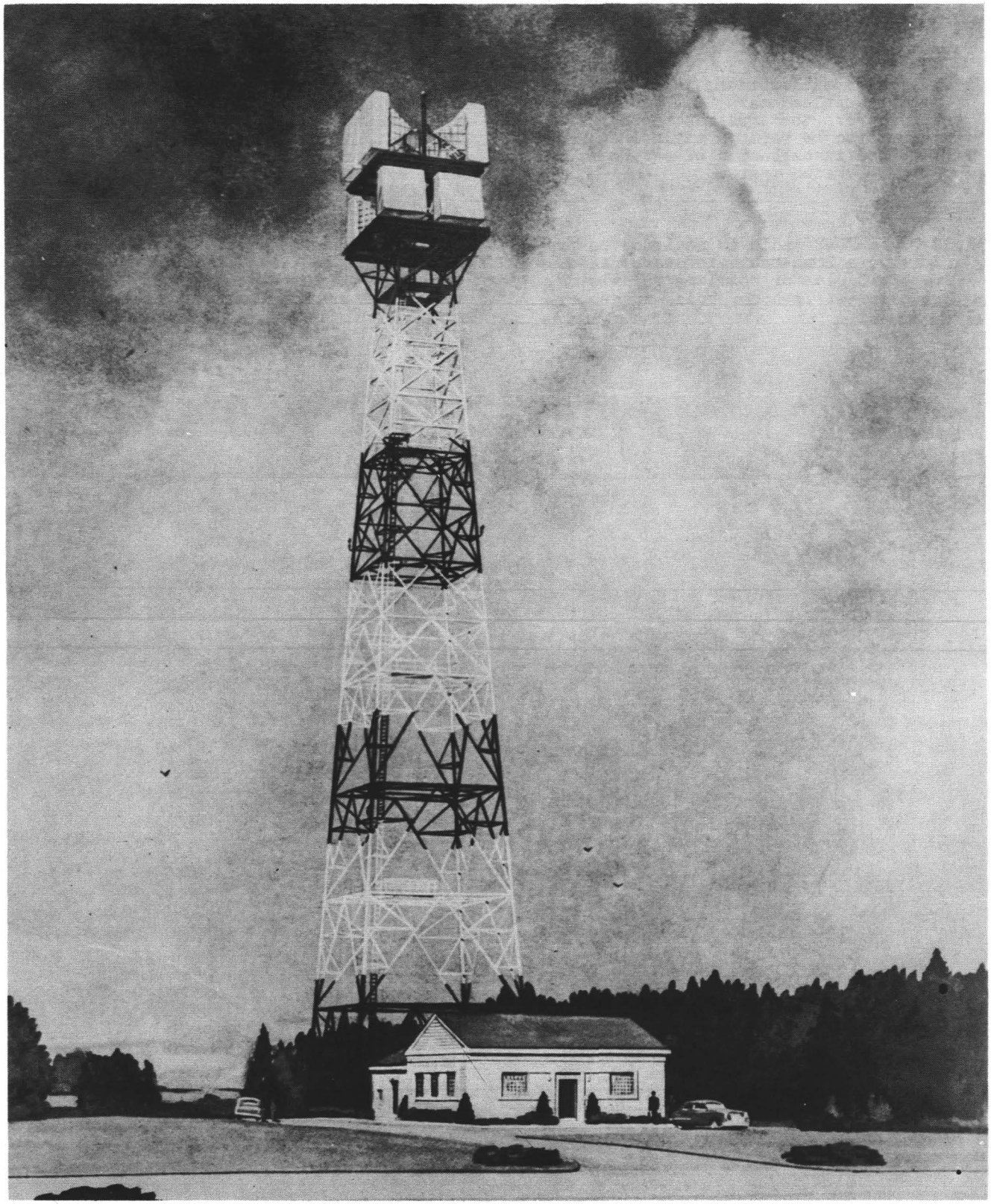

Fig. 3 - Steel Tower With Single Story Building

buildings are 60' high, type 2 vary from 74'-6" to 103'-6" in height, type 3 vary from 118' to 132'-6" in height and type 4 buildings vary from 147' to 190'-6" in height. Steel towers having one or two antenna decks are available in heights from 50'to 250'. The antennas atop the steel towers are connected by waveguide to the radio equipment which, with the power equipment,is housed in a separate one-story building at the base of the tower as illustrated by Fig. 3. Repeater stations are installed at invertals in the order of 20 to 40 miles, depending upon the terrain, fading and other transmission considerations, and over-all system economies. The selection of sites is a result of study of topographical data and is generally verified by a check with path loss measuring equipment to assure that reliable transmission may be obtained between stations. The TD-2 system is set up to provide a maximum of six wide band communication channels in each direction of transmission. At a normal repeater point, this will mean a 2-way system with a maximum of six channels in each direction, however, crossover and spur points may involve as much as double this equipment. Provision is made for dropping and picking up channels at repeater stations as well as at terminals which is a requirement for network usage. Each channel has a transmission band of 7 to 8 megacycles which is suitable for one video program or one multichannel carrier telephone band providing 480 to 600 voice channels in one direction of transmission. Frequency modulation is used in applying the video signal to the microwave carrier. The audio portion of a television program is not transmitted by a TD-2 system. Regular program network wire facilities are required for this service.

Types of Radio Stations

1.03 There are three general types of radio stations involved in establishing a type TD-2 radio system, as follows:

(1) Terminal stations.

(2) Auxiliary repeater stations.

(3) Main repeater stations.

Figure 4 shows the TD-2 route layout between New York and Chicago and illustrates the number and spacing of radio stations.

1.04 Terminal stations are end points in a system where video signals are accepted and delivered. These stations will be either fully or partially attended.

1.05 Auxiliary stations are introduced in the system to provide transmission gain or are required due to geographical considerations to maintain line-of-sight paths or both. They will comprise the majority of the stations in any large system and will be normally unattended. Provision is made for dropping or picking up programs to local video or spur radio facilities.

1.06 Main stations provide all the facilities and functions of auxiliary stations and in addition furnish points of flexibility in a system. At a main station, provision is made for intermediate frequency (IF) patching, enabling switching between channels for general traffic purposes or for dropping or picking up programs to local video or spur radio facilities, and switching from regular to spare channels for maintenance purposes. This IF patching point also provides a convenient location for carrying out systems tests. These stations will be either fully or partially attended.

1.07 The spacing of main stations along the radio relay route will depend on traffic, maintenance or other considerations but on an average will occur every fifth or sixth station. This requirement is based upon maintenance procedures, since sections of the radio system between terminal and main stations or between adjacent main stations will normally be operated as a unit.

1.08 Terminal and main stations are similar insofar as facilities provided for switching, testing and branching are concerned. It is expected that in terminal stations the majority of channels will terminate in video facilities, whereas in main stations any video connections will consist essentially of bridged facilities.

Alarm and Maintenance (Repair) Centers

1.09 Maintenance (or repair) centers are offices to which equipment is sent for repair and test and may or may not be continually attended. These centers are provided with test benches and other necessary testing gear not available at radio stations. Maintenance centers may also be fully or partially attended offices having no repair facilities from which repair and maintenance personnel may be dispatched to the various unattended radio stations.

1.10 Alarm centers are offices attended 24 hours a day to which trouble conditions are automatically reported via the C1 alarm and control system described in another part of this specification.

1.11 Alarms and Order Wires. All radio stations which are either unattended or partially attended will be provided with alarm and remote control facilities (C1 Alarm and Control System) which will connect by wire to an associated alarm center which is continuously attended. Order wire facilities are also required for system maintenance.

Frequency Allocation

1.12 The TD-2 radio relay system operates in the common carrier band between 3700 and 4200 megacycles. This band is divided into 12 microwave channels, spaced at 40 megacycles, with a band width of 20 megacycles. Channels in any one direction are spaced 80 megacycles apart with a 40 megacycle shift between receiving and transmitting frequencies to prevent a transmitter interfering with a receiver. This allocation of frequencies will allow six channels in each direction of transmission to be spaced within the common carrier band. A typical channel frequency allocation arrangement at two adjacent radio repeater stations is shown in Fig. 5.

1.13 Although these frequencies are the general standard for through circuits on a backbone route, it is possible to use "slot" frequencies where spur or other routes intersect at an angle of approximately 90°, the slot frequencies being spaced 20 megacycles or half way between these standard frequencies. Where such spur channels are required, interference may result from the use of the same frequencies in more than one direction at a radio station. The equipment to permit the use of "slot" frequencies is still in the development stage at the time of issue of this specification.

Equipment Required for TD-2 Radio

1.14 The major equipment required in building up a TD-2 radio system is listed below followed by a descriptive paragraph on each. Fig. 6 covers a requirements layout of the over-all system; i.e., the equipment which goes into a radio station.

(a) Antennas.

(b) Antenna waveguide and waveguide gas pressure equipment.

(c) Transmitter-receiver equipment.

(d) Tube cooling system for type 416A and 418A vacuum tubes.

(e) Individual alarm equipment.

(f) C1 alarm and control equipment.

(g) Local and express order wires.

(h) IF and video patching and monitoring equipment.

(i) Remote control equipment for IF switching.

(j) FM terminal equipment.

(k) -12 volt power plant.

(l) +130 volt power plant.

(m) +250 volt power plant.

(n) -24 volt power plant.

(o) AC service and alarms.

(p) Reserve engine alternator power plant.

(q) Air navigation obstruction lighting.

(r) Cable racks and auxiliary framing.

(s) Spare parts and tools.

(t) Maintenance and testing equipment.

1.15 Antennas (J41610): Requirements for delay lens microwave antennas and their mounting are covered in Specification J41610. The delay lens antenna per KS-5759, List 1, illustrated by Fig. 7, was designed especially for TD-2 radio, however, it may be applied to any system operating in the TD-2 frequency range of 3700 to 4200 megacycles. One antenna is required for receiving and one for transmitting in each direction of transmission. Each antenna will serve a maximum of six channels in one direction of transmission. Thus, for a 2-way system at a repeater point without branching or spur facilities, four antennas are required. The associated terminal would require only two antennas, one for receiving and one for transmitting.

1.16 The antenna is a rectangular cross-section aluminum horn approximately 10'-0" by 10'-0" square at the mouth and approximately 10'-0" deep. The mouth of the horn contains a microwave delay lens mounted in a rectangular housing. The antenna provides gain in the forward direction of about 39.5 db (mean value), referred to an isotropic radiator, over the frequency range of 3700 to 4200 megacycles. The antenna is designed for the propagation of vertically polarized radio waves only. It is shipped knocked down for assembly at the sites.

1.17 Antenna Waveguide and Gas Pressure Equipment (J68335): The antennas are located on the top decks of the radio station towers or on the roofs of tall office buildings and are connected to the radio equipment (transmitter-receiver bays) by means of waveguide having a rectangular internal cross-section of 2.290" by 1.145". The waveguide runs are filled with a dry gas under low pressure to avoid condensation in the waveguide due to atmospheric variations. These waveguide runs are equipped with a low pressure alarm feature which connects to the C1 alarm and control system. The method of installing the waveguide and associated pressure system, together with the various types of waveguide sections, such as bends, elbows, flexible

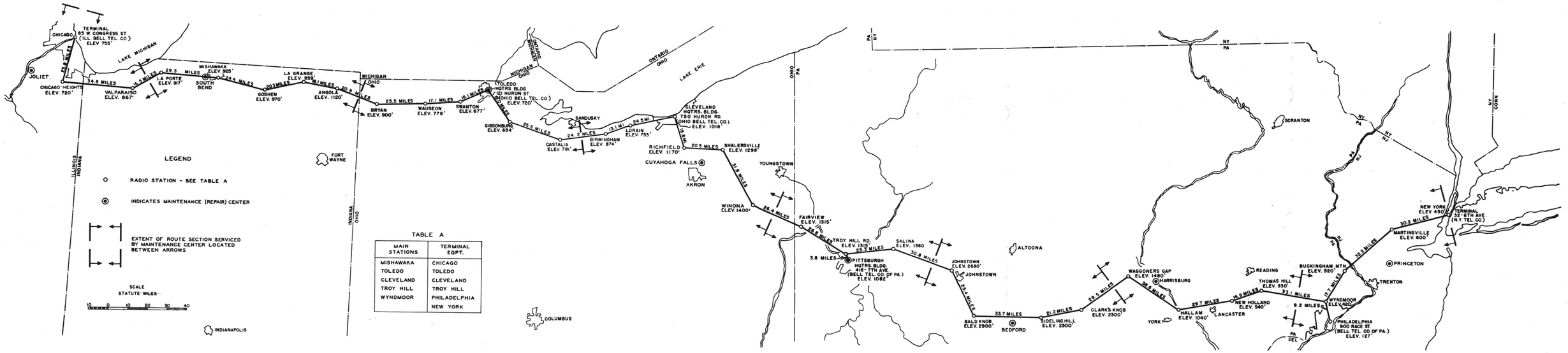

TABLE A

MAIN STATIONS	TERMINAL EQPT.
MISHAWAKA	CHICAGO
TOLEDO	TOLEDO
CLEVELAND	CLEVELAND
TROY HILL	TROY HILL
WYNDMOOR	PHILADELPHIA
	NEW YORK

Fig. 4 - New York - Chicago Radio Relay Route Layout

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42

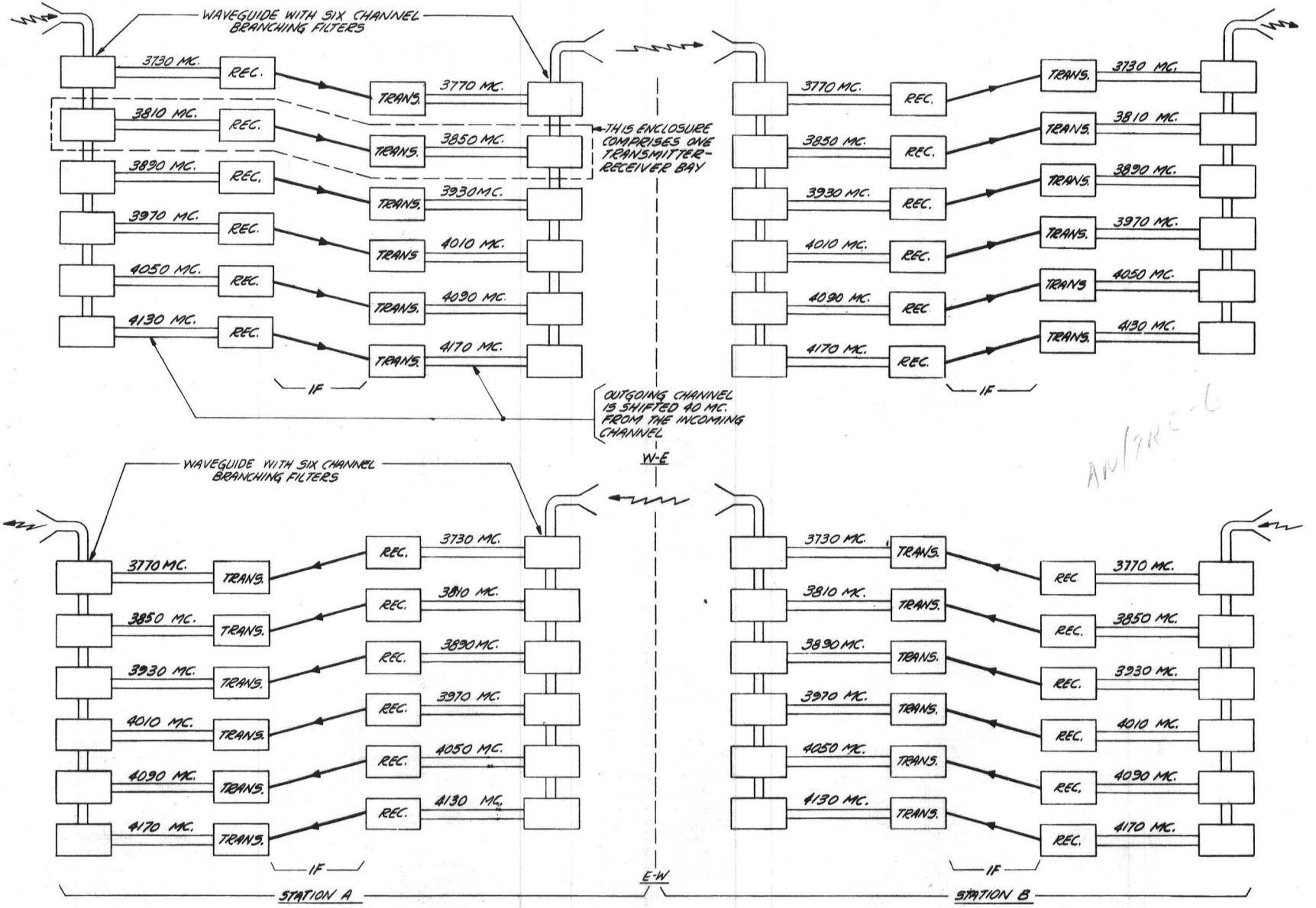


Fig. 5 - Frequency Allocation Chart

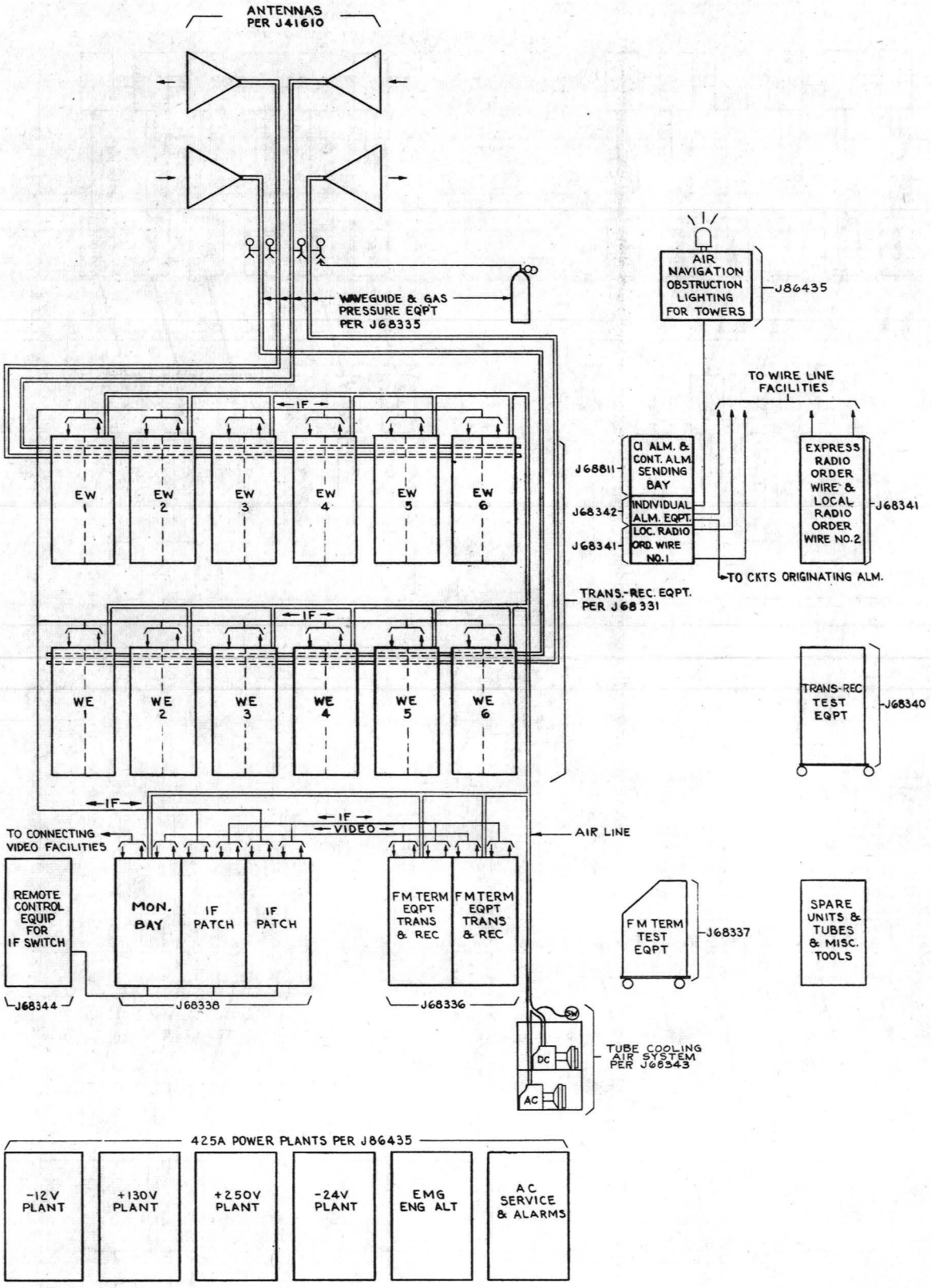


Fig. 6 - Over-all System - Requirements Layout

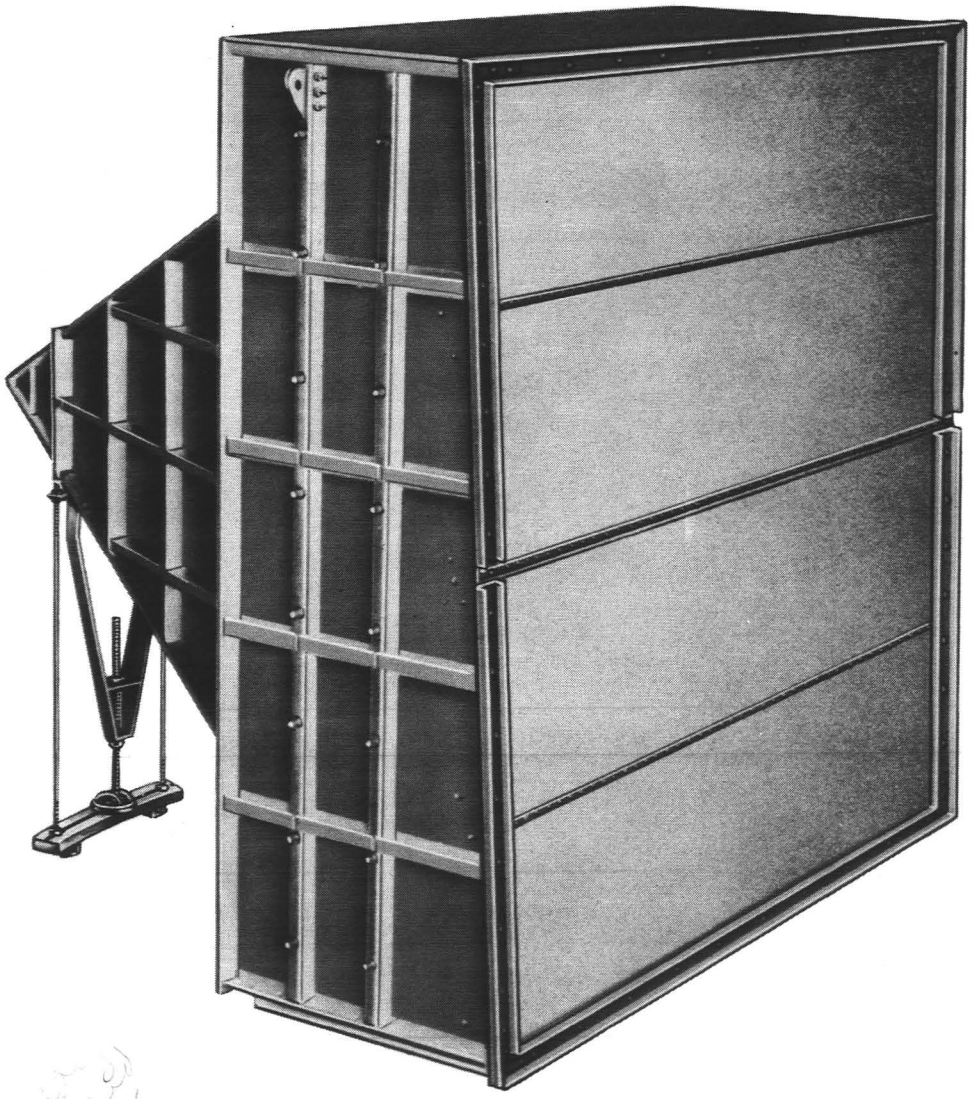
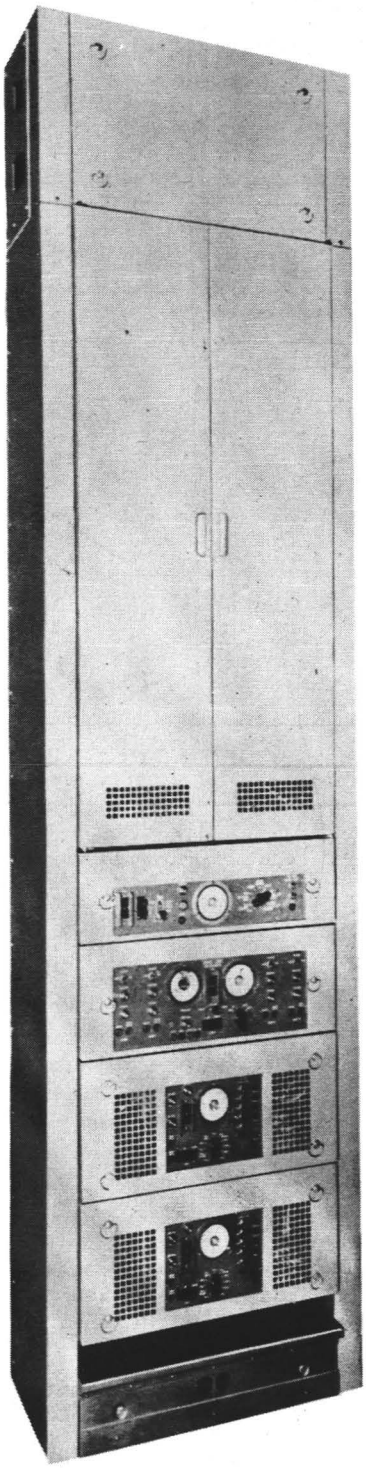


Fig. 7 - Delay Lens Antenna

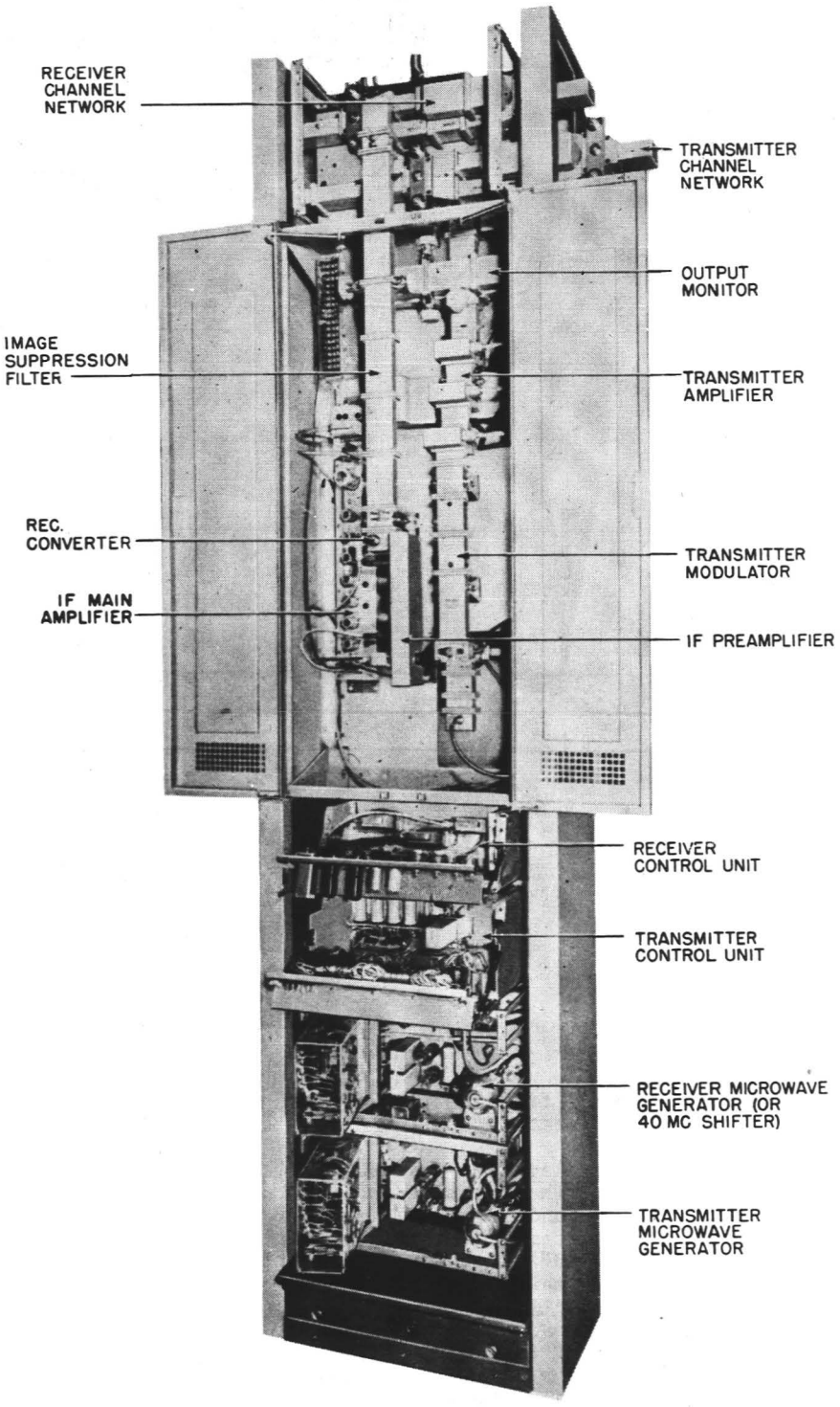
sections, pressure fittings, etc., are covered in Specification J68335.

1.18 Transmitter-Receiver Equipment (J68331A): The transmitter-receiver equipment is the fundamental element of the TD-2 radio system. This equipment is mounted on a 22-3/8" wide, 15" deep and 9' high duct-type framework as illustrated by Fig. 8 and comprises two components, a receiver and a transmitter. The equipment is so arranged that either a transmitter or receiver or both may be provided. At auxiliary stations the transmitter and receiver in a bay are connected back-to-back (IF to IF) to provide a repeater. At terminals and in main repeater stations they are connected to IF patching equipment which permits interconnecting as required. The units are all designed with plug-in connections to permit quick replacement in case of trouble.

(a) Receiver: The incoming microwave signals from a distant station may contain any combination of one to six channel signals. This complex signal as received by the antenna is carried by waveguide to the transmitter-receiver bays in the radio room. Located in the waveguide run at the top of each frame is a receiving channel separation filter or network which selects the particular signal for that channel. Frequencies for other receiving channels pass through the first network and are dropped at successive networks in numerical order with the



Doors and Covers in Place



Doors Opened and Covers Removed

Fig. 8 - Transmitter-Receiver Bay

lower frequencies first. Six frames lined up side by side with the horizontal network runs across the top provide for the maximum arrangement of six channels in one direction. After passing through the specific channel dropping network, the microwave signal is modulated with a local fixed source of microwave frequency to produce a 70-megacycle IF signal which is amplified to the proper level to drive the associated radio transmitter or FM terminal receiver as required. An AVC circuit is provided in the receiver control panel to compensate for fading and variations in transmission.

(b) Transmitter: The transmitter modulator combines the 70-megacycle IF signal from the receiver or FM terminal transmitter with a source of microwave frequency generated by a local oscillator to produce the final frequency modulated microwave signal. The modulator is followed by three stages of microwave amplification to raise the signal to the level required for transmission to the antenna. This signal enters a channel separation network which parallels the receiving channel networks at the top of the frame, and combines the output signals from as many as five other transmitters. The combined signals are then passed by means of waveguide to the transmitting antenna.

(c) At auxiliary stations which involve only straight through repeaters, the IF output of the receiver is normally patched through a 5-db pad, to the input of the transmitter in the same frame. For main and terminal station application, the output of the receiver and the input to the transmitter are cabled to an IF patching bay. At this bay, patches may be made as required between transmitters and receivers of regular and spare, branch or spur radio circuits, or to FM terminal circuits. At main and terminal stations, a buffer amplifier is incorporated in the input to the radio transmitter. Provision is also made in the IF patch bay for various maintenance or alignment test procedure hook-ups. Fig. 9 covers a block diagram of a repeater station showing a typical channel. Arrangements are shown for connecting the transmitter modulator directly to the IF main amplifier or patching in monitoring and FM terminal equipment.

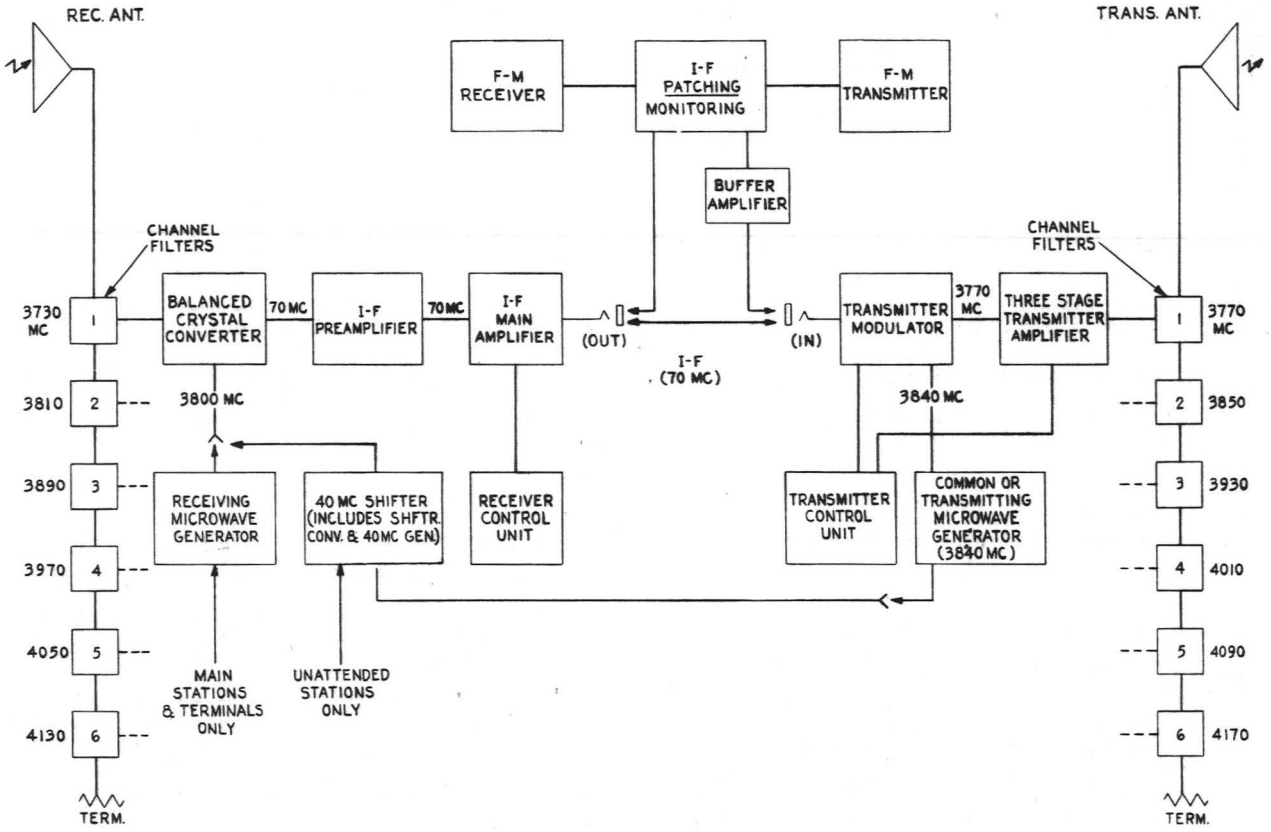


Fig. 9 - TD-2 Radio System - Block Diagram

(d) At auxiliary stations, the transmitter-receiver has a single microwave generator which supplies the local microwave frequency required for modulation in both the transmitter modulator and receiver converter. For applications in main and terminal stations separate microwave generators are used in the transmitter and receiver thus allowing greater flexibility and freedom when patching and switching the circuits. Specification J68331 is so arranged that the various combinations may be obtained by ordering the proper list numbers. Options include separate transmitters and receivers or both, transmitting or receiving on any one of the 12 frequencies in the band from 3730 to 4170 megacycles with common or separate microwave generators. Fig. 10 illustrates the various parts of the transmitter-receiver bay and the functions they perform.

1.19 Tube Cooling System For Type 416A and 418A Vacuum Tubes (J68343): Certain units in the transmitter-receiver contain type 416A and 418A vacuum tubes requiring forced air cooling to prevent overheating and subsequent loss of tube life. The test bench also employs a 416A tube, and the IF patching bay and FM terminal bay contain 418A tubes. This tube cooling system is covered by specification J68343 and provides air from a central blower source and distributes it by means of pipe and hose supported by the auxiliary framing in the equipment room. Two blowers are supplied in each office, one operating from 115-volt AC power and the second from 130-volt DC battery. Under normal conditions, the AC blower is in operation. Under failure of the AC blower because of AC power failure, or for any other reason, the DC blower starts and takes the load. A switching circuit is provided which controls the operation of the two blowers. This circuit by monitoring the AC supply and the air pressure determines the control of the motors and supplies adequate alarm indications for any trouble condition. The blowers are designed for continuous operation. One tube cooling system will supply air to all the transmitter-receiver bays of an office including the FM terminal receivers and FM terminal transmitters as provided at main or terminal stations.

1.20 Distribution Fuse, Individual, Audible and Visual Alarm Equipment (J68342): This equipment provides the connecting link between the various equipments where alarms may originate and the facility which informs the maintenance personnel that a trouble condition exists. This latter facility may be the C1 alarm and control system, which forwards information to a distant continuously attended alarm center. If the station is continuously attended, the facility will be the local office audible and visual alarm equipment. The distribution fuse, individual, audible and visual alarm equipment provides for alarm registration for the following trouble conditions:

(a) Various battery voltage fuse failures.

(b) Low or high room temperature and open door alarm.

(c) Low waveguide gas pressure and vacuum tube cooling air pressure alarms.

(d) Low transmitter microwave output power alarm.

(e) Failure of air navigation obstruction lighting.

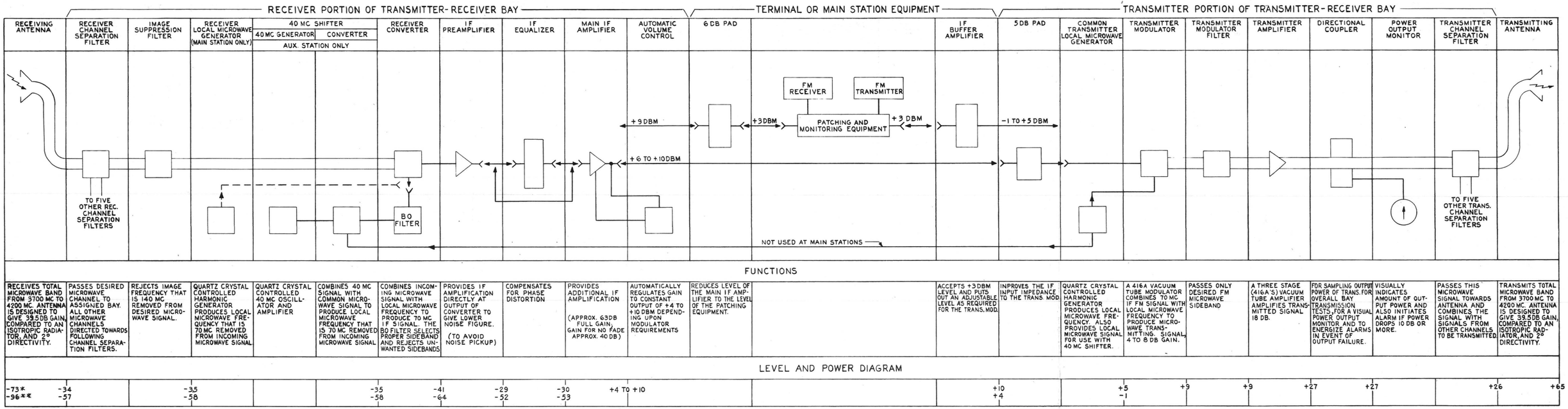
(f) Low and high microwave generator crystal oven temperature alarm.

1.21 Comparable alarm equipment is required for various power plant circuits. This specification (J68342) does not include this equipment since it is incorporated in the power plant specification (J86435).

1.22 C1 Alarm and Control Equipment (J68811): In order to insure reliability of service in a communication system involving stations which must be operated on a nonattended or partially attended basis, various trouble or abnormal conditions which originate in these stations (Alarm Sending Stations) must be promptly reported to an associated continuously attended alarm center (Alarm Receiving Station). It is also important that the attended center be able to perform certain functions at unattended offices on a remote control basis such as starting the emergency gas engine alternator and checking the alarm and signaling systems. The C1 alarm and control system (J68811), which operates on a voice-frequency basis, provides these facilities.

1.23 Each unattended or partially attended station transmits a continuous distinctive tone over an alarm pair to an attended alarm center. Absence of, or interruption of this tone at the alarm center indicates the presence of a trouble condition or impaired transmission at the unattended station. Fig. 11 covers a simplified block schematic of the system.

1.24 Detailed information as to the particular trouble is obtained by sending an order (2-frequency sequence signal) over the local order wire to the station in trouble directing it to report the status of all alarm circuits in that office. This information is transmitted by pulsed voice-frequency tones over the alarm pair which



* SIGNAL OVER 30 MILE PATH WITH NO FADING - PATH LOSS ASSUMED TO BE 138 DB.

** MIN. SIGNAL WHICH CAN BE FULLY COMPENSATED WITH IF AMPLIFIER OUTPUT OF +10 DBM; ≡ 23 DB FADE

LEVEL & POWER DIAGRAM FIGURES IN DBM.

Fig. 10 - Transmitter-Receiver Functional Diagram

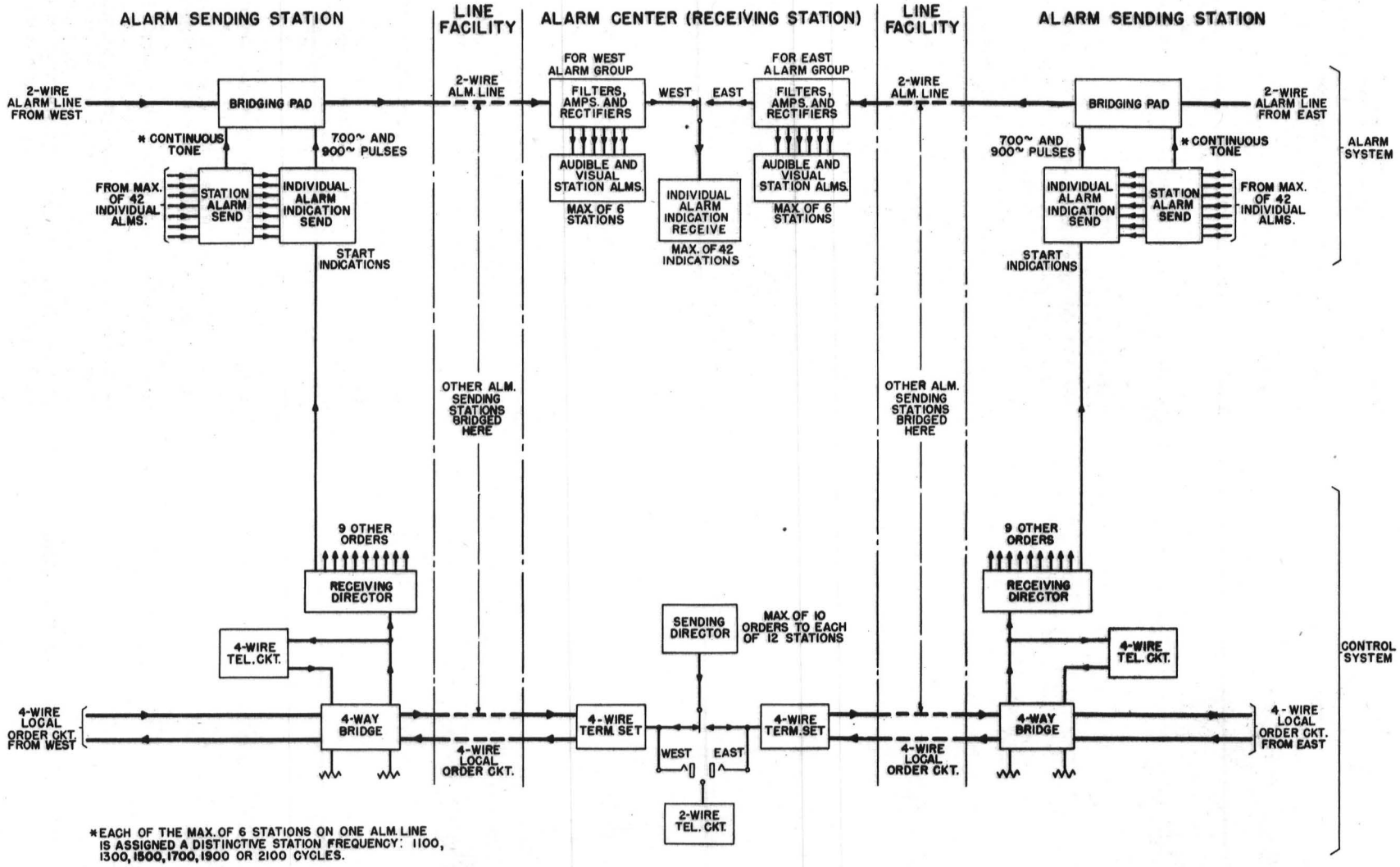


Fig. 11 - C1 Alarm and Control System - Simplified Block Schematic

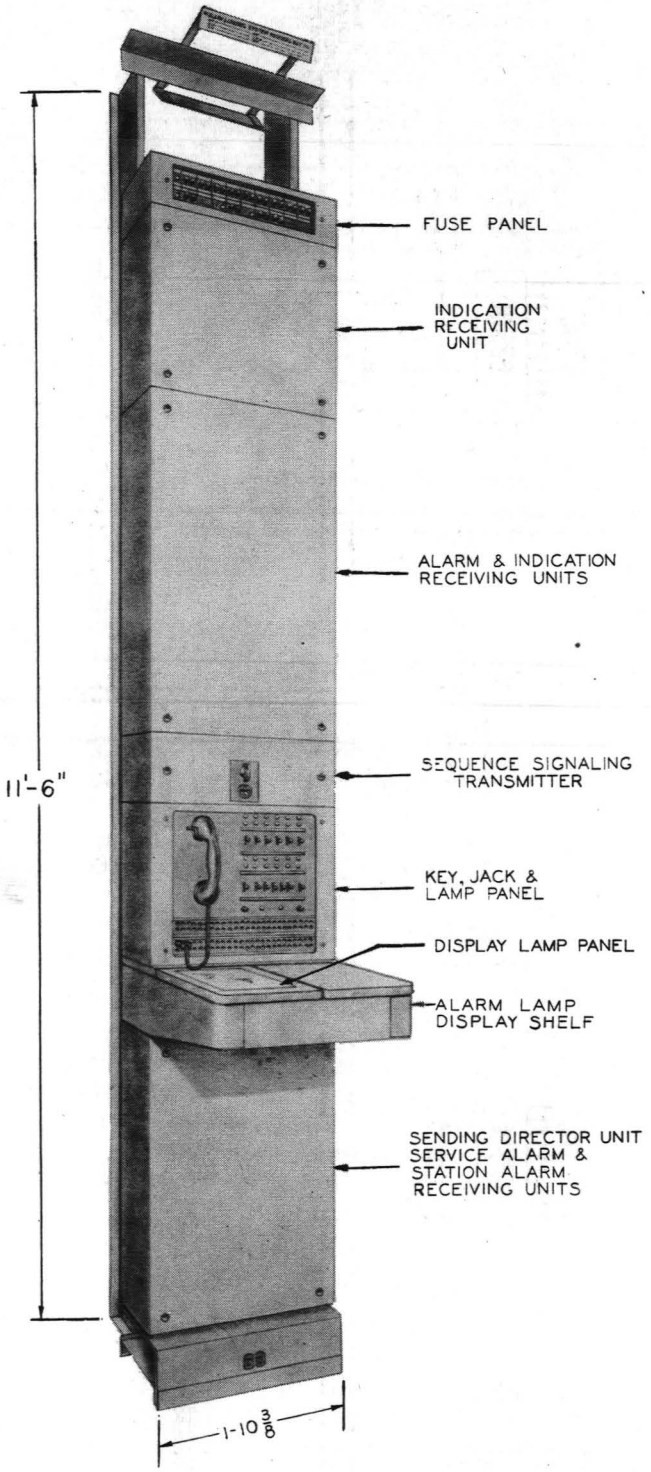


Fig. 12 - Cl Alarm Receiving Bay

cause appropriate lamps to light in an alarm lamp display shelf in the alarm center. A maximum of 42 different indications may be received from each station. A maximum of 10 orders may be sent out to each station. One alarm center may serve as many as 12 unattended stations.

1.25 Two groups of equipment are covered by the specifications for the Cl alarm and control system, namely that which is required at alarm centers for receiving alarms, and that required for unattended or partially attended stations for sending alarms. The alarm receiving bay equipment provided at an alarm center consists of one 11'-6" high duct-type framework bay containing signaling, ordering and alarm reporting display facilities as illustrated by Fig. 12. Various options are available, primarily dependent upon the number of stations which will be reporting to the alarm center and the positions of those stations in the maintenance section. The alarm sending bay equipment provided at the sending stations is mounted in a 9' high cable duct framework as illustrated by Fig. 13. The options depend upon the number and type of alarms which may originate at that station and the position of that station in the maintenance section. The alarm sending bay is normally located on the radio floor at auxiliary stations. At main stations where radio frame space may be at a premium, the sending bay may be located on the floor below although the preferred location is in the room with the radio equipment.

1.26 Local and Express Radio Order Circuits (J68341): Two types of order circuits are required for maintenance and operation of a TD-2 radio system, local and express radio order circuits. These order circuits require separate wire line facilities into the radio stations. Fig. 14 shows typical alarm lines and local order circuits as used for the Cl alarm and control system.

1.27 Local order wire circuits are required for local or sectional maintenance. These circuits terminate at adjacent main repeater or terminal stations and have appearances at all intervening auxiliary stations, at the one or more alarm centers, and at any maintenance centers which may be serving the section. In addition to being used to carry on general maintenance order work within the maintenance sections, the local order wire circuits furnish the facilities over which orders originating in the Cl alarm equipment are transmitted from the alarm center to the auxiliary station which it serves. The Cl alarm equipment includes all necessary apparatus to provide signaling facilities on the local order wires, where the signaling originates at the alarm center. Signaling from an auxiliary station to the alarm sender is

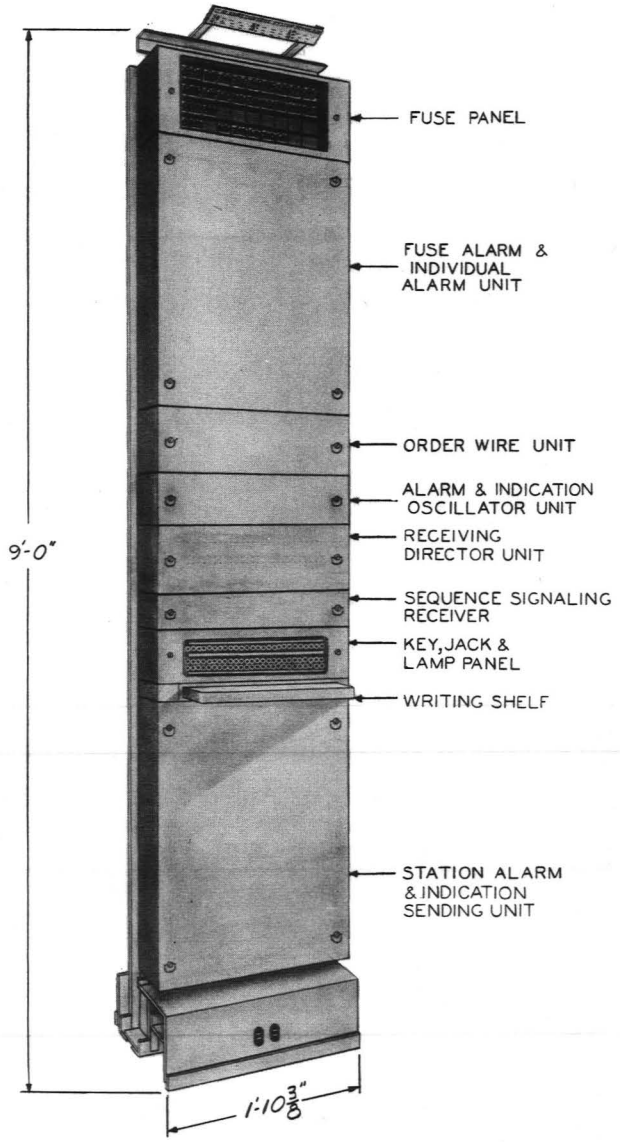


Fig. 13 - C1 Alarm Sending Bay

carried over the alarm circuit pair and is handled in a manner similar to an originating alarm.

1.28 Express order wire circuits are required for system wide radio maintenance and traffic control. These circuits terminate at the end terminal stations of a TD-2 system and have appearances at all intermediate main repeater and terminal stations, and at all alarm and maintenance centers. Sequence signaling is used on the express order wire circuits, and separate sequence signaling transmitting and receiving equipment is required at all radio stations having express order wire appearances, except in the case of alarm centers. At alarm centers, a sequence signaling receiver is required, but the transmitter incorporated in the C1 alarm equipment is used for transmitting signals.

1.29 The sequence signaling transmitter (J68814A) provides a 1600-cycle carrier signal which is modulated by a pair of lower frequencies varying from 277.5 cycles to 442.5 cycles in 15-cycle steps. The receiver (J68814B) receives the modulated 1600-cycle carrier, amplifies it and detects the lower frequencies and in turn amplifies the wanted signals. Translating equipment consisting of frequency conscious selectors or reed relays receives the two audio signaling frequencies, recognizes their sequence and translates them into orders. The translator equipment when required separately is furnished per J68814C but is incorporated as part of the receiving director unit (J68811J) when a C1 alarm and control system sending bay is provided.

1.30 The various order wire arrangements and requirements for use with TD-2 radio are covered in specification J68341. In general, at auxiliary stations and main repeater stations, new equipment is required. In existing offices, as might be used for terminals, alarm and maintenance centers, or main stations located in telephone offices, existing plant facilities and equipment may be used in part to build up the order wire system.

1.31 IF and Video Patching and Monitoring Equipment (J68338): Facilities which will permit switching and branching, pick-up and drop-off spurs are essential to a radio system adaptable to network usage. Facilities are also required to permit switching from regular to spare channels of the system in connection with maintenance procedures and testing routines and to permit rapid replacement of channels which suffer transmission impairment or are inoperative due to a trouble condition. This flexibility is provided for in the TD-2 radio system by IF and video patching equipment.

1.32 At all main repeater or terminal stations, all IF connections, namely, the output of the radio receiver, input of radio transmitters, output of FM terminal transmitters and input to FM terminal receivers, terminate in the IF patch bay. Switching and distributing amplifiers provided in this bay enable connections to be made as required between radio transmitters and receivers or between these elements and the FM terminal transmitters and receivers. In general, the distribution amplifier enables a single input to feed in three directions simultaneously and the switching amplifier enables a rapid traffic switch or permits a quick substitution of a spare channel for a regular channel in a maintenance section.

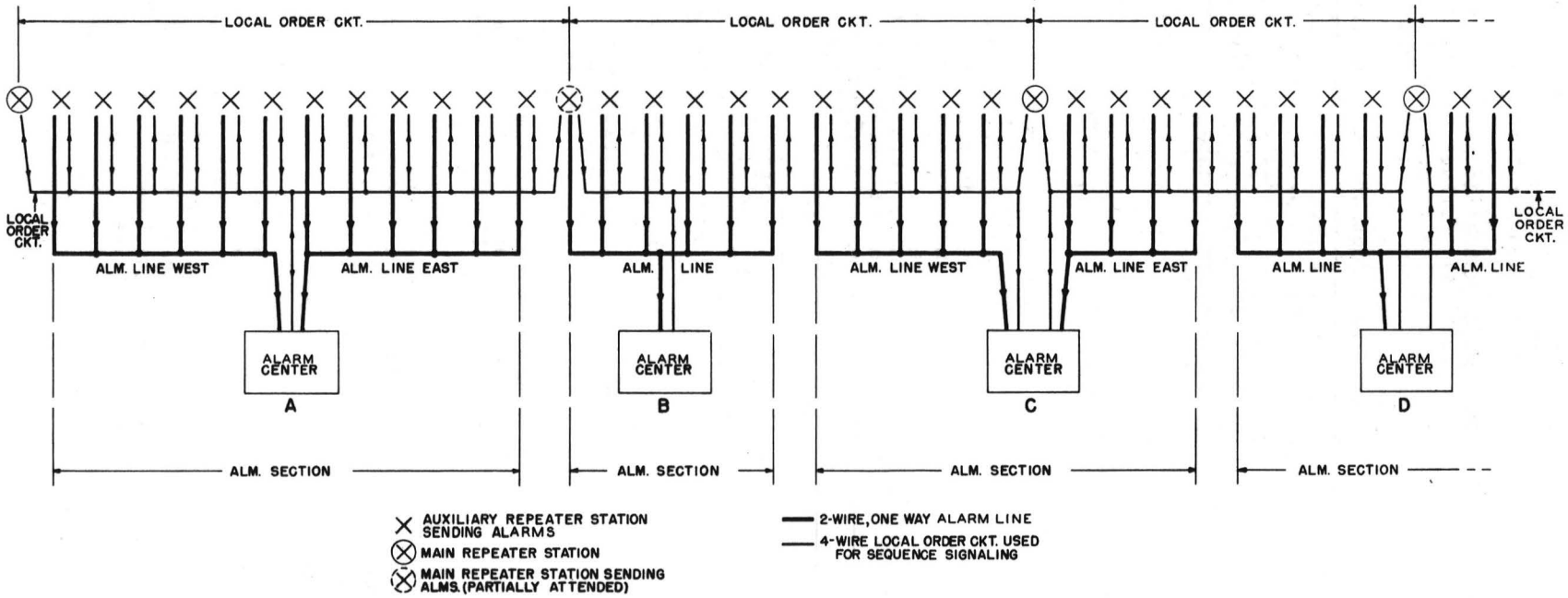


Fig. 14 - Typical Alarm Lines and Local Order Circuits Used for Cl Alarm and Control System.

1.33 Typical circuit layouts and equipment arrangements for the patch bays and the associated monitoring bay are covered in specification J68338. Figs. 15, 16 and 17 cover typical patching conditions which may be set up. In a normal through patch, two switching amplifiers and two distributing amplifiers are connected as shown in Fig. 17. Maintenance patches normally employ the first switching amplifier and the second distributing amplifier. Traffic switching patches normally employ the first distribution amplifier and the second switching amplifier. The IF patch bay provides for as many as ten of each of these groups (40 amplifiers) which is sufficient to handle five through channels in each of two directions. A second bay is required to provide for associated spur radio circuits. Options available depend entirely on the number of channels involved and whether the circuits are through or terminating and upon the type of traffic switching to be carried on. These bays are 9' high duct-type frameworks, similar to other frames in the radio station. Facilities are provided for visually monitoring on any circuit by patching means. The monitoring bay furnishes equipment for tapping off a small portion of the IF signal through a high impedance bridge, amplifying by means of an auxiliary IF amplifier, and provides demodulating means using a standard FM terminal receiver for obtaining the impressed video signal. This video signal is presented on a television monitor. In order to obtain complete flexibility, it is also necessary to provide a patching facility on the video side of the FM terminal transmitters and receivers, for substituting spare FM terminal facilities for maintenance purposes and for video monitoring. A video monitoring amplifier is provided to facilitate this procedure.

1.34 Specification J68338 also covers applications of the distributing and switching amplifiers at auxiliary stations when it may be necessary to connect to spur circuits on an unattended basis.

1.35 Remote Control Equipment for IF Switching (J68344): The IF patching equipment described in the previous paragraph provides switching amplifiers which have two inputs and a common output. Each amplifier has two control leads which serve to enable one or the other of the two inputs. Thus two separate programs may be fed into the two inputs and by enabling one or the other of the control leads one of the two programs will appear at the output. By using these switching amplifiers in a cascade arrangement it is possible to set up a switch group having a large member of inputs and a single output. Such an arrangement would be required at a repeater point having several through circuits in each direction with provision for furnishing service to a single customer from any one of the through circuits.

1.36 The tapping of one of several through circuits for dropping purposes, or the picking up of programs from one of several sources is generally under the control of an operator at a television operating center. Since the actual point of connecting to through circuits is accomplished in a radio station which may or may not be attended, switching equipment is required which can be controlled from a location remote from the radio station. Specification J68344 provides relay equipment capable of enabling the controls of a cascade arrangement of switching amplifiers such that any one of the transmission paths through the switch group may be selected. Any capacity of switch group may be set from a 1 by 2 (1 output and 2 inputs), involving a single switching amplifier up to a 1 by 8 switch group involving seven switching amplifiers. The control at the remote point is by means of nonlocking push-button type keys. A separate key is required for each transmission path through a switch group; thus a 1 by 8 switch group requires eight control keys. Lamps associated with the keys indicate the transmission path which has been selected. Local controls may be provided at the radio stations which can take over the control of switching under emergency or special conditions.

1.37 This system of remote control operates on a DC basis requiring separate leads for each path being controlled. Thus a 1 by 8 switch requires eight separate leads from the control station to the radio station. The circuit provides for operation over outside line facilities as well as interoffice cable.

1.38 FM Terminal Equipment (J68336): The transmitter-receiver equipment (J68331), delivers a 70-megacycle frequency modulated signal (IF) at the output of the radio receiver and requires a similar signal at the input to the radio transmitter. It is the function of the FM terminal equipment to provide the connecting and converting link between the IF signals required at the radio equipment and the video or multichannel carrier telephone signals which are delivered to the receiver from connecting facilities. The equipment consists of two fundamental units, an FM terminal receiver and an FM terminal transmitter. Fig. 18 illustrates the bay equipment and Fig. 19 covers simplified block schematics of the FM transmitter and FM receiver.

1.39 The FM terminal transmitter accepts a single video channel or multichannel carrier telephone signal from an

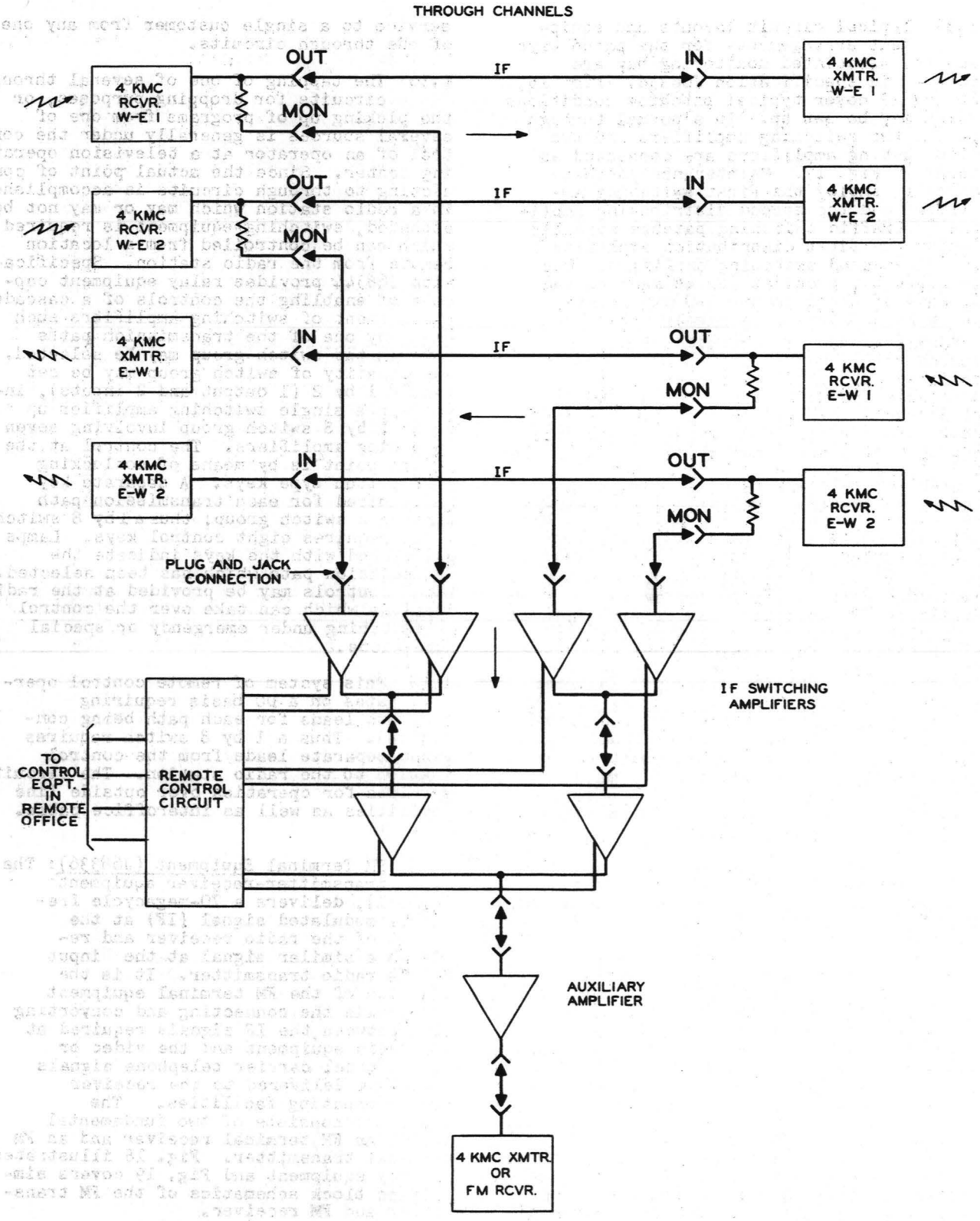


Fig. 15 - Method of Connecting a Drop or Spur Circuit to Any One of 4 Thru Channels at an Auxiliary Station

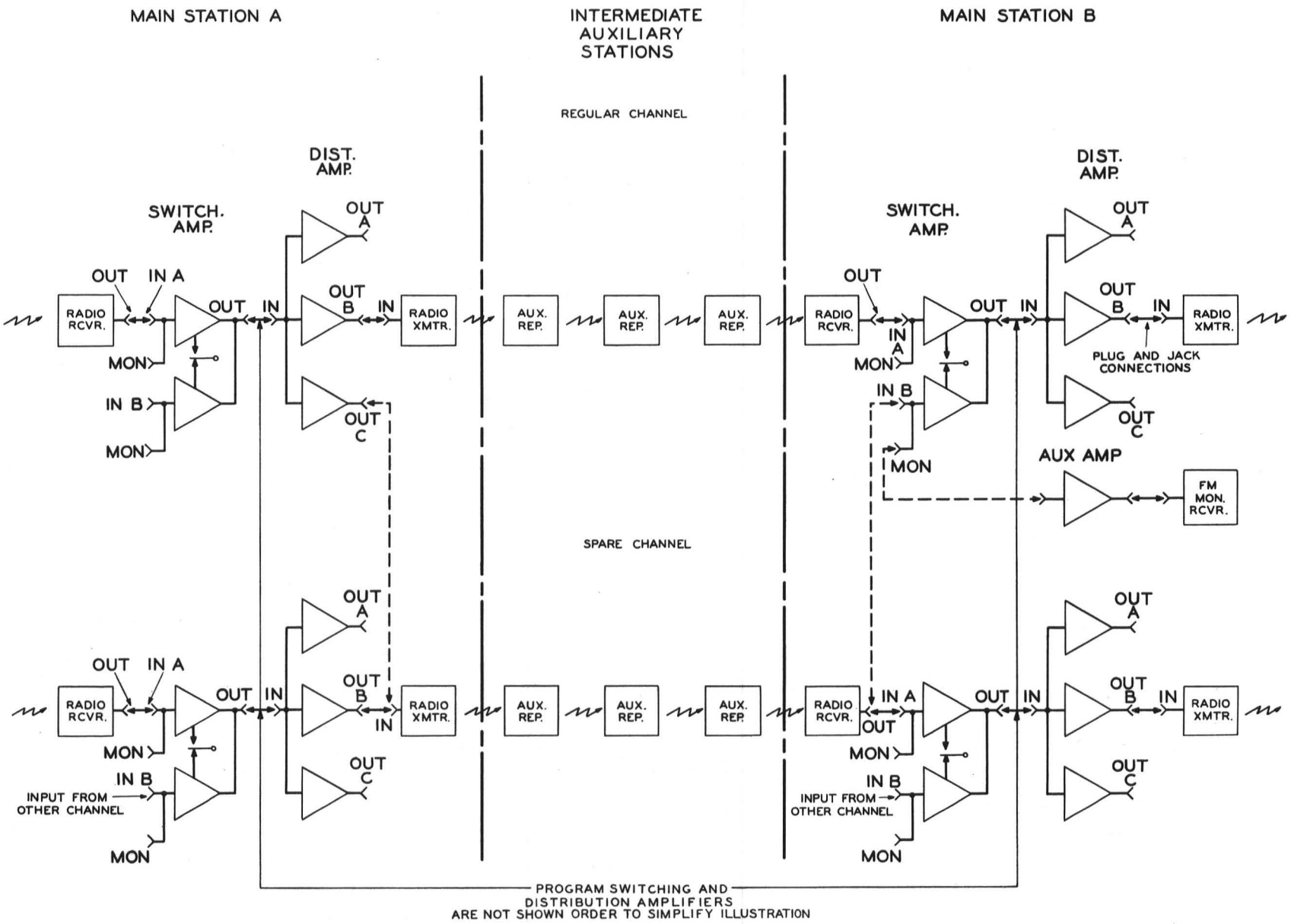


Fig. 16 - Method of Performing a Maintenance Switch

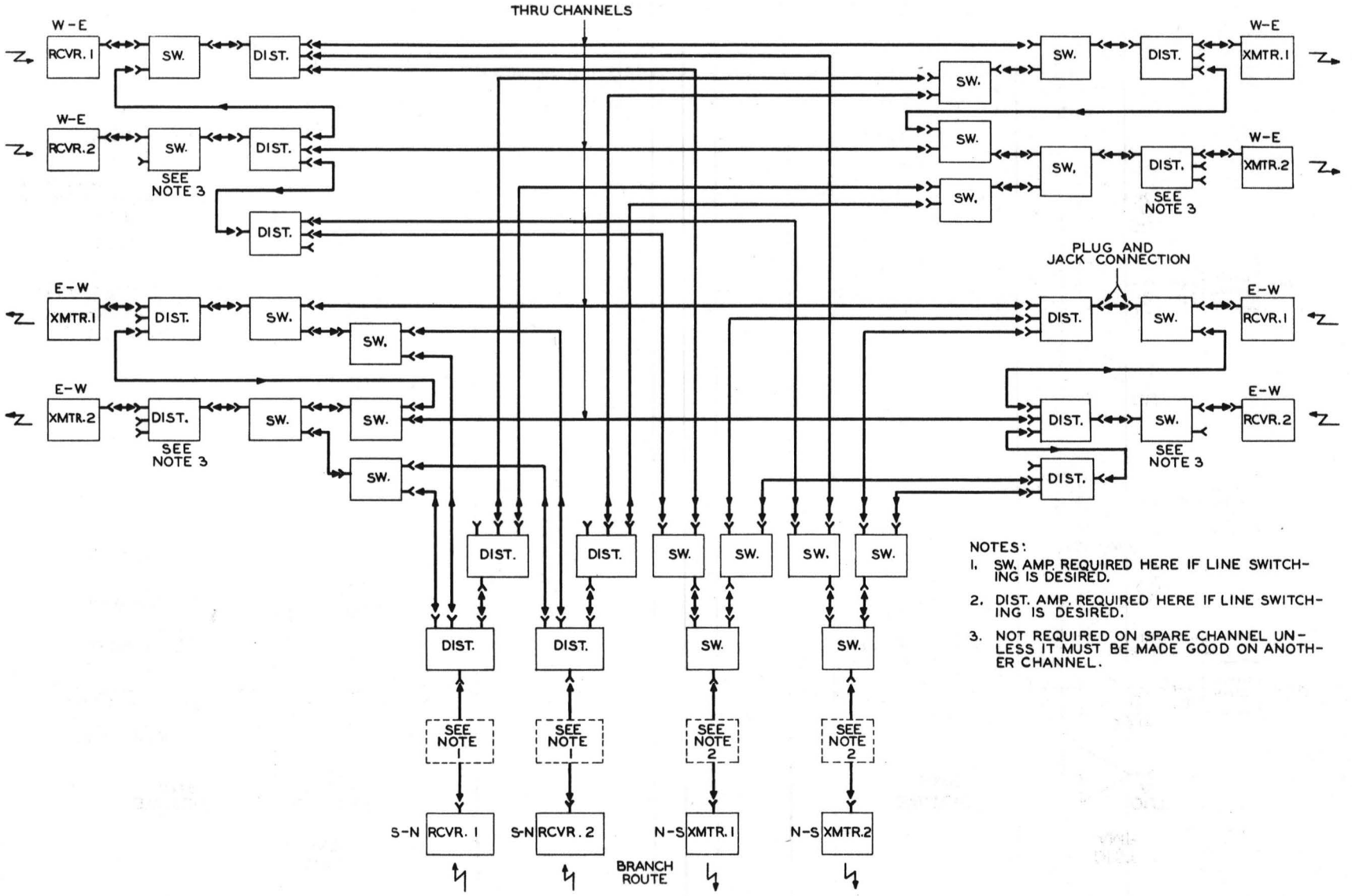


Fig. 17 - Attended Repeater Station with Permanent Patches For 4 Thru and 4 Branch Channels

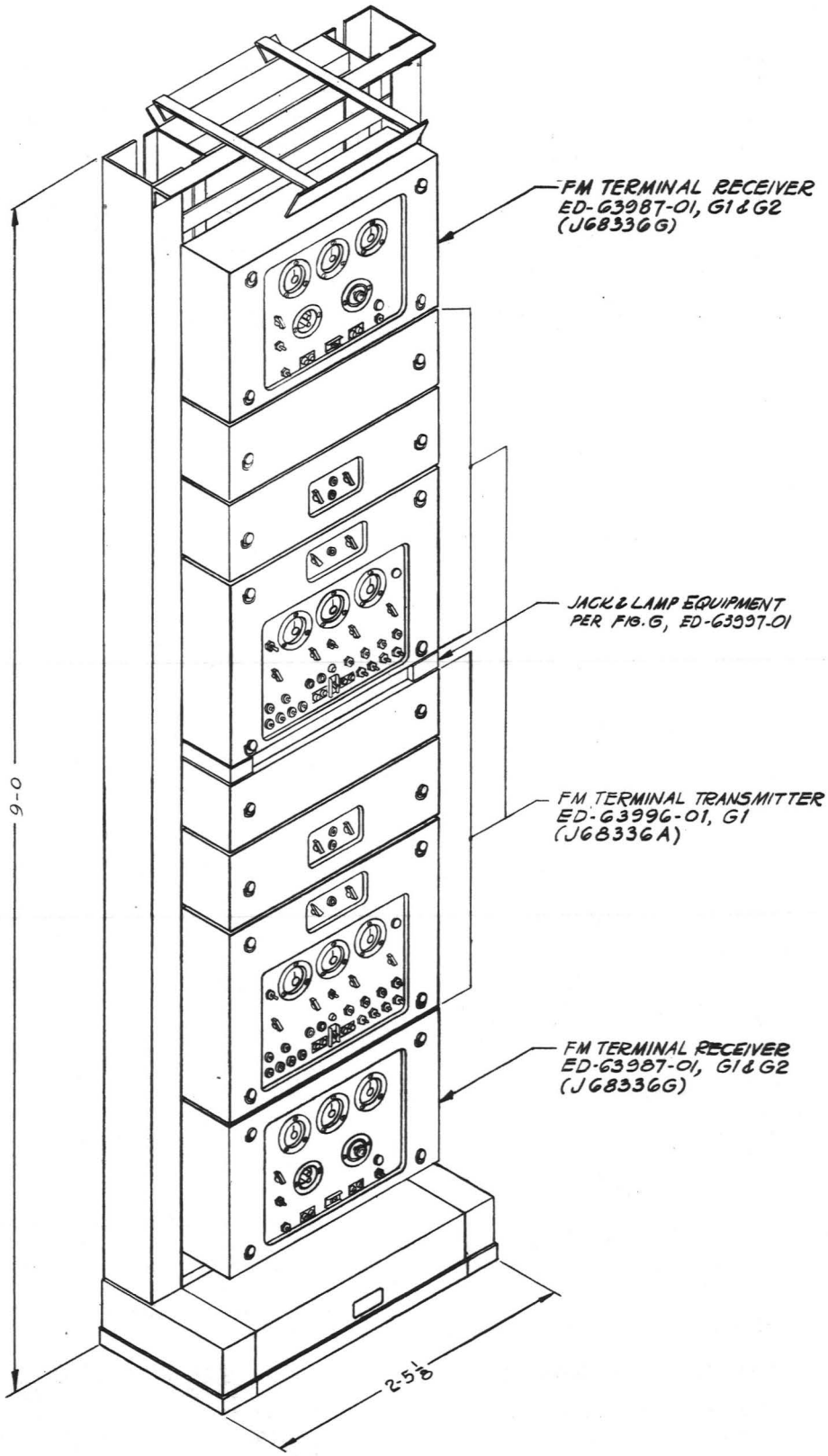
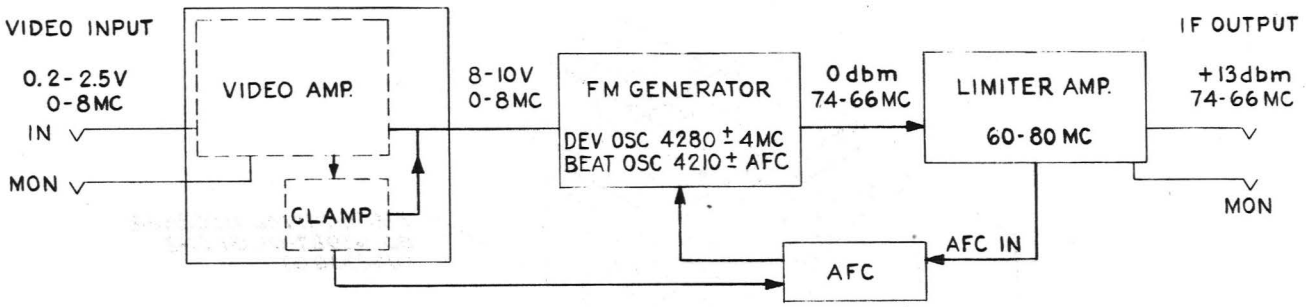
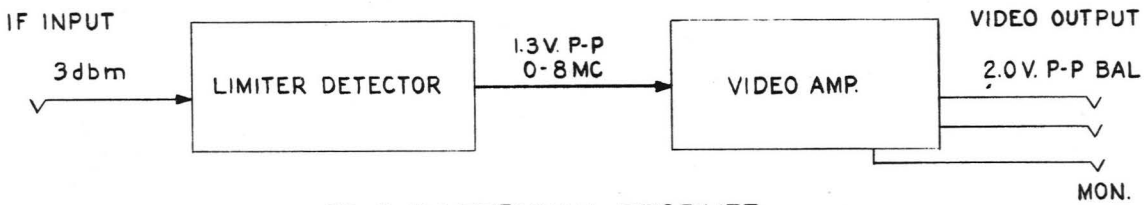


Fig. 18 - Typical FM Terminal Equipment



TD-2 FM TERMINAL TRANSMITTER



TD-2 FM TERMINAL RECEIVER

Fig. 19 - FM Terminal Block Schematics

unbalanced 75-ohm line and delivers a 70-megacycle frequency modulated signal (IF) at the proper level for transmission to the radio transmitter. The FM terminal receiver accepts a 70-megacycle frequency modulated signal from a radio receiver and delivers a video or multichannel carrier telephone signal to a 110-ohm balanced line. The FM terminal units are arranged for mounting on duct-type frameworks designed for 19" mounting plates. Two receivers and two transmitters will mount on one 9' high rack.

1.40 Power Plant Equipment for TD-2 Radio (J86435): The TD-2 radio requires four different fundamental voltages for its operation as follows:

Voltage	Usage
-12 V DC	RF, IF and FM terminal equipment vacuum tube heater supply
+130 V DC	General plate battery supply
+250 V DC	General plate battery supply
-24 V DC	General telephone usage and relay operation

1.41 These voltages are obtained from batteries which are floated on the line by means of charging rectifiers operating from commercial 60-cycle power. In order to insure reliable operation and dependability of service, a standby gasoline engine alternator is provided to carry the load in the event of commercial power failure. In the event of failure of both commercial power and the engine alternator, the battery reserve will carry the load for six to eight hours, dependent on the capacity of battery provided.

1.42 Specification J86435 is the master specification for the 425A power plant provided for TD-2 radio. This specification and the associated specifications listed therein establish the requirements for engineering the power supplies for TD radio. These plants are designed for unattended automatic operation and connect to the C1 alarm system to indicate abnormal or trouble conditions to an attended maintenance center. The equipments covered by J86435 and associated specifications are briefly described in the following paragraphs.

1.43 425A Power Plant - 12 Volt: The 12-volt vacuum tube heater supply plant consists of rectifier control apparatus, distribution fuse apparatus and two or more 200-ampere rectifiers permanently connected to one or more strings of a positive grounded 6-cell, 1320

or 1680 ampere-hour battery apparatus. The initial charge-discharge bay mounts rectifier alarm and control apparatus, charge fuses for a maximum of 5 charging rectifiers and 16 distributing fuse circuits. Each supplementary discharge bay, if provided, can mount 32 distributing fuse circuits in multiples of four, and each rectifier bay can mount 8 additional distributing fuse circuits. The batteries are mounted on a 2- or 3-tier, 2-row battery stand. The rectifiers are mounted individually in their own cabinets of the same construction as the control and distributing bays and are illustrated by Fig. 20.

1.44 425A Power Plant - 130 Volt: The 130-volt plate supply consists of rectifier control apparatus, an 8-ampere charging rectifier for each 5 amperes of load, and a negative grounded 63-cell battery. The initial bay mounts two rectifiers and the rectifier control equipment for four rectifiers. The control equipment automatically cuts rectifiers in and out of the circuit as load conditions dictate. The second bay mounts discharge fuses and filter equipment, and provides mounting space for two rectifiers. Additional rectifiers and control equipment as required, may be provided in supplementary charge bays. The batteries are mounted on enclosed battery stands, and the rectifier and control equipment in sheet aluminum cabinets as illustrated by Fig. 21.

1.45 425A Power Plant - 250 Volt: The 250-volt plate supply consists of rectifier control apparatus and an 8-ampere rectifier for each 5 amperes of load. Two strings of 56-cell, 50 or 100 ampere-hour batteries are provided. These batteries are not grounded, but are connected in series with the 130-volt battery to produce 250 volts. The initial bay mounts two rectifiers, control apparatus for four rectifiers and one set of discharge fuses and filter equipment. Two additional rectifiers and a second set of discharge fuses and filter equipment may be provided in a supplementary bay. Each string of batteries is located in a separate cabinet equipped with a system of key interlocks to prevent opening the battery discharge circuit when a cabinet is opened for maintenance and also to disconnect the battery being worked on from its circuit to protect personnel. Fig. 21 shows the cabinet equipment.

1.46 24-Volt Power Plant (J86440): The 24-volt miscellaneous supply for alarms, order wire circuits and control circuits consists of a 9-ampere rectifier, relay equipment for alarm and control, discharge fuses and a positive grounded 11-cell, 100 ampere-hour battery. All equipment is mounted in one bay. Space is available in this bay for a second rectifier and an additional string of batteries. The control and alarm relays for all four plants are supplied with power from this 24-volt plant. This equipment is not part of the 425A plant.

1.47 425A Power Plant - AC Service Distribution and Alarms: AC service distribution to the TD-2 power plants and radio equipment is supplied from two sets of fuses in the engine room service cabinet, which is available for both single-phase and 3-phase distribution. One set of fuses is connected to commercial power only, and the other arranged for engine alternator standby power. Feeders run from each of these fuses to fuse distribution cabinets in each power room.

1.48 The AC service cabinet in the 12-volt power room supplies the 230/115 volts for the power bays and mounts the alarm equipment indicating commercial service failure, engine operate and failure alarms, and connections to the alarm sending circuit for remote control of the engine starting.

1.49 The AC service cabinet in the 130/250-volt power room supplies the 230/115 volts for the power bays and in addition the 115 volts to the radio room for testing equipment and the tube cooling system AC blower motor. A line voltage regulator in the cabinet provides voltage regulation when the commercial power varies more than 7%. Emergency lighting circuits are energized by a relay circuit which operates during commercial power failure. Low voltage lightning protection facilities are also provided in this cabinet. For applications in single-story buildings, the AC service equipment referred to above for 12-volt and for 130- and 250-volt power rooms is combined in a single bay of equipment.

1.50 425A Power Plant - Reserve Engine Alternator Power Plant: Automatic gasoline engine alternator plants of from 20- to 60-kilowatt capacity are available for use as reserve power plants for the TD-2 radio. These plants are completely automatic for unattended operation with alarm and remote starting features arranged for maintenance and control from a distant point. All sets are capable of delivering rated load at voltages up to 240 volts so that their output may be adjusted to match the normal commercial service voltage. In general, the 20-kilowatt size will usually have sufficient capacity as standby for auxiliary TD-2 repeater stations. These plants are completely automatic for unattended operation with alarm for maintenance from a distant point as described in J86616.

1.51 Power Drain Data and Power Discharge Lead Requirements: The individual

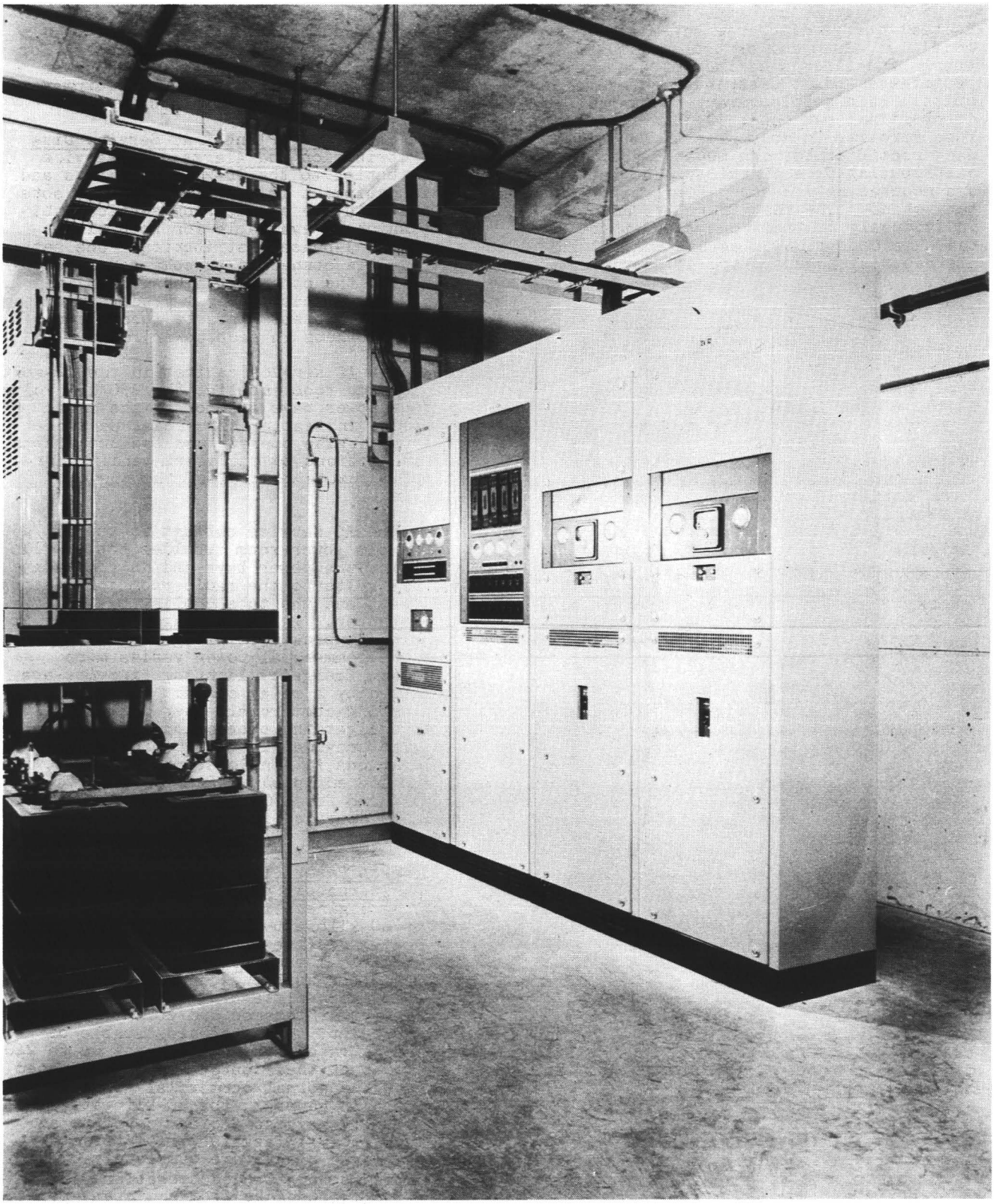


Fig. 20 - 12 Volt Power Plant

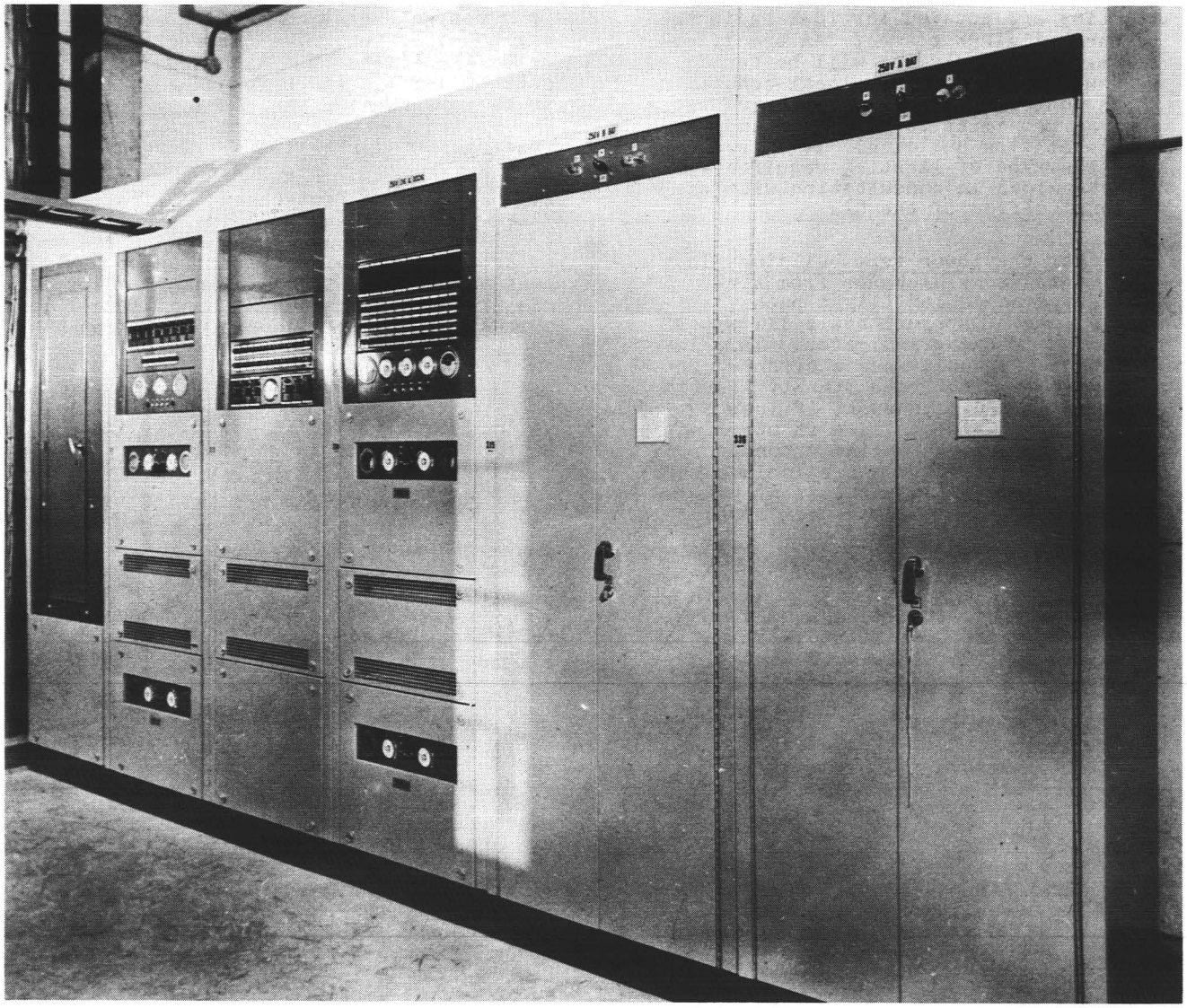


Fig. 21 - 130 and 250 Volt Power Bays
and 250 Volt Battery Cabinet

specifications referred to herein provide the necessary battery drain data for the equipment covered. Due to the importance of a single wide band channel, it is essential that trouble specific to any one channel should not cause failure in another channel. Therefore, particular attention has been paid to the fusing and discharge lead problems. In general, separate discharge leads with separate discharge fuses are provided for each voltage for each major element of a channel. Thus it is expected that regardless of how the channel elements may be patched together, a fuse failure will cause loss of only one channel.

1.52 The following specifications should be referred to for specific current drains associated with each voltage supplied to the equipment. The battery discharge lead requirements for each voltage required may then be ascertained from the appropriate power supply specification.

Equipment	Specification
Transmitter-Receiver Equipment	J68331
FM Terminal Equipment	J68336
IF and Video Patching and Monitoring	J68338
C1 Alarm and Control Equipment	J68811
Order Wire Equipment	J68341
Individual Alarm Equipment	J68342

1.53 Air Navigation Obstruction Lighting (J86435): Two types of obstruction

lighting are covered for TD-2 radio repeater buildings to meet CAA specifications. This equipment will be furnished by the customer to meet local conditions which control the specific requirements, such as proximity to airfields and height of the station building. It is expected that the type of lighting required will be determined in consultation with the regional office of the CAA.

1.54 For the lower type buildings located some distance from airfields and scheduled flight paths, a single lamp of approximately 111 watts provides a warning indicator. This lamp is lit continuously and is arranged for automatic transfer to a standby lamp in case of failure. In event of loss of commercial power, the lamp is operated from the reserve AC engine attenuator. Suitable alarm features are included to indicate lamp failure or loss of power. This system is known as duplex obstruction lighting.

1.55 For the higher buildings and those located near airfields or scheduled flight paths, a 300-milliameter flashing beacon of approximately 1240 watts is provided. This beacon is provided with a flashing rate of 40 times per minute and is continuously in operation. Failure of either or both of the two lamps which provide the beacon, as well as loss of their 115 volt AC power supply, will actuate suitable alarm features.

1.56 Both types of obstruction lighting obtain their 115 volt AC supply from the engine service distribution cabinet in the reserve engine plant room. When the commercial service is 3 phase, 3 wire it will be necessary to furnish a tranformer for the obstruction lighting facilities to prevent excessive phase voltages to ground during engine operation.

1.57 For steel towers, the same lighting as described above for high buildings is provided and in addition, side lighting consisting of four single obstruction lights. Two lights are located at a point 1/3 the way up the tower on opposite sides and two more 2/3 the way up the tower on opposite sides but at 90° to the lower two.

1.58 The responsibility for the provision of all air navigation obstruction lighting is as follows. The customer provides the lights and control equipment and mounts them in place. The contractor must provide these lights as soon as the building or steel tower is constructed. The steel tower must be lighted in progressive stages as it is going up during construction. The contractor connects the lights to a lighting fuse cabinet using a spare fuse. When the installers come on the job they connect the system to the power distributing fuse cabinet and to the alarm equipment.

1.59 Lightning Protection, Office Grounding and Building Lighting (J86435): An extensive grounding system to provide lightning protection to equipment and personnel and to insure a low resistance power ground return is required for either a concrete building or steel tower type radio station, as covered by Specification J86435.

1.60 Typical building lighting plans are covered in J86435.

1.61 Buildings and Floor Plans: As outlined in paragraph 1.02, the TD-2 radio stations may be concrete tower structures, or one-story buildings with an associated steel tower for the antennas. The height of these buildings or steel towers will vary depending on geographical considerations. In flat terrain, heights up to 200' or more may be required to give the necessary clearance for the radio beam. On mountain tops, the height of the building or tower may only need be sufficient to clear surrounding obstructions such as trees. A typical tower-type building for radio stations includes four floors and one or two antenna decks as illustrated by Fig. 22. The first three floors are allocated to the power equipment as follows, the reserve engine alternator occupies the first floor, the 12-volt power equipment is located on the second floor, and the 130- and 250- volt power equipment is located on the third floor. The fourth floor houses the radio equipment namely the radio transmitter-receiver bays, alarm and order wire equipment, IF patch and monitor equipment and test equipment.

1.62 Although it is desirable to engineer short waveguide runs from the antennas to the radio equipment frames, the economies of short runs versus more expensive building construction must be balanced. No limit has been established for the length of waveguide run since most tower heights which have been considered are within practicable limits (200' to 250' maximum heights). Since the adverse effect of long waveguide runs is primarily one of attenuation, special consideration must be given to the path length between adjacent radio stations where extremely long waveguide runs are involved. The entire question is one of balancing transmission degradations with building and tower costs.

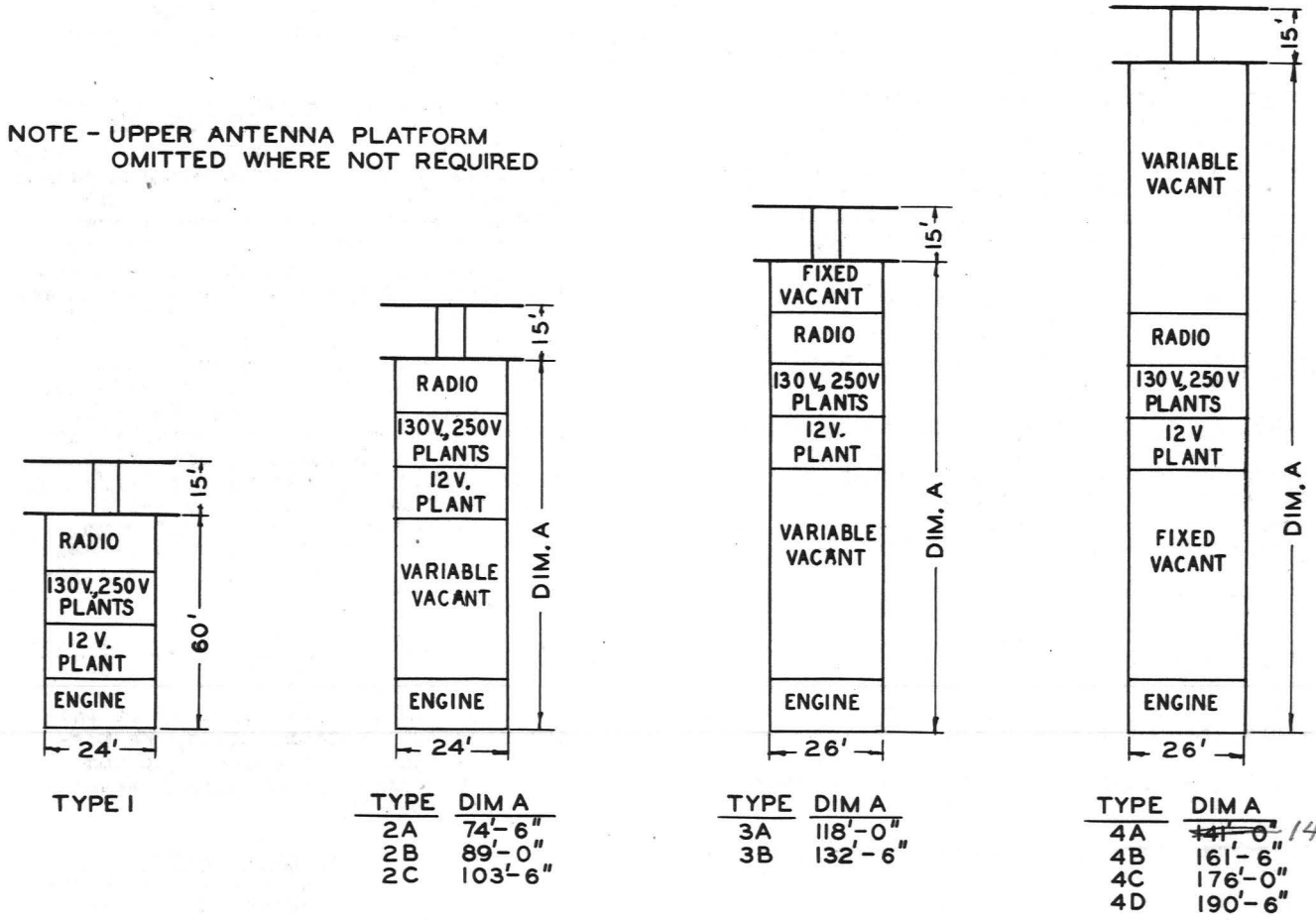


Fig. 22 - Standard Square Buildings - Elevation Plans

1.63 The tower layouts shown in Fig. 22 were based on a requirement of maintaining short waveguide runs. Present requirements are more lenient and the vacant space above the engine room for types 2, 3, and 4 towers is not a requirement.

1.64 In general, the floor plan arrangements covered by drawings listed herein should be followed and represent typical conditions. For jobs where these plans cannot be applied due to local considerations, a few fundamental rules should be followed as covered on Floor Plan Data Sheet 9 of Section 1.1. These rules cover such items as maintaining minimum length of IF (70 megacycles) cable runs between frames, close association of IF patching and monitoring equipment, use of minimum lengths and minimum number of bends in waveguide and the desirability of maintaining a straight lineup of transmitter-receiver bays feeding any one pair of antennas.

1.65 Fuse Design: The use of 250-volt plate battery in TD-2 radio introduced a mandatory requirement for a distribution fuse which would insure protection to operating personnel. The new 70-type fuse, which is mounted in a completely enclosed type fuse block per KS-14169, has been employed throughout the TD-2 project for all voltages. The new 70-type fuse is available in the same standard capacities as the 35 type (grasshopper). Fuse blocks per KS-14170 are also available for an NEC fuse paralleled with a 70 type for power fusing.

1.66 Cable Racks and Auxiliary Framing: The radio and other bays of equipment employ 9'-0" high frameworks on top of which a low level of auxiliary framing is fastened. This framing is in turn fastened to the side walls for support rather than employ a second high level of framing which would otherwise be required in the concrete buildings due to the relatively high 13'-8" ceilings. The ceiling in the single-story building is only 10'-6" approximately.

1.67 A 12" cable rack is run over each line of frames to support IF coaxial

cables, order wire and alarm leads, 12- and 24- volt power cables and ground wiring. The 130- and 250- volt supplies are carried in a 4" by 4" duct in order to segregate them, this duct being supported by the cable rack. The air line hose from the blower to the 416A and 418A tubes in the various bays is supported by the framing bars. Since the length of IF cables is critical, the cable racks must be so placed to keep these cable runs to a minimum length.

1.68 Maintenance Tools: For the list of special and common purpose tools required at various locations, refer to the "Maintenance Tool" drawing ED-63783-01.

1.69 Spare Components: The radio equipment has been designed on a plug-in basis to permit quick replacement of complete units in case of trouble. Spare components must therefore be provided at each radio station for this purpose. The list of these spares is covered in specification J68331. Spare tubes, crystals, varistors and thermistors are provided at the various locations in quantities as determined by the customer. Drawing ED-63781-01 covers the locations where replacement of these items can be made: i.e., where the parts should be stocked.

1.70 Spare Components Cabinet: A spare parts cabinet as covered by ED-63767-01, Group 1, provides the necessary mounting space for the spare components required at a radio station. This cabinet has the capacity for all the spare units required for a station having six channels in each of two directions. The spares consist of:

6 - Receiver converters
6 - Transmitter amplifiers
6 - Transmitter modulators
1 - Microwave generator
1 - 40-megacycle generator
1 - IF main amplifier.

These spare units are not furnished with the cabinet but must be ordered separately as indicated in paragraph 1.69. The cabinet is approximately 7' high by 2'-9-3/4" wide by 1'-5" deep. One cabinet is required at each radio station.

1.71 The spare components and parts for maintenance centers should be furnished as specified by the customer.

1.72 Maintenance and Test Equipment: Various maintenance, testing and alignment procedures to be carrier out at main, terminal or repeater stations, and at maintenance centers require that the correct complement of testing equipment be furnished at the respective locations. The equipment to be furnished is outlined on ED-63784-01. A brief description of the coded items required at these various points in the system is furnished in the following paragraphs.

(a) The J64001AK - 1AK tube test set provides a means of in-service testing of 404A vacuum tubes in certain elements of the TD radio system, namely IF switching and distribution amplifiers, the auxiliary IF amplifiers and the IF buffer amplifiers. This set measures the grid-cathode voltage and the cathode activity. The set consists of a meter, two toggle switches and seven miniature potentiometers which permit testing up to seven vacuum tubes per test position. No external power supply is required. Two cords for connecting to the circuits whose tubes are to be checked, are attached to the set. The unit weighs 2-1/2 pounds and is approximately 4-1/4" long, 7-1/4" wide, and 2-3/4" high. This set is normally required at main and terminal stations and at maintenance centers.

(b) The J64061B - 61B signal generator provides a means of testing television video loops from the transmitting end and is normally used at main and terminal stations having FM terminal equipment. The test set comprises two independent signal generators, as follows:

(1) A sine wave generator continuously variable from 300 kilocycles to 10 megacycles in five bands selected by push buttons. In addition, fixed frequencies of 60 cycles, 5, 10, 25, 50, 75, 100, 150, 200 and 250 kilocycles and 2 and 4 megacycles are available on push button keys. The output level of the oscillator is controlled by a precision attenuator from +10 dbv to -60 dbv in 1-db steps. The output impedances are either 75 ohms unbalanced or 110 ohms balanced. A vacuum tube voltmeter is provided to permit continuous output monitoring. This oscillator is used to transmit signals of known levels into the television loop when making transmission measurements over the band.

(2) A 15.75-kilocycle video signal generator delivers a 2-volt peak-to-peak maximum output into a 75-ohm unbalanced load impedance. This signal consists of a wave which changes polarity in two successive steps in each cycle; a 5-microsecond portion at extreme negative polarity, a variable interval between 10 and 45 microseconds where the wave rises positively to approximately 1/4 of the maximum value, and the remaining

interval where the wave sharply rises to the maximum positive value. This cycle simulates the synchronizing pulse and picture signal of a television wave. The frame frequency is simulated by the introduction of a 60-cycle square wave modulating the television signal, if desired. The unit is portable and operates from 105-125 volts, 60-cycle AC, with an input power of approximately 125 watts. Connecting cords for power and transmission circuits are furnished with the set. The set weighs 55 pounds and is 17" long, 13" wide and 12" deep.

(c) The J64063A - 63A signal generator provides a means of testing and maintaining television systems by producing a composite signal similar to the standard television video signal except for the vertical synchronizing group. This set is normally used in main and terminal stations having FM terminal equipment. The following features are provided.

(1) A negative synchronizing pulse, nominally five microseconds wide, is produced at 15.75-kilocycle rate, not synchronized with the power frequency. The pulse width is adjustable over a considerable range.

(2) The positive "picture" signal follows the synchronizing pulse by about 2 microseconds and consists of either a broad flat topped pulse adjustable over 15-50 microseconds, or a single, narrow, triangular spike approximately 0.3 microseconds wide at the base.

(3) The composite signal may be modulated by a 60-cycle square wave to disable the video signals without interruption of the synchronizing pulses, to simulate the frame frequency sequence of pulses.

Normal adjustment of the composite signal proportion will provide a peak-to-peak amplitude of one volt, with the negative synchronizing pulse equal to approximately 30 percent of the signal. The maximum peak-to-peak output of the composite signal is 2 volts peak-to-peak. The unit is portable, and operates from 105-125 volts, 60-cycle AC, with an input power of approximately 125 watts. The power cord is supplied with the equipment. The test set weighs 52 pounds and is 21-1/2" long, 10-1/2" wide and 15" deep, exclusive of carrying handle and bumper feet.

(d) The J64070A - 70A power meter is primarily intended for testing television video loops, and consists of a 75-ohm unbalanced or 110-ohm balanced thermocouple type power measuring circuit. This set is normally required for use at main and terminal stations having FM terminal equipment and is also required at maintenance centers. The set is capable of measuring power in the frequency range from 0 to 10 megacycles in a level range of 1 db or more above and below 0 dbm, with an accuracy of ±0.1 db. The thermocouple units are protected by two 13-db protection pads which may be switched out of the circuits by depressing nonlocking push buttons. Spare thermocouple units are provided in the cover of the set. The power meter is a portable, battery operated set, contained with its battery in a metal carrying case. The unit weighs approximately 20 pounds and is 15" long, 10" wide and 8" deep. Cords for connection to unbalanced and balanced lines are provided with the equipment.

(e) The J68333A test bench equipment, illustrated by Fig. 23, in conjunction with the J68340A test bay, provides the equipment required to repair, align and maintain the components of the TD-2 radio system and is required only at maintenance (repair) centers. The test bench is a commercial steel bench equipped with drawers and shelves for storing the test components when not in use. The bench is 60" long by 30" wide by 34" high and has a wood top. The test bench may be used to perform the following functions:

(1) Measure and align a transmitter amplifier, a transmitter modulator, and a receiver converter and IF preamplifier.

(2) Measure output impedance, balance and conversion loss of the 40-megacycle shifter.

(3) Provide power and controls for testing the various components of the transmitter-receiver bay.

(4) Provide means for making filament activity tests on tubes in the IF preamplifier and IF main amplifier.

(5) Provide air supply for cooling 416A or 418A vacuum tubes.

In general, the elements of the transmitter-receiver bay are checked against performance requirements without removal from their position in the bay. However, if it is found that the adjustments and aligning procedures are time consuming and require a more complex test set-up than is available at

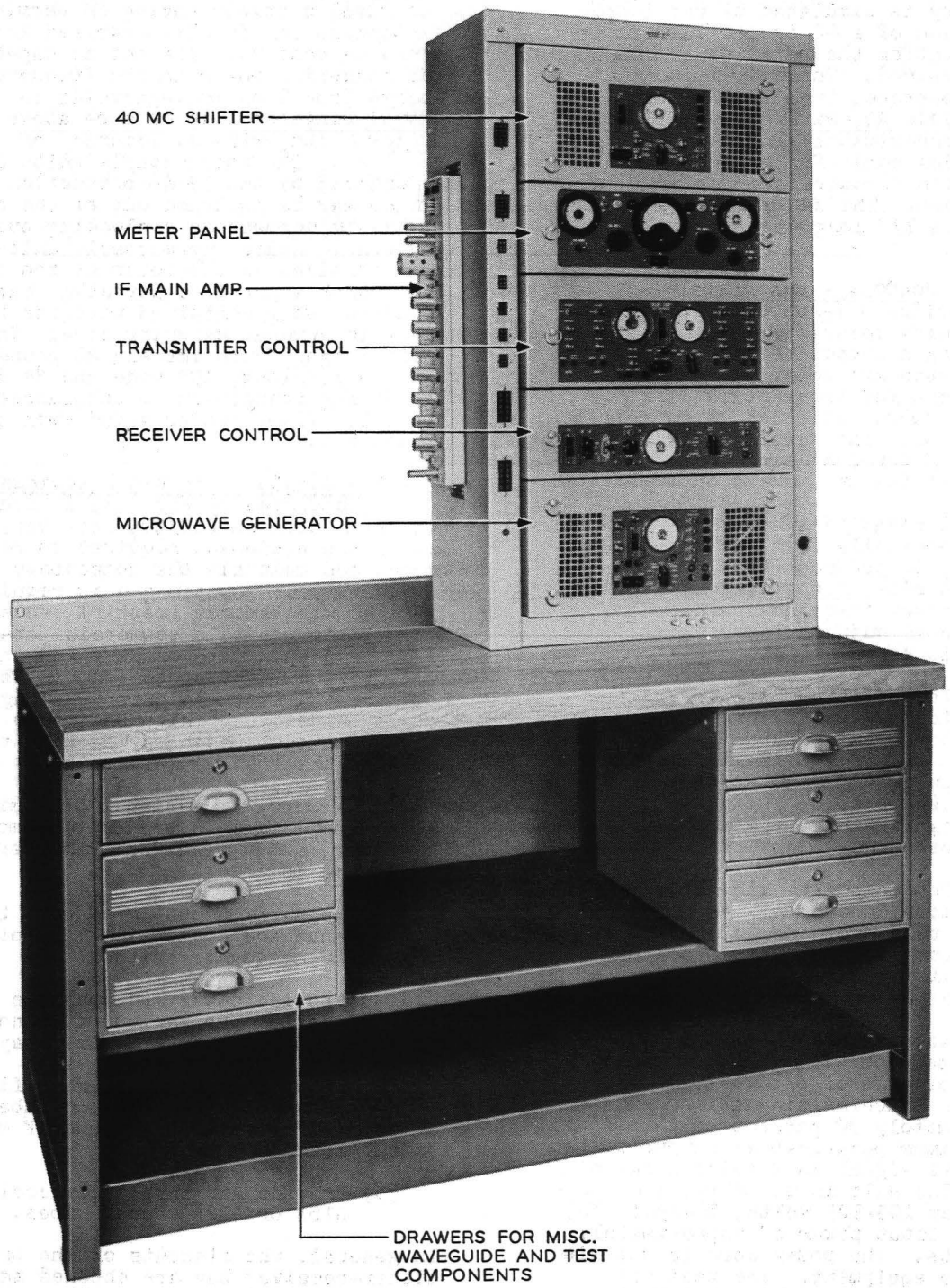


Fig. 23 - Test Bench Equipment

each radio station the units in trouble will be replaced by spare units and taken to the nearest maintenance (repair) center. The test bench at the maintenance center has the operational equipment required namely, transmitter and receiver control units, 40-megacycle shifter and associated connecting cables, so that the units to be tested may be placed in operation on the test bench and checked for alignment and operation. The cabinet equipment mounted on top of the bench provides mounting space for the equipment referred to above. Miscellaneous items furnished with the test bench include variable attenuators, waveguide sections, bends, transducers directional couplers and similar parts required to complete test set-ups. The control panel for the test bench provides switches and fuses for -12, +250, and +130-volt power. The 130- volt power required for the test bench may be obtained from an existing 130-volt battery plant. The 250-volt supply may be obtained from an AC operated rectifier. The -12-volt power may be obtained from a -24-volt battery plant using counter cells. Various supplementary testing components are furnished with the test bench, such as a tube tester, voltohmmeter, tools and other accessories.

(f) The J68337A FM terminal test equipment provides the facilities required to maintain and align the FM terminal transmitter and the FM terminal receiver. The primary functions are linearity testing, frequency checking, and frequency deviation measurements. The mobile console, illustrated by Fig. 24, incorporates a signal generator, cathode ray oscilloscope, linearity test set, FM terminal receiver and electronic switch. Associated power supplies, controls, cooling fan, and auxiliary equipment are also furnished. A calibrated IF oscillator and comparison circuit is used to determine the output frequency of the FM terminal transmitter. It is essential to keep the output signal centered on the 70 ± 10-megacycle band to which all of the radio equipment IF amplifiers are aligned. The linearity test is likewise a comparison check to determine if the frequency-modulated IF output from the FM terminal transmitter is linear with respect to the input amplitude-modulated signal, and vice-versa for the receiver, since a nonlinear system introduces distortion. The results of both of the above tests are determined by visual means on an "A" scope, where both signals to be compared are displayed. Connections are made to the equipment under test by means of patch cords. The equipment is mounted in a 5'-0" high mobile

Fig. 24 - FM Terminal Test Set

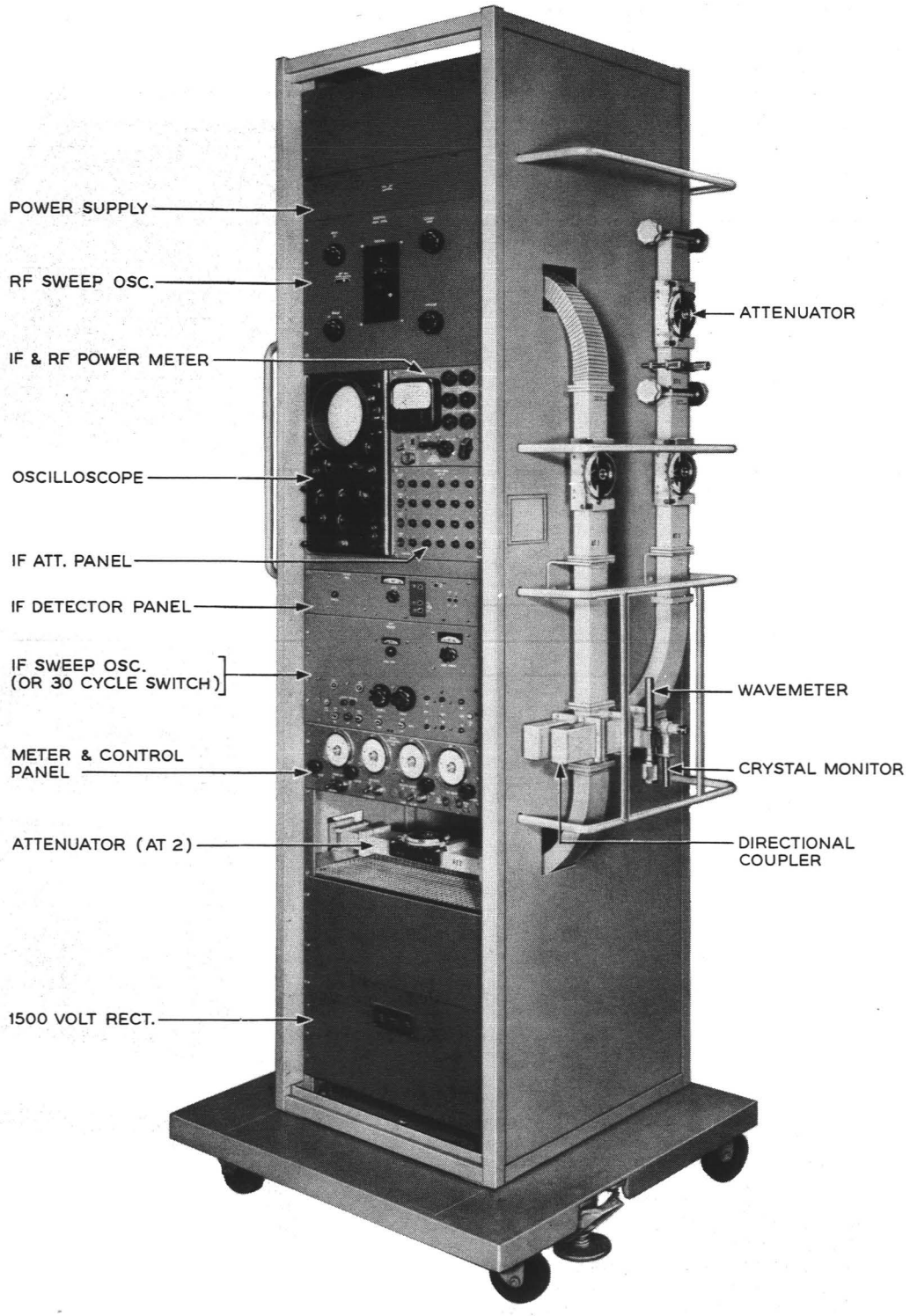


Fig. 25 - Transmitter-Receiver Test Equipment

console weighing 320 pounds, and occupying a floor area of approximately 30" by 30". FM terminal test equipments will be provided only at terminal stations along the TD-2 radio system.

(g) The J68340 transmitter-receiver test equipment, illustrated by Fig. 25, consists of transmission measuring apparatus mounted in 7'-5-5/8" high floor-supported cabinet equipped with casters, occupying a floor area of approximately 30-1/2" by 33-1/4".

(1) The primary purpose is to locate abnormal transmission conditions in the radio and IF units of the transmitter-receiver bay (J68331). It will also be used in conjunction with a test bench (J68333) for maintenance work on transmitter and receiver subassemblies.

(2) The cabinet incorporates an RF sweeping oscillator, IF sweeping oscillator, cathode ray oscilloscope, an absolute power level meter for measuring RF and IF output power, and associated power supplies, controls and auxiliary equipment. Two lists are available, list 3 being used at terminals, main stations and maintenance centers, and list 4 at repeater stations. The major change between list 3 and list 4 is that the IF sweeper is replaced by a 30-cycle switch.

(3) Over-all band-width measurements are made by comparing oscilloscope traces of swept microwave input with similar traces of microwave output. The band-width of the IF main amplifier is checked by the same method using comparable swept IF inputs and outputs. In addition, the swept IF input to the main amplifier may be compared with the microwave output. For these measurements, the rectified input and output are applied alternately at the rate of 30 per second to the vertical deflection amplifier of the oscilloscope.

(4) For single frequency tests and aligning procedures the oscillators are used non-sweeping, fixed frequencies at known power levels are applied and the resultant RF or IF output power levels are observed.

2. SUPPLEMENTARY INFORMATION

AA128.006 - List of General Equipment Requirements Sections

Equipment Design Requirements

J41610 (AA294.001) - Antennas for Microwave Communications Systems
J68330 (AA266.027) - IF, Microwave and Control Units
J68331 (AA266.026) - Transmitter-Receiver Bay
J68333 (AA266.036) - Test Bench Equipment
J68335 (AA266.030) - Antenna Waveguide
J68336 (AA266.032) - FM Terminal Equipment
J68337 (AA266.033) - FM Terminal Test Equipment
J68338 (AA266.035) - IF and Video Patching and Monitoring Equipment
J68340 (AA266.034) - Transmitter-Receiver Test Equipment
J68341 (AA266.028) - Order Wire Equipment
J68342 (AA266.029) - Individual Alarm Equipment
J68343 (AA266.037) - Tube Cooling System
J68344 (AA266.038) - Remote Control Equipment
J68811 (AA268.809) - C1 Alarm and Control System
J68814 (AA262.006) - Sequence Signaling-Transmitting, Receiving and Translating Equipment
J86240 (AA362.032) - Rectifier-Electron Tube Type - 130 Volt, 8 Ampere - Automatic Regulation
J86243 (AA362.033) - Rectifier - Metallic Type - 24 Volt, 9 Ampere - Automatic Regulation
J86244 (AA362.034) - Rectifier - Metallic Type - 12 Volt, 70 and 200 Ampere - Automatic Regulation
J86435 (AA367.413) - 425A Plants - 12, 24, 130 and 250 Volt Battery and Miscellaneous Supplies
J86437 (AA367.408) - 425A Plants - Positive 130 Volt, 0.5-20 Ampere Plate Supply
J86438 (AA367.409) - 425A Plants - Positive 250 Volt, 0.5-20 Ampere Plate Supply
J86439 (AA367.410) - 425A Plants - Negative 12 Volt, 60-800 Ampere Filament Supply
J86440 (AA367.030) - 24 Volt DC Power Supply

J86443 (AA367.412) - 425A Plants - AC Service Equipment for 12, 24, 130 and 250 Volt Power Plants
J86616 (AA367.911) - Reserve Engine Alternator Power Plant
J86725 (AA360.013) - AC No-Voltage and Low-Voltage Alarm and Transfer Control and Automatic Engine Alarms
J97035 (AA381.325) - Cable Duct Framework
X-64607 - Microwave Path Testing Equipment

Floor Plan Data Sect.1.1,Sheet 9,TD-2 Radio-General Notes (For Bay Details)

Floor Plan Data Book

Power Data Book

Radio - General - Description, Operation and Maintenance

R10.260 - X-64607 Radio Transmitter
R10.300 - FM Terminal Transmitter J68336A
R20.340 - X-64607 Radio Receiver
R20.360 - FM Terminal Receiver J68336G
R40.160 - Antenna KS-5759
R40.230 - X-64607 Microwave Antenna
R60.040 - IF Patching and Monitoring Equipment J68338
R60.060 - IF Switching Amplifier J68338A and IF Distributing Amplifier J68338B
R60.070 - IF Auxiliary Amplifier J68338C
R60.080 - Video Monitor Amplifier J68338D
R60.250 - X-64607 Tower and Accessories
R60.260 - X-64607 Engine-Generator Sets
R70.150 - X-64607H Relative Power and Frequency Meter
R70.160 - FM Terminal Test Equipment J68337A
R70.170 - Electronic Switch J68337B
R70.180 - Linearity Test Set J68337C
R70.190 - Signal Generator KS-5782
R70.200 - Transmitter-Receiver Test Equipment J68340A
R70.210 - Test Bench Equipment J68333A
R70.230 - Power Meter J68340E
R70.240 - RF Sweeping Oscillator J68340H
R70.270 - 1AK Tube Test Set
R70.490 - 62A Signal Generator
R70.500 - 71A Frequency-Power Meter
R90.250 - X64607 Microwave Path Testing Equipment
R90.260 - FMTRU-50B(A) VHF Communication Equipment
R90.300 - TD-2 Radio System
R90.310 - Transmitter-Receiver Bay J68331A
R100.010 - Siting of Fixed Radio Stations
R100.020 - Microwave Radio - Interference Considerations

Test and Inspection

A220.961 - Cl Alarm and Control System
A220.962 - Order Wires

Operating Methods

A301.247 - Engine Alternator KS-5636
A301.318 - 1500 Volt Rectifier KS-5789
A301.325 - 150 Volt Rectifier J86225
A301.326 - 200 Volt Rectifier J86226
A301.332 - 120 Volt, 8 Ampere Rectifier J86240
A301.335 - 24 Volt, 9 Ampere Rectifier J86243
A301.336 - 12 Volt, 200 Ampere Rectifier J86244
A301.543 - Line Voltage Regulator KS-5655
A301.821 - 130 Volt Power Plant J86437
A301.822 - 250 Volt Power Plant J86438
A301.823 - 12 Volt Power Plant J86439
A301.824 - 24 Volt Power Plant J86440
A320.571 - Cl Alarm - Tracing and Clearing Troubles
A320.572 - Order Wires - Tracing and Clearing Troubles

Apparatus Requirements

A401.247 - Engine Alternator KS-5636
A401.522 - Ammeter Relay KS-5787
A401.543 - Line Voltage Regulator KS-5655
A401.577 - Engine Control Relays
A490.161 - Cl Alarm - Apparatus Readjustment Requirements

General Description

A820.911 - Cl Alarm and Control System and Associated Sequence Signaling and Order Circuit

3. DRAWINGS

Assemblies and Miscellaneous

ED-63138-01 - Lightning Protection at Repeater Stations
ED-63409-01 - Cable Duct Framework 11'-6" High
ED-63418-01 - Cable Duct Framework 9'-0" High
ED-63572-01 - Mobile Steel Cabinet
ED-63616-01 - Appliance Outlets
ED-63767-01 - Spare Parts Cabinet
ED-63774-01 - Typical Plan of Radio Floor-Type 1 and 2 Buildings
ED-63775-01 - Typical Plan of Radio Floor-Type 3 and 4 Buildings
ED-63778-01 - Typical Floor Plan - Single Floor Repeater Building
ED-63781-01 - Replacement of Tubes, Crystals, Varistors and Thermistors
ED-63783-01 - Maintenance Tools
ED-63784-01 - Maintenance and Test Equipment

ED-63833-01 - Alarm and Order Wire - Wall Mounted Apparatus
ED-63834-01 - AC Outlet Panel
ED-63845-01 - Tube Cooling System
ED-63861-01 - Cable Rack and Auxiliary Framing - Type 1 and 2 Buildings
ED-63880-01 - Cable Rack and Auxiliary Framing - Type 3 and 4 Buildings
ED-63881-01 - Cable Rack and Auxiliary Framing - Single Floor Repeater Building
ED-63908-01 - Waveguide Flange Protection
ED-63972-01 - End Guard and Frame Junction Details
ED-63974-01 - Alarm Assignments
ED-63977-01 - Waveguide Gas Pressure System
ED-80190-01 - Spare Fuse Holders
ED-81421-01 - Enclosing Cabinets
ED-81436-01 - Typical Lighting Plan - Small TD-2 Building
ED-81489-01 - Floor Plan, Conduit and Cable Rack Plan - 12 Volt Floor
ED-81490-01 - Typical Cabling and Conduit - 12 Volt Plant
ED-81492-01 - Cable Rack Enclosure
ED-81493-01 - Floor Plan, Conduit and Cable Rack Plan - 130 Volt Floor
ED-81494-01 - Typical Cabling and Conduit - 130 and 250 Volt Plant
ED-81497-01 - Engine Room and Interfloor Conduit Plan
ED-81498-01 - Typical Duplex Obstruction Lighting
ED-81499-01 - Typical 300 Millimeter Flashing Beacon
ED-81500-01 - Typical Lighting - Large TD-2 Buildings
ED-91982-01 - Steel Cabinet - Framework Assembly

Circuits

SD-59375-01 - Keysheet - TD Radio System
SD-59376-01 - FM Terminal Test Set - Application Schematic
SD-59389-01 - IF Circuits - Main Stations - Application Schematic
SD-59390-01 - IF Circuits - Auxiliary Stations - Application Schematic
SD-59391-01 - Main Station Monitoring Circuits - Application Schematic
SD-59403-01 - Transmitter-Receiver Bay - Application Schematic
SD-59408-01 - 40 MC Shifter - Application Schematic
SD-59418-01 - Transmitter-Receiver Test Equipment - Application Schematic
SD-59436-01 - Test Bench Equipment - Application Schematic
SD-81094-01 - Grounding - TD-2 Repeater Stations
SD-81095-01 - Power Service Circuit - TD-2
SD-81113-01 - Duplex Obstruction Lighting
SD-81114-01 - 300 Millimeter Flashing Beacon
SD-95021-01 - Keysheet - Transmission Measuring Systems

4. GENERAL NOTES

4.01 Waveguide: Since slight dents or contamination in waveguide runs or components effects transmission, particular care should be exercised in handling this type of gear. Open ends should be protected by a flange protector per ED-63908-01 even on a temporary use basis. This information is covered in detail in specification J68335.

4.02 416A Microwave Tube: The 416A tube is particularly fragile and any slight shock or jar may seriously damage the tube. Consequently special care must be exercised in the handling of this type of tube. A special torque wrench is required to insert or remove the tube from its associated cavities.

4.03 Cable Terminals: The order wire, alarm, control or other miscellaneous connections coming into radio repeater buildings should be brought in through a B26 or similar cable terminal. Inside the building a GA16 or GA26 cable terminal box with G16 or G26 binding post chamber can be employed on each equipment floor to carry these outside circuits to their terminations or to carry interfloor wiring.