POWER DISTRIBUTION SYSTEM
DESCRIPTION AND THEORY
1 AND 1A *ESS*™ SWITCH

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1. GENERAL

A. Introduction

1.01 This practice describes the power distribution system for the 1 and 1A ESS switch.

1.02 This practice is reissued for the following reasons:

(a) To add the TRIPORT II power supply

(b) To update J5A007B-1 1A processor power distribution frame to a J5A007C-1 distribution frame.

Revision arrows are used to emphasize the more significant changes. The ETL will not be affected.

1.03 This practice includes:

- Purpose of power distribution system
- Physical description of components that comprise the power distribution system
- Power distribution system grounds
- Functional description (theory).

B. Purpose of Power Distribution System

1.04 The purpose of the power distribution system for any telephone office is to provide uninterrupted electrical power of the required voltages and current at precise frequencies to operate the office in normal and emergency power conditions.

C. AC Power Designations

1.05 AC power is designated as commercial ac, essential ac, protected ac, ▶or uninterrupted ac.◀

Commercial ac is the ac power supplied by the power company.

Essential ac is the commercial ac backed up by a reserve engine-alternator. Breaks in the continuity of essential ac power may range from a fraction of a minute to several hours, depending on manual or automatic starting of the reserve source. It is used to power frame—base convenience outlets and those loads that can tolerate the possible outages.

Protected ac is "no break" ac power. The term is relative and means that breaks in continuity of extremely short duration are tolerable. Breaks of up to 5 seconds are considered acceptable.

▶***Uninterrupted ac*** is ac power in which there is absolutely no breaks occurring in continuity due to commercial power failure, overloads, etc.◀

2. PHYSICAL DESCRIPTION

2.01 The power equipment described in this practice represents typical components of 1 and 1A ESS switch power distribution systems. Generally, most power equipment is considered common use equipment and may be used wherever its characteristics and design apply. When 1ESS switch, 1A ESS switch, or other systems equipment are added to the existing building and primary power plant, the power equipment is usually compatible and can satisfy the demand with the addition of supplementary control, output, and distribution circuits. Thus, a particular 1 or 1A ESS switch may have some power equipment that differs from the typical equipment described in this practice. The principal units of power plants for medium and large sized central offices are:

- Commercial ac power supply fusing and protective equipment for safeguarding the supply as it enters the power plant.
- The charging equipment consisting of the rectifiers and their associated equipment used to convert the commercial power supply to direct current at voltages suitable for central office operation.
- The power board containing the control and distribution equipment which includes switches, meters, safety devices and other equipment, necessary for the operation of the plant.
- The storage batteries for providing a source of emergency power in case of failure of the power source, and to aid in maintaining a uniform voltage for the current supply.
- The reserve power supply consisting of an engine-alternator or gas turbine with their associated controls and equipment is used to furnish ac power when the commerical power service fails.

A. +24 Volt or −48 Volt Plant (111A Power Plant)

2.02 The 111A power plant (Fig. 1) consists of control units, discharge or load fuses, and +24 volt and −48 volt rectifiers housed in cabinets and relay racks. These plants, one each for +24 and −48 volt rectifiers, have capacities of up to 800 amperes in multiple (maximum of two). When higher current capacities are required, the 326B or 326A power plants (combined +24 volts and −48 volts up to 10,000 amperes) may be installed. Cabinets for the 0 to 800 ampere plants measure 2 feet 3 inches wide, 2 feet 6 inches deep, and 7 feet 0 inches high.

B. Combined +24 Volt and −48 Volt Plant (326A and 326B Power Plants)

2.03 The 326A and 326B power plants (Fig. 2) are designed for use in ESS switches where the use of multiple 111A power plants are not economically feasible because a capacity of 2000 amperes is anticipated.

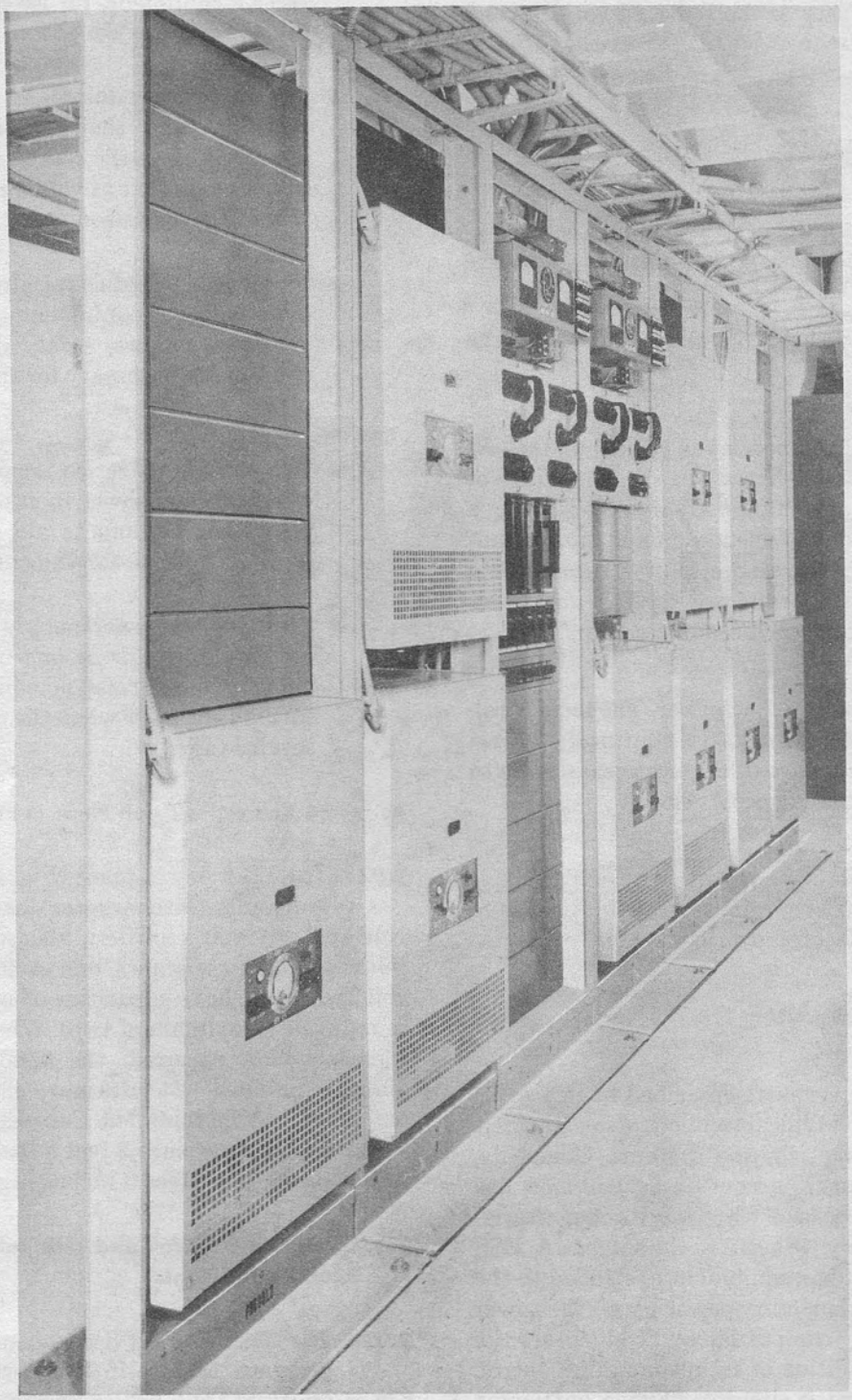


Fig. 1—111A Power Plant—+24V or −48V

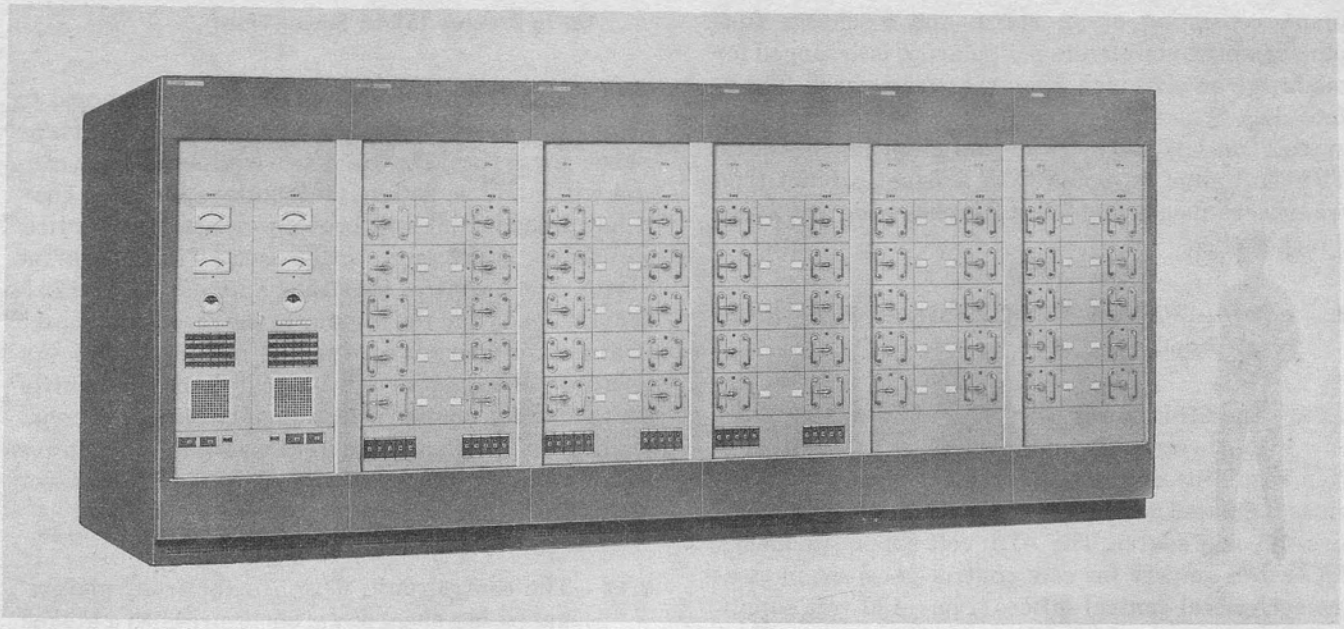


Fig. 2—326A/326B Power Plant—Combined +24V and −48V, 6000 Amperes

2.04 The 326A power plant provides a combined +24 volt and −48 volt power supply of up to 10,000 amperes for each voltage with automatic float regulation of a 12-cell battery at 26 volts and a 24-cell battery at 52 volts from an ac power service. The power plant includes charging equipment and its controls, batteries, distribution equipment, and alarms. The control board bay and discharge fuse bays for the 326A power plant each measure 3 feet 6 inches deep, 3 feet 6 inches wide and 8 feet high.

2.05 The 326B power plant is similar to the 326A power plant, except that its plant capacity is 6000 amperes and it has narrower framework which requires less floor space. The control board bay and discharge fuse bays for the 326B power plant each measure 2 feet 6 inches deep, 3 feet 6 inches wide, and 8 feet high.

C. +130 Volt or −130 Volt Power Equipment (610B, 660B, and 660C)

2.06 The 1 and 1A ESS switches require ±130 volts for coin control and miscellaneous signaling functions. The 610B converter plant (3/4 ampere), 660B or 660C converter plant (2 to 15 amperes) are available. Power from these plants is delivered to fuse panels on a miscellaneous frame in the switchroom for distribution to circuits requiring ±130 volts. The following power plant codes are involved:

J86801C-1—610 Alarm and Distribution Unit
J86801B-3—610B Converter Units
J86884A—660C Power Plant Common Equipment
J868834A-1—660B Converter Plant Framework Equipment
J87309A-1—660B/660C DC/DC Converter 5 Ampere
J87309B-1—660B/660C DC/DC Converter 2 Ampere

D. +130 Volt or −130 Volt Plant (660B or 660C Power Plant)

2.07 The 660B or 660C power plant (Fig. 3 and Fig. 4) is designed primarily for small central offices with anticipated loads of 2 to 15 amperes, +130 or −130 volts using two converters and an alarm and discharge fuse panel initially for each polarity. The +130 or −130 volt dc supply is obtained from the −48 volt central office battery through the use of dc-to-dc converters. The converters are rated at 2 and 5 amperes capacity and additional converters up to a maximum of four of the same capacity may be furnished. The working limits of this plant are 125-to-135 volts

dc output and minus 44-to-52 volts dc input. The basic plant, consisting of an alarm and discharge fuse panel and two converters per polarity, is arranged for mounting on a 23-inch relay rack framework. The 9-foot duct type framework for the 660C plant measures 2 feet 7-1/2 inches wide and 1 foot 3 inches deep. The 660B plant is mounted in a 7-foot cabinet type framework measuring 2 feet 3 inches wide and 2 feet 6 inches deep.

E. ±120/±130 Volts DC-DC Converter Plant (610B Power Plant)

2.08 The 610B power plant (Fig. 5) contains a dc-to-dc converter and is equipped with either a step regulator or voltage regulator. The plant provides regulated dc at ±120 or ±130 volts from a negative 48 volt source. The ±120 volt supply furnishes 0.5 or 0.75 ampere for coin control purposes in electromechanical central offices. The ±130 volt supply at 0.75 ampere provides coin control current for ESS switches.

2.09 The plant circuit consists of a dc-to-dc converter, filter and alarm circuits, either a step voltage regulator or output voltage regulator, alarms, optional distribution fuses, alarm circuit, and polarity alarm relays. The distribution fuses and alarm circuit may be provided when additional distribution fuses and alarms are required for loads. Polarity alarm relays are added only in traffic service position system (TSPS) offices. A plant with two converters, two regulators, and one fuse distribution unit requires approximately 18 inches maximum height and all of the equipment can be mounted on a 23-inch wide relay rack.

F. Emergency 208/120 Volts AC Supply Unit (504B Power Plant)

2.10 The 504B power plant (Fig. 6 and Fig. 7) provides single or 3-phase ac power from −48 volt central office battery during commercial power failure, or low voltage, by means of an inverter (dynamotor) or motor-alternator. In addition to the battery driven inverter or motor-alternator, the plant includes control and distribution equipment mounted in a floor supported bay. The plants designed for ESS switches have a capacity of 1.5 and 5 kW. The cabinet size for each of the two plant capacities is 2 feet 6 inches wide, 2 feet 6 inches deep, and 7 feet 0 inches, or 8 feet 0 inches high.

G. AC Power Plant with Automatic Transfer from Regular to Reserve (524A Power Plant)

2.11 The 524A power plant (Fig. 8) is designed to provide reliable 117-volt single phase 60-Hz ac power for critical central office equipment that cannot withstand ac power interruptions for more than a few seconds and still provide satisfactory service. Reliability is enhanced by the use of a solid-state inverter and a control unit that automatically transfers the load from the regular to the reserve ac source if a power failure occurs in the regular source. An operation selector switch is located on the control unit panel for manual selection of either commercial or inverter alternating current as the regular power source. The plant is 7 feet high, 30 inches deep, 3 feet wide, and weighs approximately 1810 pounds.

2.12 The control unit, designed for front maintenance, is a sheet metal enclosure with a hinged door panel upon which are mounted the fuse holders, pushbutton switches, lamps, and relays. The control unit weighs approximately 110 pounds and is 15 inches deep by 17 inches high. Terminal blocks TB2 and TB3 are mounted on the inside of the rear panel. These provide terminations for a maximum of eight load leads, commercial service leads, and inverter ac output leads. TB1 for alarm leads and TB4 for the battery leads are also fastened to the rear panel.

◗H. AC Uninterruptible Power Supply (UPS) TRIPORT II (J85527A TRIPORT II Power Supply)

Note: The TRIPORT II replaces the 504B and 524A Power Plants (504B and 524A are manufacture discontinued).

2.13 The TRIPORT II power supply (Fig. 9) is designed to provide 120 volts uninterrupted ac to critical electronic equipment despite irregularities or failure of commercial power. The uninterruptible output is obtained by parallel processing of normally available 208-volt nominal commercial ac and 43 to 55 volts dc power supplied from the central office battery or a self-contained battery string within the TRIPORT II cabinet (Option W). The TRIPORT II cabinet is 84 inches high, 25 inches wide, 15 inches deep; floor mounted and weighs approximately 1000 pounds without the self-contained batteries and approximately 1250 pounds with self-contained batteries.◀

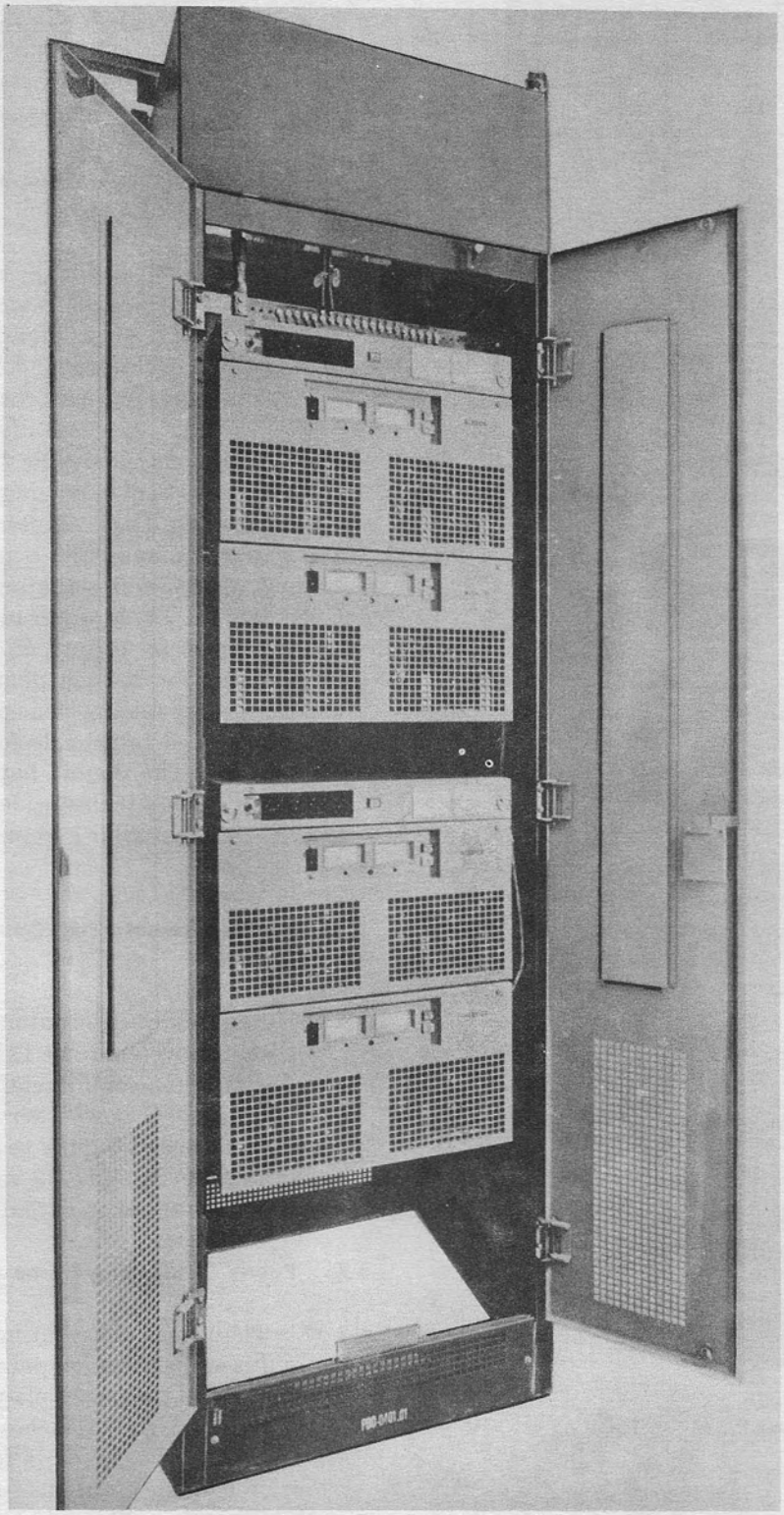


Fig. 3—660B Power Plant—+130V or −130V

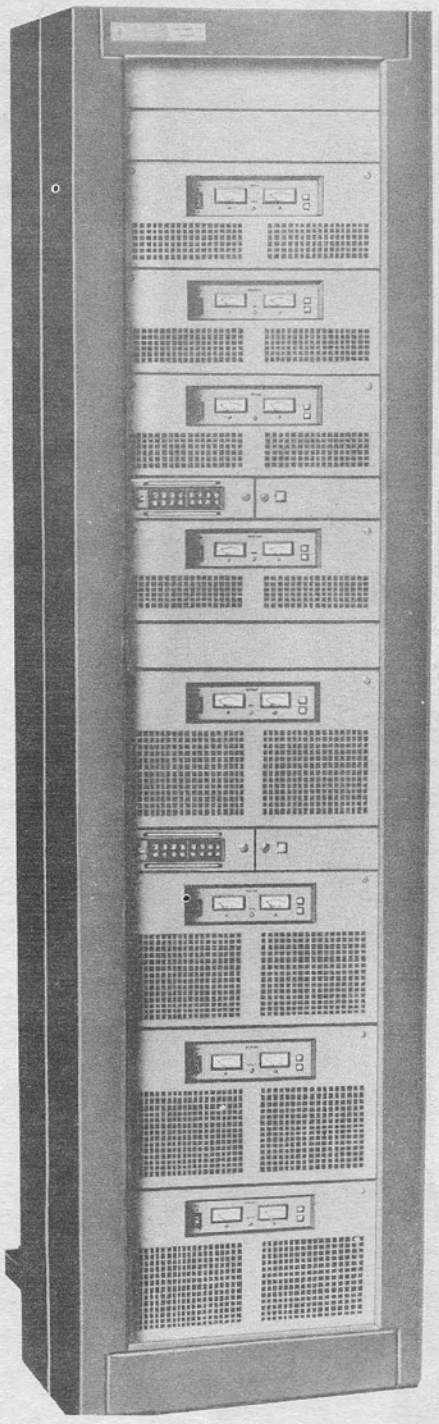


Fig. 4—660C Power Plant—+130V or −130V

2.14 ▶The control panel, located on the front of the power supply, contains status lamps, switches, and the power switch. On the front is also a hinged sheet-metal door and under it: circuit breakers, battery compartments for Option W, the hard bypass switch, and the CP1 microprocessor circuit board.◀

I. Ringing and Tone Equipment (806H Plant, 812A Plant and 808A Plant)

Note: Although the ringing and tone equipment is part of the switching equipment and not part of the power plant, it is appropriate to include the ringing and tone equipment in this power distribution practice.

2.15 Three ring-and-tone frames are available for the particular ringing requirements in a 1 or 1A ESS switch. These plants, 806H 1/2 ampere, 812A 1-1/2 amperes, and 808A 6 amperes, provide ringing current, tones, and signaling interruptions for the ESS switches. These power plants (Fig. 10, 11, and 12) are designed to mount on ESS switch standard frameworks for 25-inch mounting plates. A double bay is required for the basic power plant and a single bay is required to provide for the ringing and tone distribution. The double bay is 7 feet high, 1 foot deep, and 4 feet 4 inches wide. The dimensions of the single bay are similar except that the width is 2 feet 2 inches.

J. Engine-Alternator or Gas-Turbine Reserve Power System

2.16 The engine-alternator or gas-turbine reserve power system (Fig. 13 and Fig. 14) is required to substitute for commercial ac power in the event that commercial power service is disrupted. This power is needed to supply essential ac loads and for charging the +24 and −48 volt batteries. Any standard plant, manual or automatic, may be used.

K. Power Distributing Frame (J1A035C-1)

2.17 The power distributing frame (Fig. 15) is the fused distribution point for the +24 volts and −48 volts from the power plant to the various frames in the 1 and 1A ESS switches. Three frame bus bars are provided for connection to the power plant. Distribution is made from terminals on fuse blocks and on the frame ground bus bar. The distributing frame provides fusing for a maximum of ninety-eight +24 volt circuits and one hundred and six −48 volt cir-

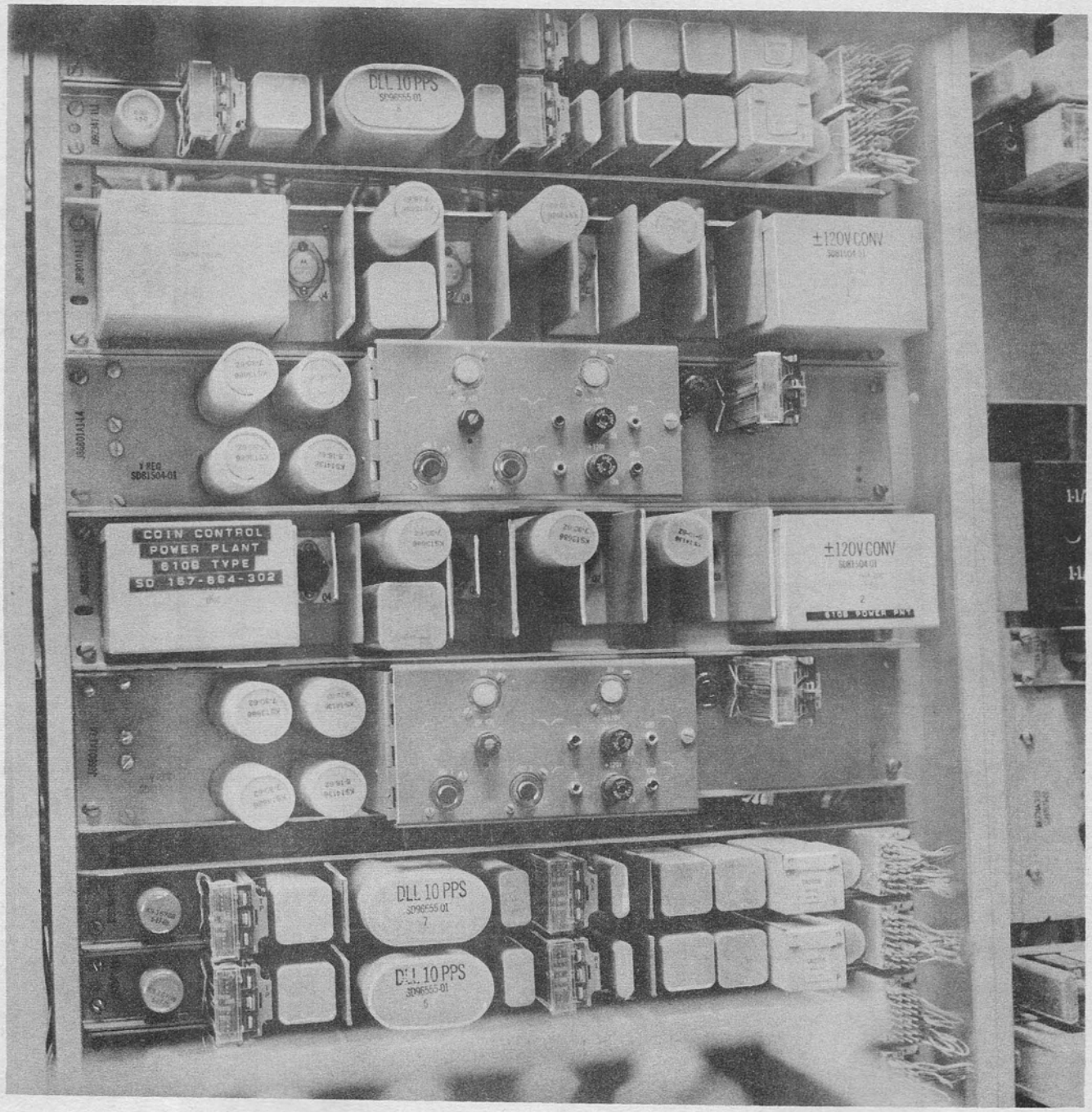


Fig. 5—610B Power Plant—±120V/±130V DC-DC Converter Plant

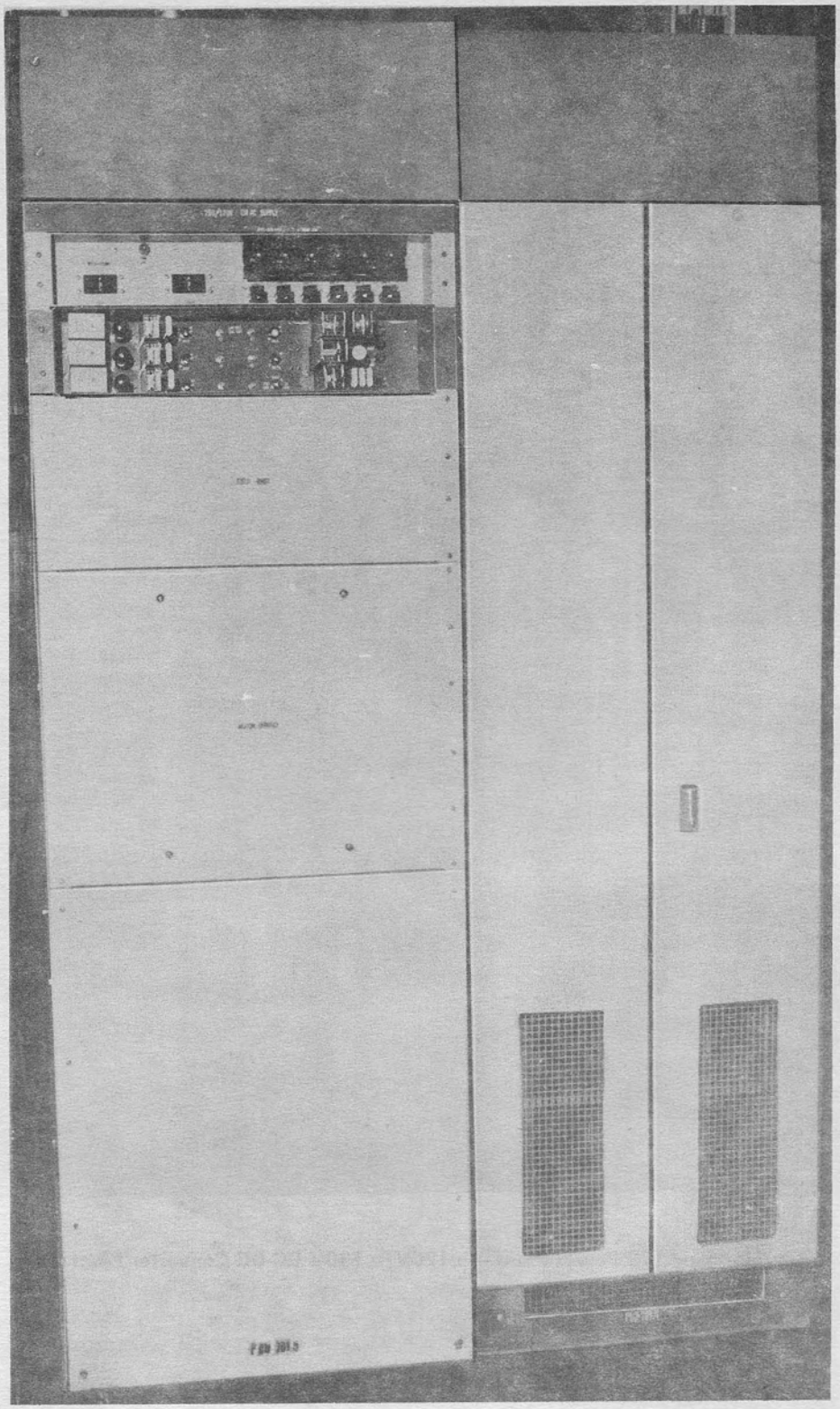


Fig. 6—504B Power Plant—Emergency 208/120 Volts AC Supply Unit

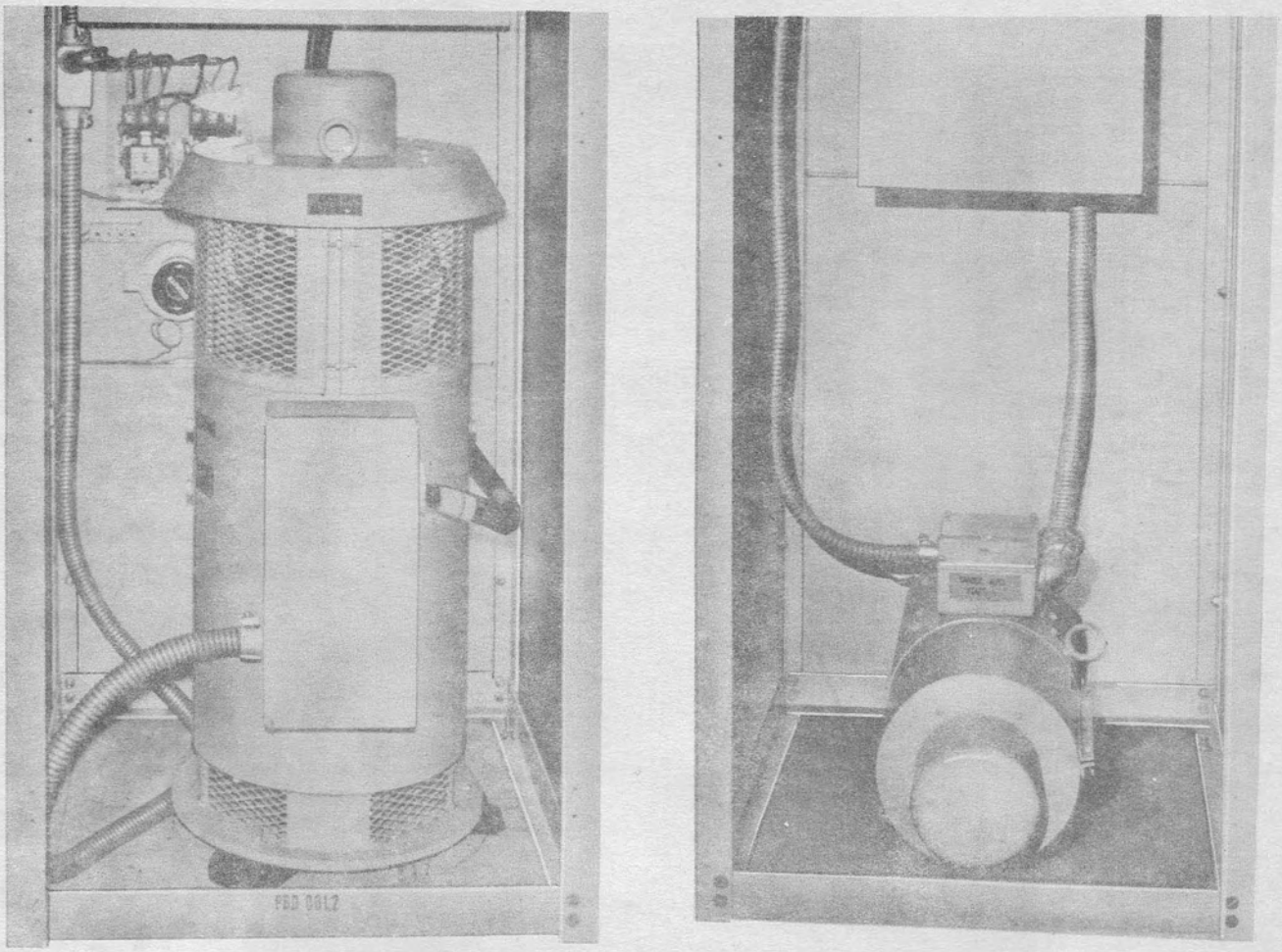


Fig. 7—504B Power Plant—Motor Alternator Sets

cuits. A minimum of two frames is required for each central office. The frame is a standard single bay frame measuring 2 feet 2 inches wide and 7 feet 0 inches high.

▶L. Power Conversion and Distribution Frames (1A ESS Switch)◀

2.18 For the 1A ESS switch, −48 volt power from the −48 volt power plant is also delivered to the ▶J5A007C-1◀ 1A processor power distribution frame located in the processor area. Converters on the power distribution frame develop +24 volt requirements for the 1A processor frames.

▶***Note:*** J5A007C-1 (Practice 254-201-072) replaces J5A007B-1 (Practice 254-201-070).◀

M. AC Power Distributing Panel

2.19 The ac power distributing panel (Fig. 16) provides both the protected and essential ac power used by 1 and 1A ESS switch switchroom equipment. Circuit breakers and indicator-type fuses protect and isolate all loads and activate alarms in the event of excessive current flow.

3. FUNCTIONAL DESCRIPTION (THEORY)

A. Introduction

3.01 The power distribution system for the 1 and 1A ESS switches (Fig. 17 through 19 and Fig. 21) follows standard plant practices. The normal ac power source for the entire office is commercial ac. If commercial ac is lost, engine-driven alternators

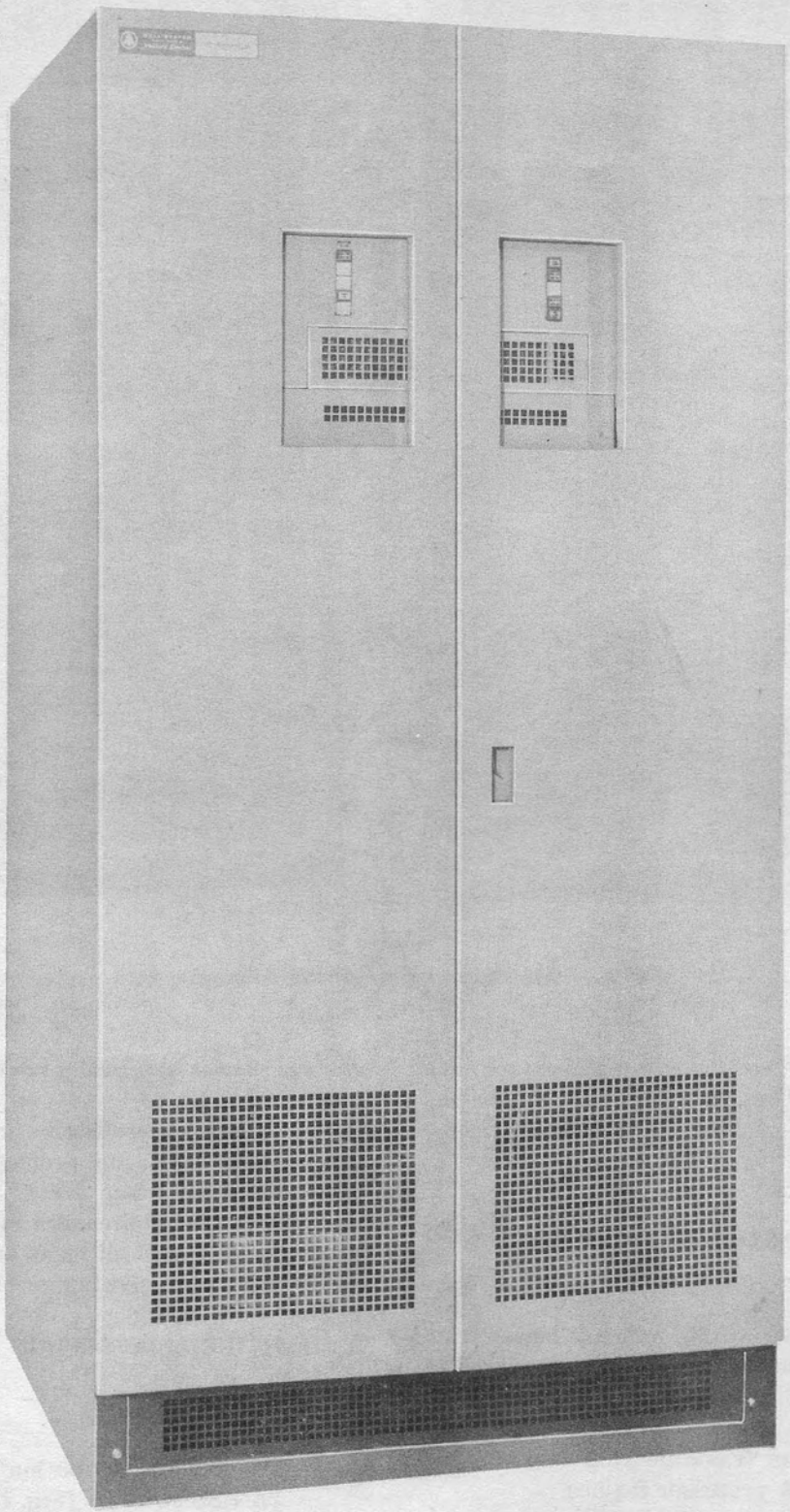


Fig. 8—524A Power Plant—AC Power Plant with Automatic Transfer from Regular to Reserve

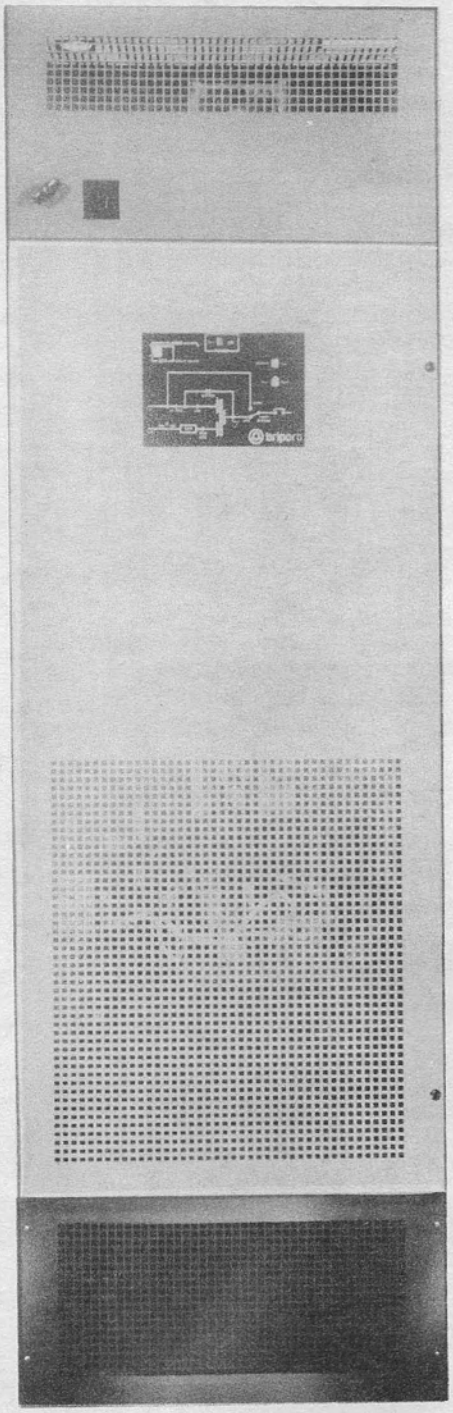


Fig. 9—▶J85527A TRIPORT II Power Supply—Front View◀

supply reserve ac power to replace commercial ac. Primary dc power is normally supplied by battery plant rectifiers that convert commercial/reserve ac to primary dc power. When commercial/reserve ac is disrupted, reserve batteries take over for the rectifiers and supply primary dc power to the office. DC voltages other than primary dc required by the office are provided by dc-to-dc converters that convert primary dc to the various dc voltages. Some critical office loads require uninterrupted (protected) ac power which is supplied by a dc-to-ac inverter when commercial ac is lost. Other ac loads that are essential to the office, but can tolerate short interruption of ac power without degrading service, are supplied commercial/reserve (essential) ac power. Those loads that are not essential to the office are supplied from only commercial ac power.

B. Normal and Reserve Power Sources

3.02 Normal and reserve power sources for 1 and 1A ESS switches are depicted in Fig. 21. The normal primary sources for the entire system is 208V, 240V, or 480V, 60-Hz, 3-phase commercial ac. For ease of presentation, the text and illustrations will have 480V, 60-Hz, 3-phase ac as the typical primary ac power source. If commercial ac power is lost, the gas-turbine alternator reserve power system supplies reserve 480V, 60-Hz, 3-phase primary ac power. Emergency 208/120 vac power can also be provided by the 504B power plant which supplies single or 3-phase ac voltage from the 48-volt office battery during a commercial power failure. Primary dc power for the system is +24V and −48V supplied by the 111A power plants or 326A and 326B power plants. Negative or positive 130 volts are supplied by the 610B or 660C converter plants and delivered to fuse panels on a miscellaneous frame in the switchroom for distribution to the loads.

C. 111A +24 Volt and −48 Volt (10 to 800 Amperes) Power Plant

3.03 The 111A power plants are recommended for use in 1 and 1A ESS switches or other electronic switching systems having ultimate busy hour load requirements of not more than 1600 amperes each for the +24 volts and −48 volts supplies. The supply voltages of opposite polarity are paired for the +24 and −48 volts to permit use of common ground feeders for the charge and discharge conductors.

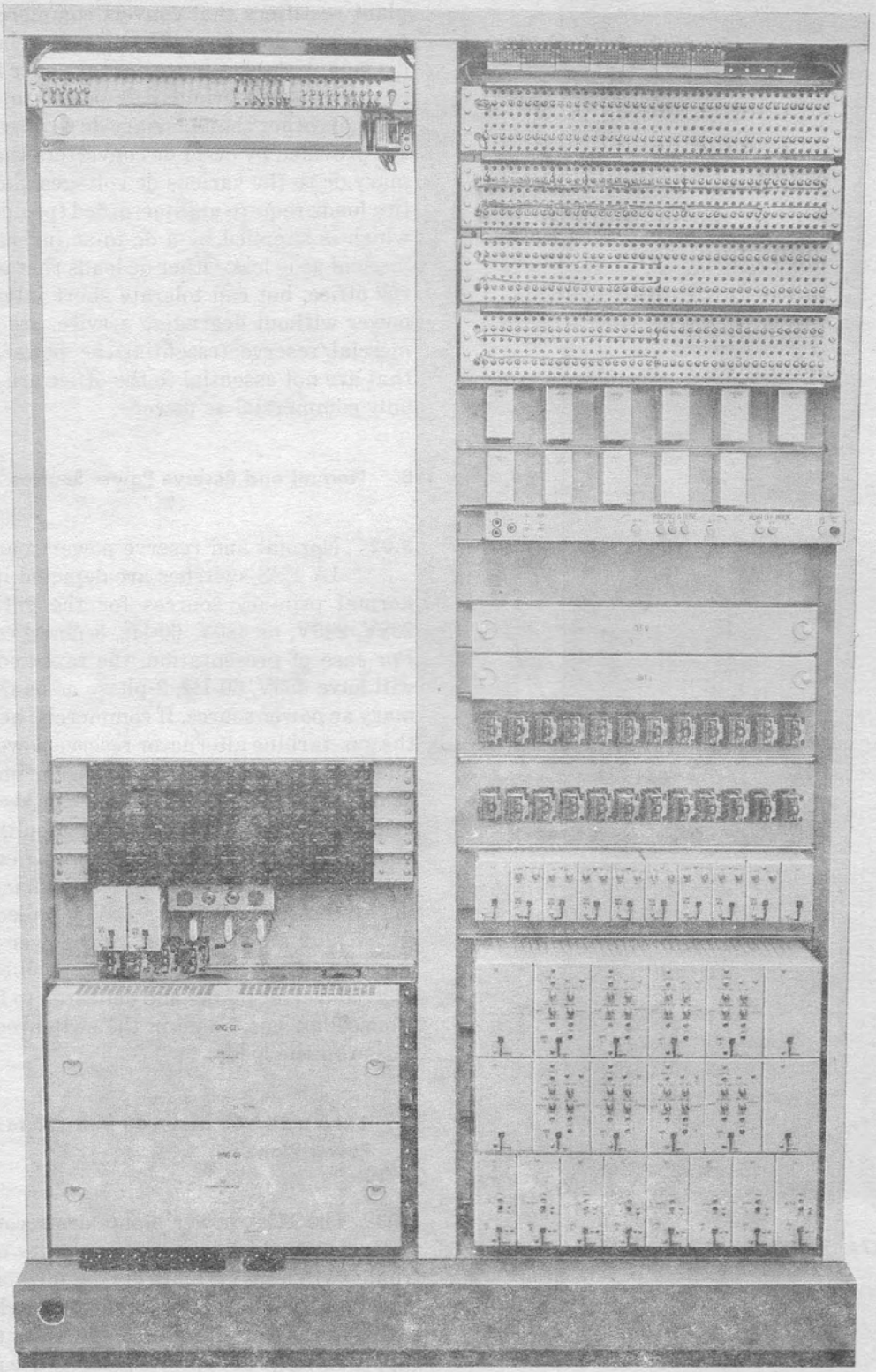


Fig. 10—806H Power Plant—Ringing and Tone Equipment

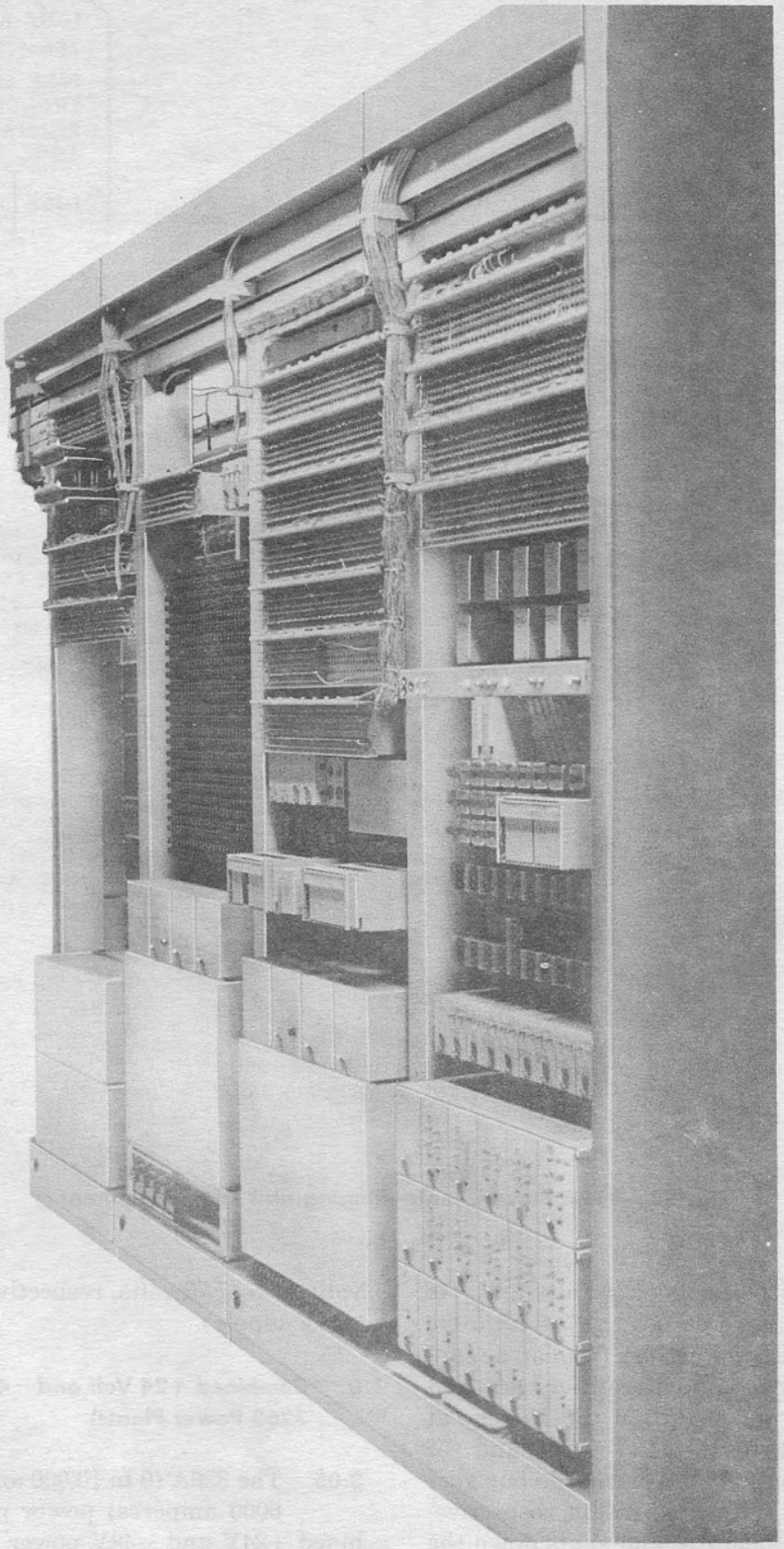


Fig. 11—808A Power Plant—Ringing and Tone Equipment

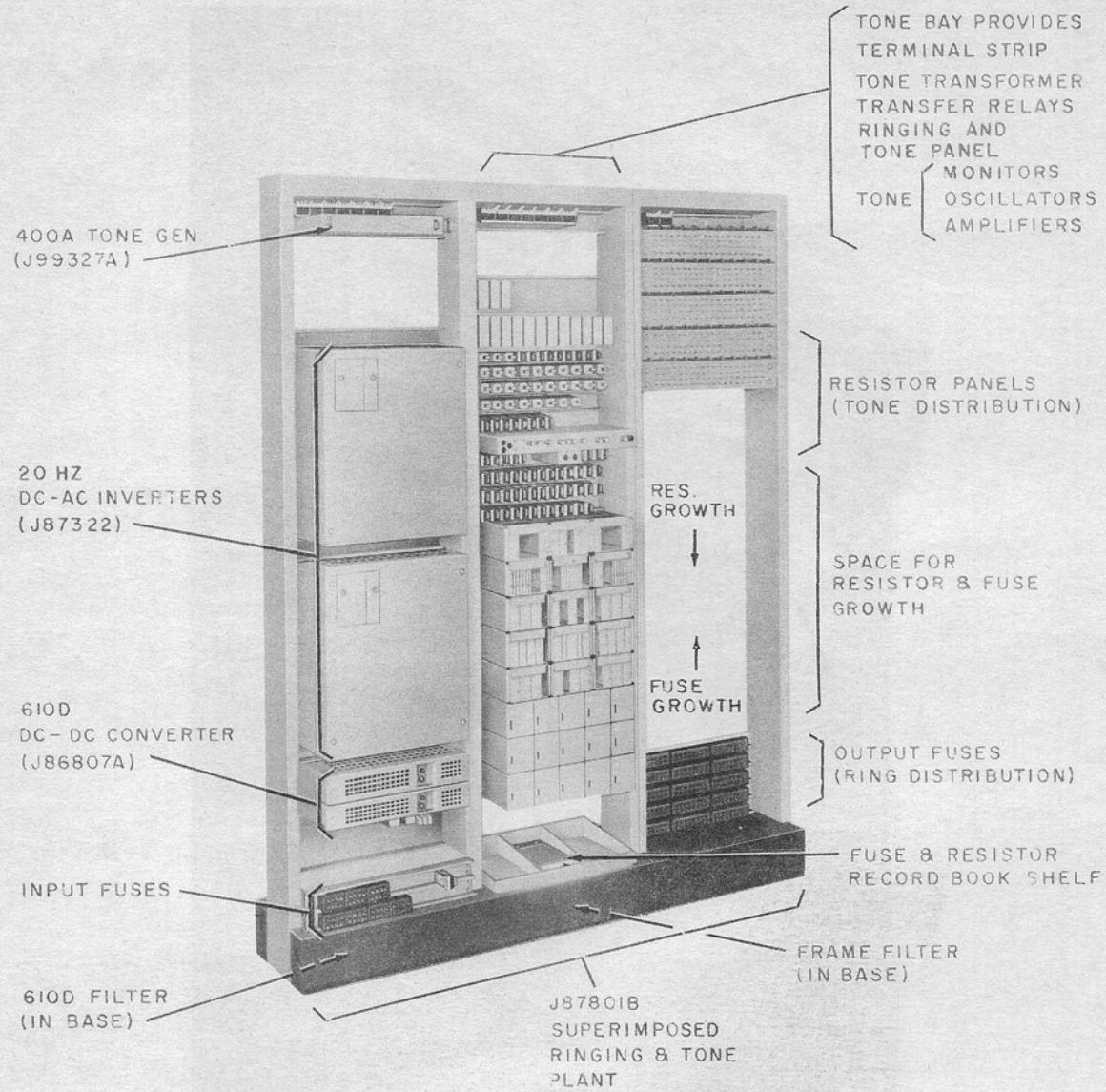


Fig. 12—812A Power Plant—Ringing and Tone Equipment

3.04 The 111A circuits provide +24 volts and −48 volts, 0 to 800-amperes positive or negative with a floated 12- and 24-cell battery from an ac supply. The automatically regulated rectifiers are connected to the battery and maintain the battery at approximately +26 volts for the +24V supply and −52 volts for the −48V supply. If the discharge bus goes to high voltage (+26.75 volts or −53 volts, respectively) the voltmeter relay operates and shuts down the faulty rectifiers and sends alarms. Alarms are also sent when the discharge bus is at a low voltage (+23.5 volts or −47.75 volts, respectively, for the +24V and −48V supply).

D. Combined +24 Volt and −48 Volt Plant (326A and 326B Power Plants)

3.05 The 326A (0 to 10,000 amperes) and 326B (0 to 6000 amperes) power plants provide a combined +24V and −48V power supply, up to 6000 or 10,000 amperes, with floated 12- and 24-cell batteries from an ac supply.

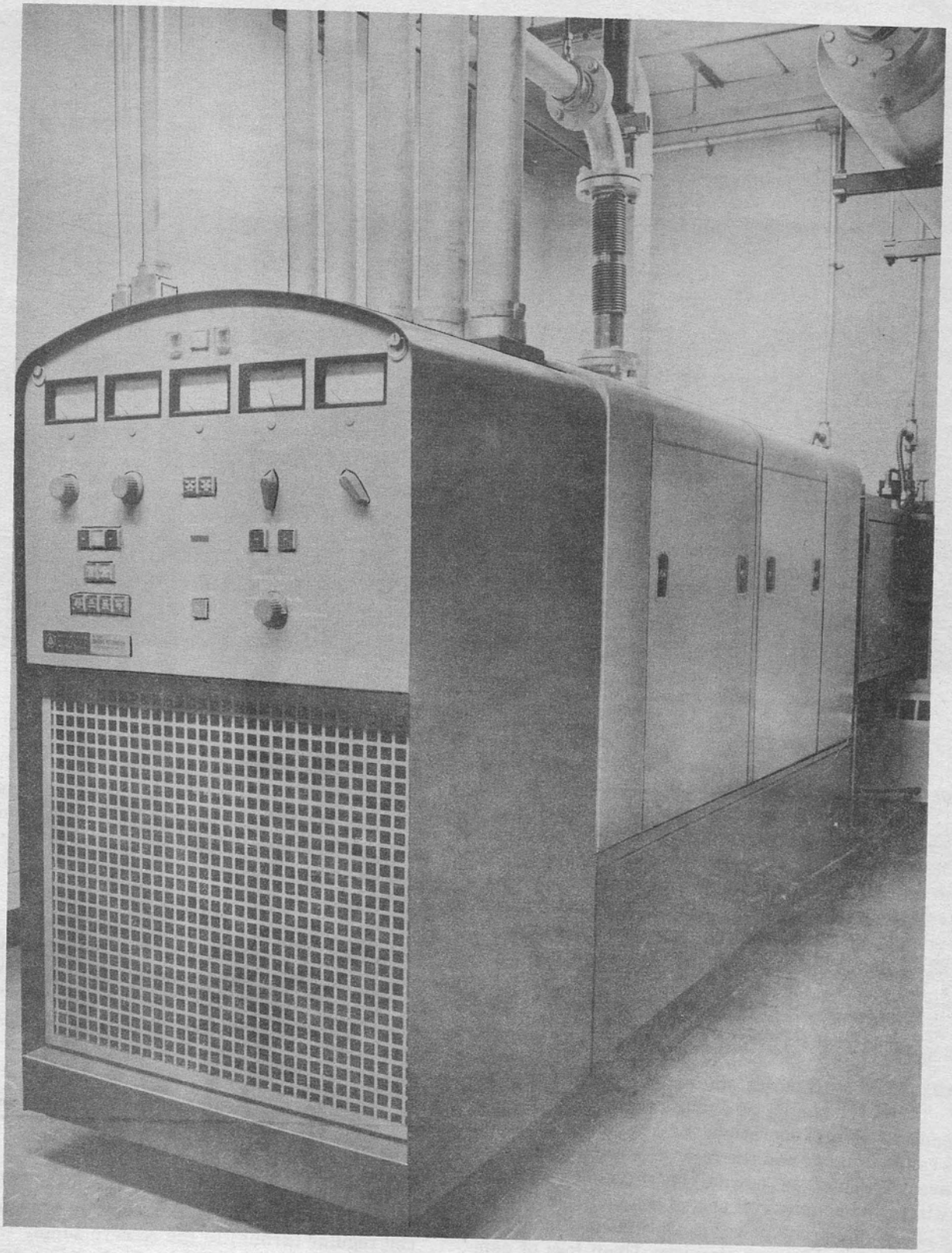


Fig. 13—Diesel-Powered AC Generating Set (Typical)

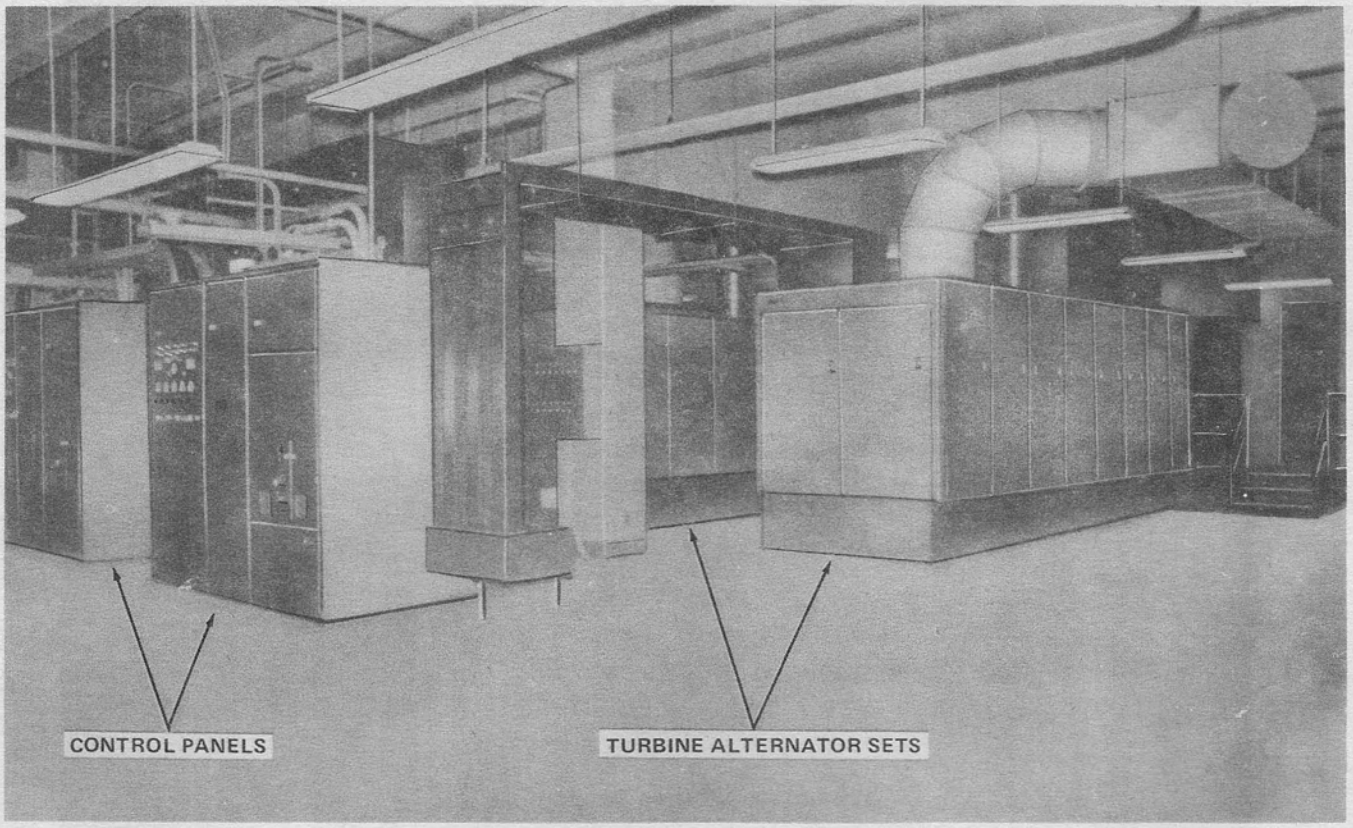


Fig. 14—Gas-Turbine-Powered AC Generating System (Typical)

3.06 The automatically voltage regulated rectifiers are connected to batteries and maintain the 12- and 24-cell batteries at approximately +26V and −52V, respectively. If the discharge volts goes to high voltage (+27V and −53.5V), the voltmeter relay operates, selectively shuts down the faulty recitifer, and sends alarms. When the discharge voltage drops to +22.5V and −47V major alarms are given.

E. Emergency 208/120-Volts AC Supply Unit 504B Power Plant (Motor Alternator Plant)

3.07 The 504B power plant supplies 208/120-volts, 60-Hz, single- or 3-phase power to critical ac loads. In normal operation, the regular power source is commercial ac and the reserve power source is the inverter. Thus, in normal operation, the load is switched to commercial ac and the motor alternator is idle. Commercial power is continuously monitored by voltage monitoring circuitry. Upon loss of commercial power, the load is switched to motor alternator power in less than 5 seconds, and a minor alarm is sent to the office alarm system. The motor alternator converts −48 volts dc to a voltage regulated 208/120-volts, 60-Hz, 3-phase ac at 5 kW maximum. Upon return of the commercial power, the load is switched back to commercial power after a 3- to 5-second delay.

3.08 The 504B plant requires an engine alternator or gas turbine to substitute for commercial power to charge the +24 and −48 volt batteries and supply essential ac loads in the event of a commercial power failure.

F. AC Power Plant with Automatic Transfer From Regular to Reserve (524A Power Plant)

3.09 The 524A power plant provides a 117-volt ac power supply with automatic transfer from the regular (prime) to the reserve supply when the regular supply fails. Each supply has a true RMS voltage monitor which will originate the signal re-

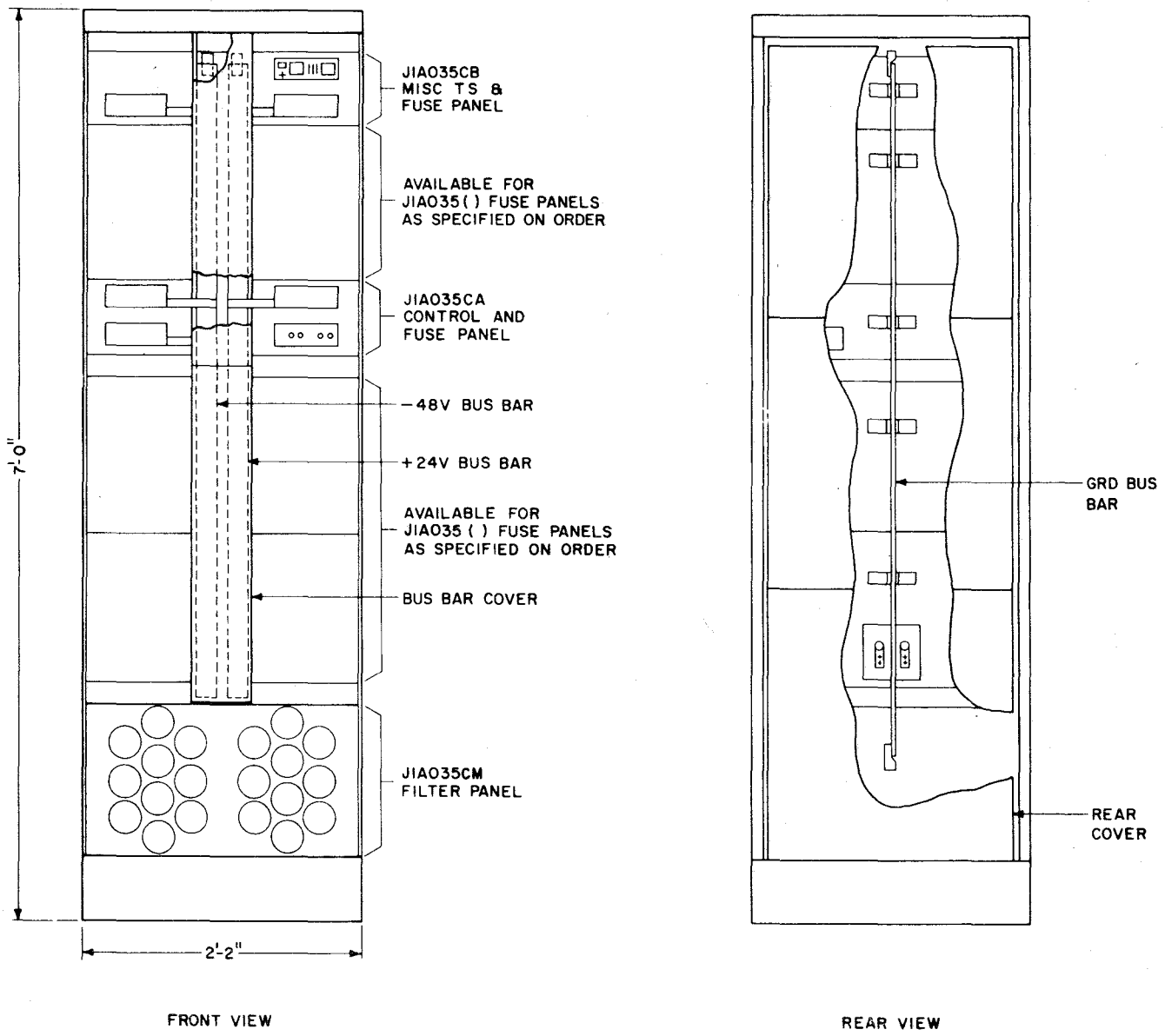


Fig. 15—Power Distributing Frame

quired to transfer the load automatically when its associated supply fails.

3.10 The plant has two sources of power; namely, the local commercial power and a battery powered solid-state inverter which is always operating. Either may be used as the prime source of power and the other as the reserve source of power by operating the OPERATION SELECTOR switch (OSS) to the desired position, COML PWR or INVR PWR, respectively. The selection is accomplished by grounding either of the two contactor coils through the contacts on the OSS.

3.11 The COML voltage monitor relay will operate when the line to neutral voltage rises above 111±1 volts RMS and remains operated unless the line to neutral voltage drops below 106±1 volts RMS.

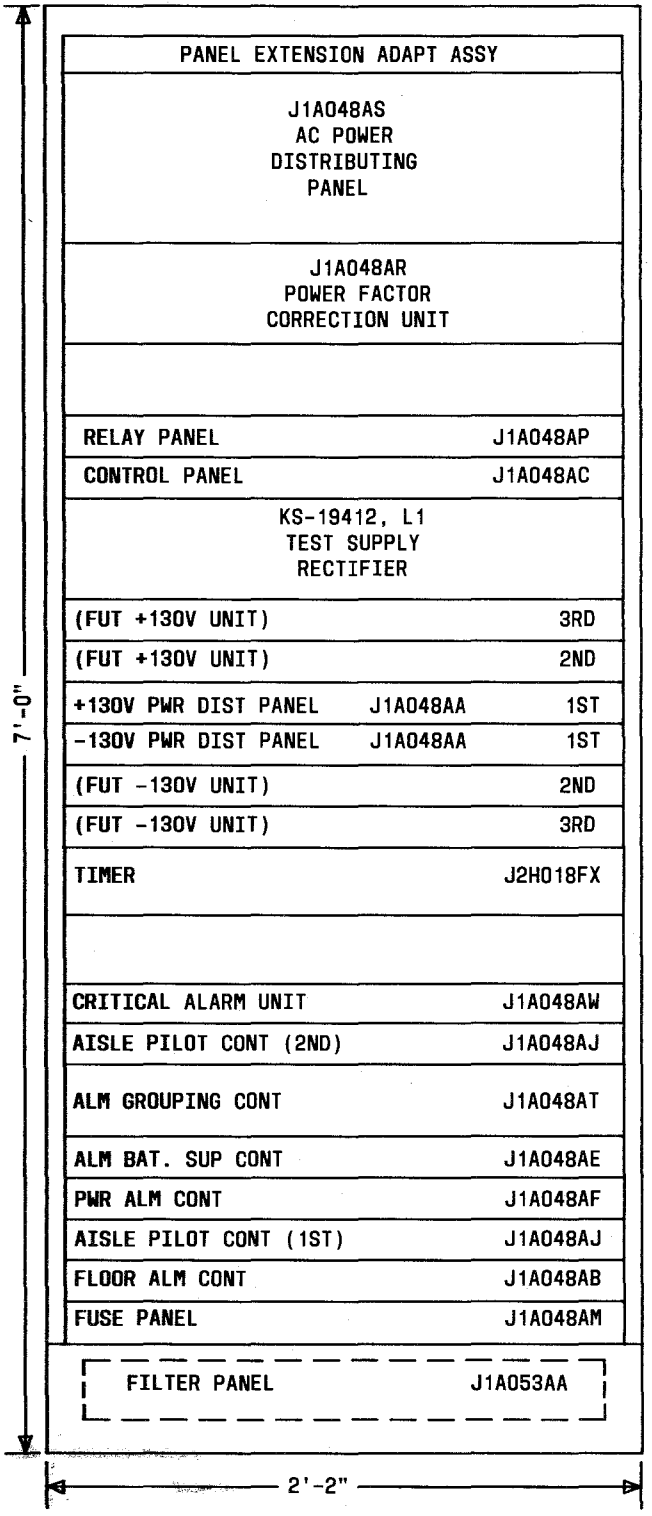


Fig. 16—AC Power Distributing Panel

▶G. AC Uninterruptible Power Supply (UPS) TRIPORT (J85527A TRIPORT II Power Supply)

3.12 The J85527A power supply operates from a 208-volt nominal, 57- to 63-Hz single-phase ac source, and/or a 43- to 55-volt dc battery and provides 116- to 124-volt ac single phase output at 0 to 47 amperes. By parallel processing the ac and dc, the TRIPORT II provides uninterrupted power despite irregularities or failure in commercial ac. The dc continuously feeds a dc-to-ac inverter. The output of the inverter, together with the commercial ac, is fed into a double-shunt ferroresonant transformer by means of two separate primary windings (input ports), each of which is loosely coupled to a common secondary (output port). The loose coupling prevents commercial ac surges from going to the load. The TRIPORT II operates with either square-wave or sine-wave inputs and provides inverter protection against output short circuits. The TRIPORT II provides ac power in one of four modes: normal mode, inverter mode, bypass mode, or hard bypass mode. (Refer to Practice 167-712-102, J85527A, TRIPORT II POWER SUPPLY).◀

H. +130 Volt or −130 Volt Plant (660B or 660C Power Plant)

3.13 The 660B or 660C plant for the 1 and 1A ESS switch will provide a ±130 volts dc supply from the −48 volts office battery. The 130 volts output is obtained from dc-to-dc converters using transistor or thyristor oscillator circuits to obtain the ac which is rectified and regulated to provide the dc output. An output voltage adjustment is provided as well as a current limiting (droop) adjustment for circuit load variations. The 70-type and 15-ampere load fuses are provided for plant outputs. If any of these fail, the fuse alarm relay is operated and a major alarm is sent. In case of a failure of only one converter, a minor alarm is sent. Failure of any converter causing a low-voltage condition will send a major alarm. Duplicate load-sharing converters paralleled across the loads ensure reliable operations. Failure of one converter automatically causes a standby converter to assume the load. The circuit also allows connections to alarm circuits which require ground signals and loop closures where these features are required.

3.14 Since there is no ±130 volt battery associated with the 660 plant, one more converter than required to carry the peak load is assumed. Blocking

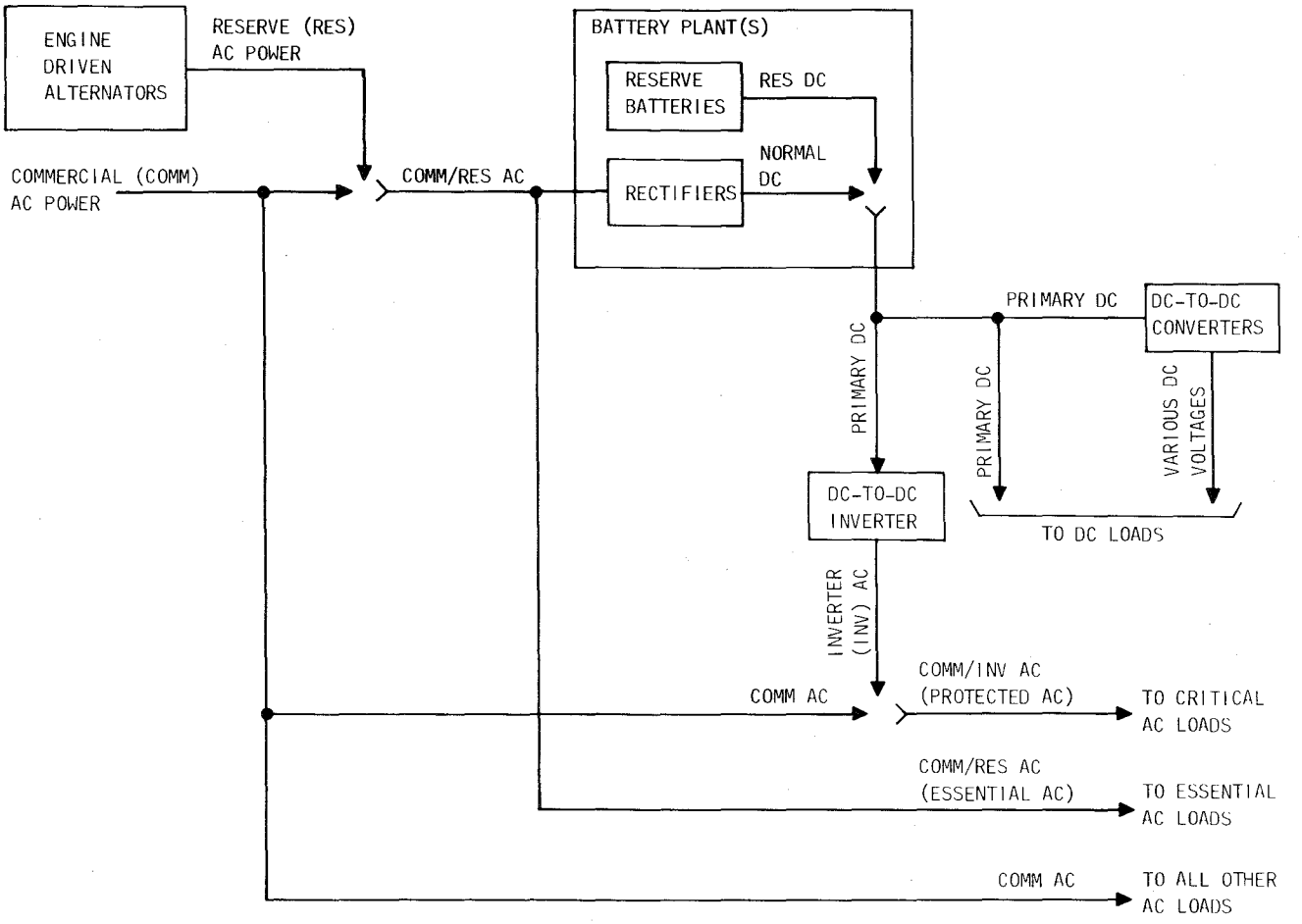


Fig. 17—Telephone Office Power Distribution System—Standard Plant Practices

diodes in the converter output leads prevent a fault in one converter from disabling the entire plant. An operated discharge fuse will connect 130 volts to the fuse alarm relay and the operated relay will light the FUSE ALARM lamp for the visual alarm and connect grounds to the major alarm circuits. Output voltage regulators maintain the positive and negative output limits of 125 to 135 volts at 0.75 ampere.

I. Ringing and Tone Equipment (806H Plant and 808A Plant)

3.15 The 806H (0.5 ampere) plant (J86815A&B) and 808A (6 ampere) plant (J86834A&B) provide ringing current, tones, and ringing signaling interruptions for 1 and 1A ESS switches. The 806H plant 20-Hz ringing is generated by 110A frequency generators which furnish regulated output 84 to 88V, 94 to 101V, and 90 to 120 Vac at 0.5A. The 808A plant 20-Hz ringing is generated by a 20-Hz dc-to-ac inverter with a regulated output of 86V at 6A. All tones consist of two frequencies (except high tones) which are generated by transistor oscillators added together and amplified by power transitor amplifiers. The frequencies per tone are of equal amplitude. The plant provides a solid-state interrupter. Duplicate 20-Hz ringing generators or inverters, tone generators, and solid-state interrupters are provided. Power is normally on both groups 0 and 1 of the ringing generators or ringing inverters, tone generators, and solid-state interrupters, but only the interrupter group 0 or 1 feeding the load is powered. The outputs of both ringing generators or ringing inverters are monitored for low voltage and all tone amplifier outputs are monitored for high and low voltage. The tone and ringing monitor outputs are fed to the system control

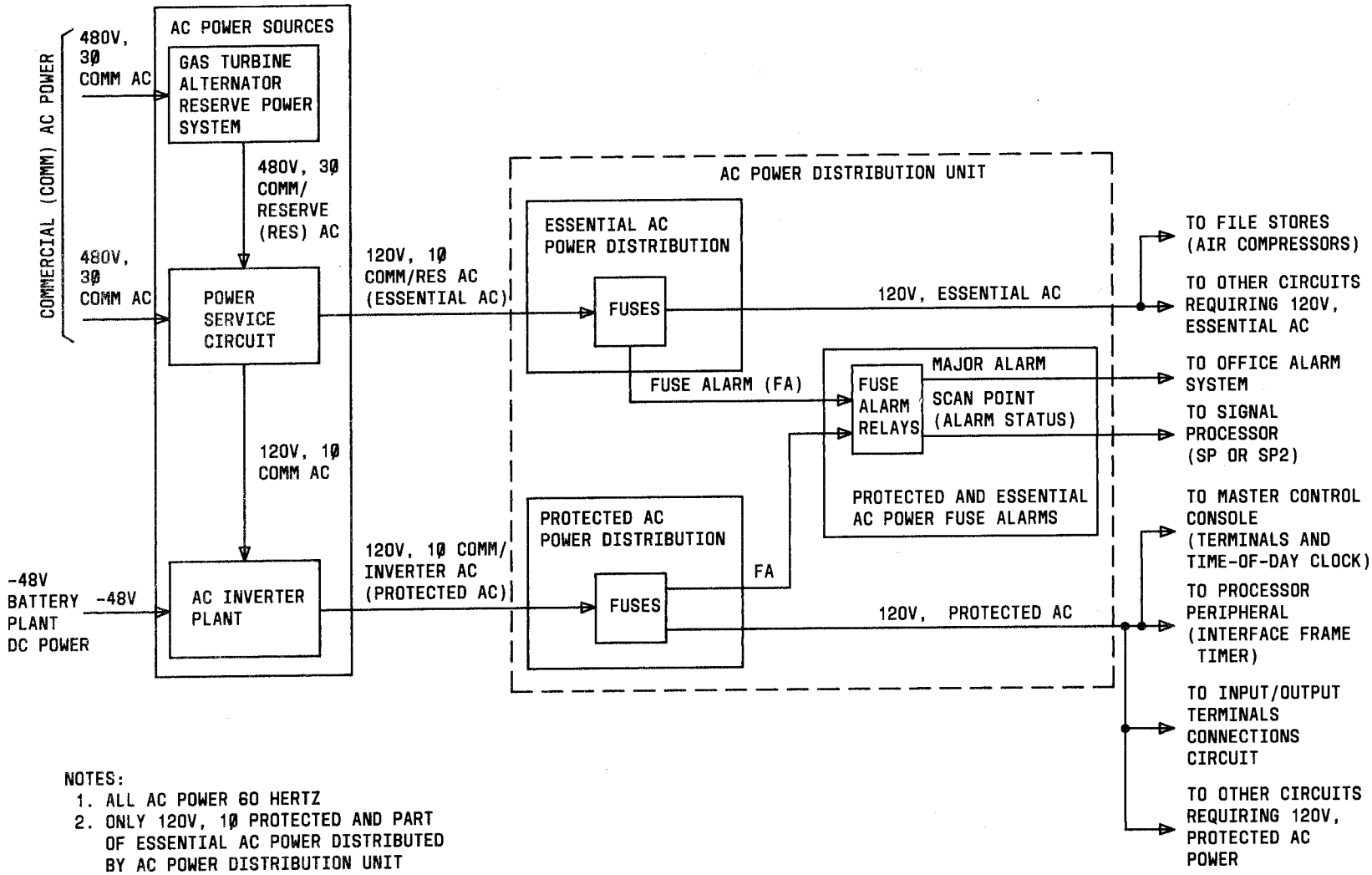


Fig. 18—AC Power Distribution Circuit—Functional Block Diagram

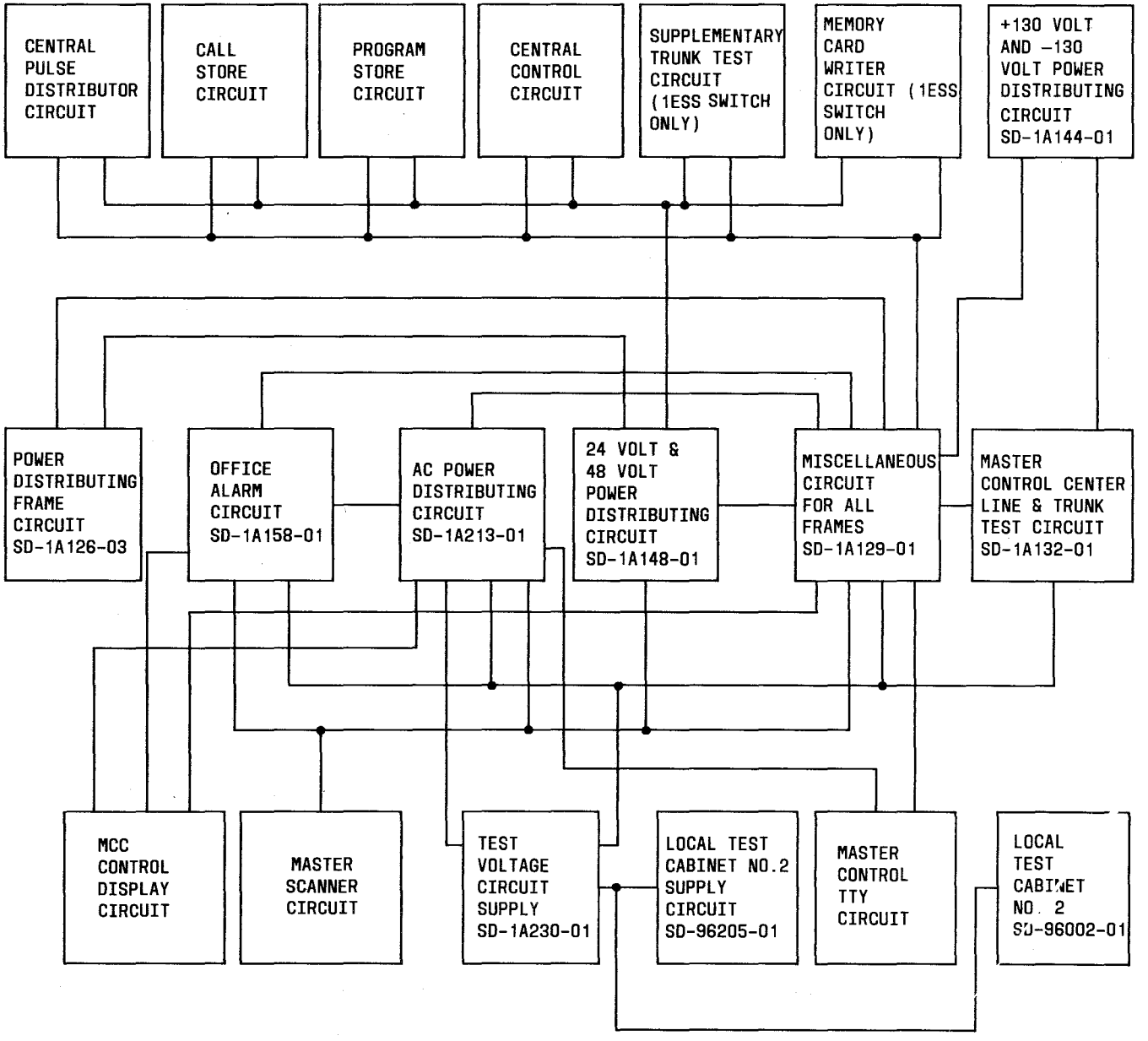


Fig. 19—1 and 1A ESS Switch Power Distributing and Alarm Circuits—Block Diagram

which determines which group, 0 or 1, of the ringing generator or ringing inverter, set of tone generators, and interrupters will feed the load. The system control also provides for automatic transfer in case of failure of either group, 0 or 1, generator or interrupter units connected to the load. All generators and interrupters are transferred as a unit. Manual control is also provided in the plant which can supersede the system control.

3.16 The 806H and 808A plants with mechanical interrupters are powered by commercial ac. During ac power failure, these plants are powered from the 504B or equivalent power plant. The solid-state interrupters operate from +24V and do not require commercial ac.

J. Ringing and Tone Equipment (812A Power Plant)

3.17 The 812A ringing and tone power plant provides 1.50 amperes of interrupted and continuous 20-Hz ringing current, continuous- and interrupted-precise call progress tones, and signaling interruptions as required by 1 and 1A ESS switches. The J807801A&B ringing and tone plants are rated at 1.50A, 20-Hz, 84 to 88 Vac.

3.18 Duplicate 20-Hz ringing generators, dial tone generators, audible ringing tone generators, call waiting tone generators, high tone generators, busy tone generators, and solid-state interrupters feed the various outputs through load transfer relays. Balanced distribution of all tones is provided through 450-ohm balancing resistors. All generators, both regular and reserve, are continuously monitored for low voltage. The monitor outputs are fed to ferrods in the master scanner for system control and class of alarm. In case of failure of any element in the side of the plant (0 or 1) feeding the loads, the system will automatically transfer the loads to the other side of the plant and provide the necessary alarms. Manual transfer, which supersedes system control, is provided for maintenance purposes. For automatic monitor and alarm checking, the system can operate relays in this plant which lowers the inputs to selected monitors about 3 dB to give an alarm indication. Power off switches are provided so that −48V and +24V power can be removed from either side of the plant for maintenance. All generators are powered from −48V while the interrupters and control are powered from +24V. Each side of the plant has its own battery and ground feeders to the power distribution frame.

K. Engine- or Gas-Turbine Alternator Reserve Power System

3.19 The automatic reserve power plant parallels several engine or gas turbine driven alternator sets on a common bus. The plant provides fully automatic unattended operation with manual operation serving as a backup mode. Commercial ac power is fed to the power bus through commercial circuit breakers and from the power bus to the essential loads through load circuit breakers. These are solenoid-controlled circuit breakers located in the company-furnished ac switchgear.

3.20 Control circuits in the alternator sets continuously monitor commercial ac via sensing leads. Upon detection of a commercial power failure, the control circuitry sends a power failure signal to the system control bay. A power failure is the loss of power, loss of phase, or voltage or frequency out-of-limits for a predetermined amount of time. The automatic operation sequence under control of the system control circuits proceed as follows:

(1) All alternator sets are signaled to start.

(2) Load circuit breakers are sequenced open.

(3) Commercial circuit breakers are opened.

(4) The first alternator set up to speed takes the A-priority load; the set circuit breaker is closed; and the A-priority load circuit breakers are sequenced closed.

(5) The second set up to speed is automatically synchronized with the first; the set circuit breaker is closed; and the B-priority load circuit breakers are sequenced closed. The resultant load is automatically shared equally by the two sets.

(6) The third set up to speed is automatically synchronized with the first two; the set circuit breaker is closed; and the C-priority load is sequenced onto the power bus. All three alternator sets, now in parallel on the single power bus, share the load equally.

3.21 The status of each alternator set is continuously monitored by the set's control circuitry. Should an alternator set fail while in operation, the lowest priority load will be dumped. When commercial power is restored, the office loads are sequenced

off the power bus; the alternator set circuit breakers are opened; the commercial breakers are closed; and the office loads are sequenced back onto commercial power. The alternator sets run through a cool-down period, then shuts down.

3.22 The alternator sets supply voltage-regulated, current-limited 480-volts, 60-Hz 3-phase ac power at a nominal (2100/2500) kW. The unit is capable of accepting the full-rated load within 5 seconds of reaching full speed (less than 60 seconds). Circuits in the control cabinets monitor the unit for a wide variety of fault conditions. Most fault conditions such as overcurrent, overvoltage, undervoltage, major circuit breaker operation, engine temperature or overspeed, etc., result in opening of the set circuit breakers, shutdown of the set, and generation of appropriate audible and visual alarms. Some faults, occurring during startup, such as starter overspeed, minor circuit breaker operation, rectifier failure, etc., result only in appropriate audible and visual alarms.

L. General Electrical Requirements for 1A Processor (1A ESS Switch)

3.23 The 1A processor requires one input voltage. A nominal −48 volts is the only source of power. In the PCDF a small amount of +24V power is converted from the −48V primary power. The nominal +24 volts is used for control purposes, alarm lamps, and miscellaneous frame functions. The −48 volts is derived from a 326A, 326B or 111A power plant, or its equivalent, and the +24 volts is derived from a plant circuit utilizing converters.

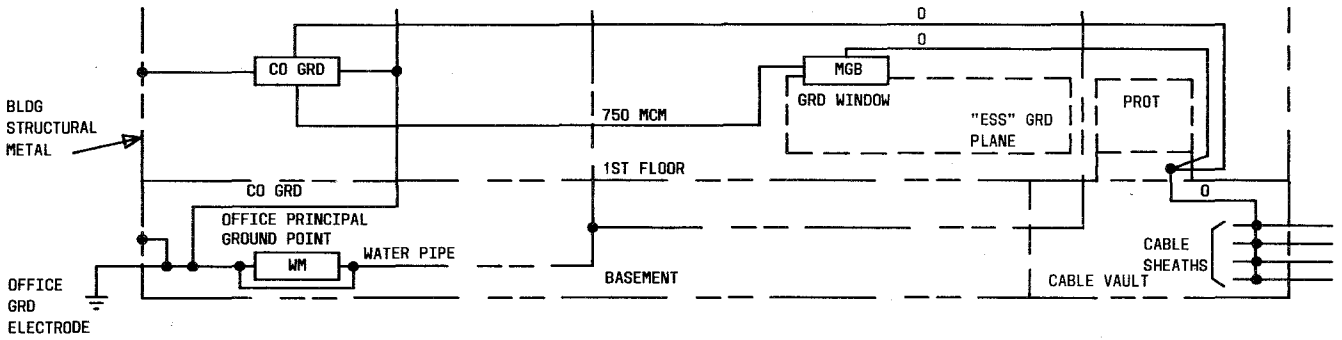
4. POWER DISTRIBUTION SYSTEM GROUNDS

4.01 Transient voltages cannot be tolerated in electronic type switching systems. It is therefore necessary to have the proper grounding system (Fig. 20) to eliminate noise that is tolerable in electromechanical switching systems. The method employed to eliminate stray currents generated outside the electronic system ground plane is to isolate that ground plane except for a single point. The isolated ground plane is established by bonding frames, power distribution frames, power conversion and distribution frames, and cable racks into an electrically interconductive network. The network is isolated from contact with any other grounded metalwork in the building, except for a single point of interconnection. A single point system is established by means of a "ground window" which is defined as a spherical zone extending to a radius of approximately 3 feet from the midpoint of the main ground bus. The main ground bus is usually the ground bar located above the miscellaneous power frame. All conduits and other conductors connected to foreign grounds coming into the network area and connecting to locally grounded circuits must pass through the ground window and connect to the main ground bus.

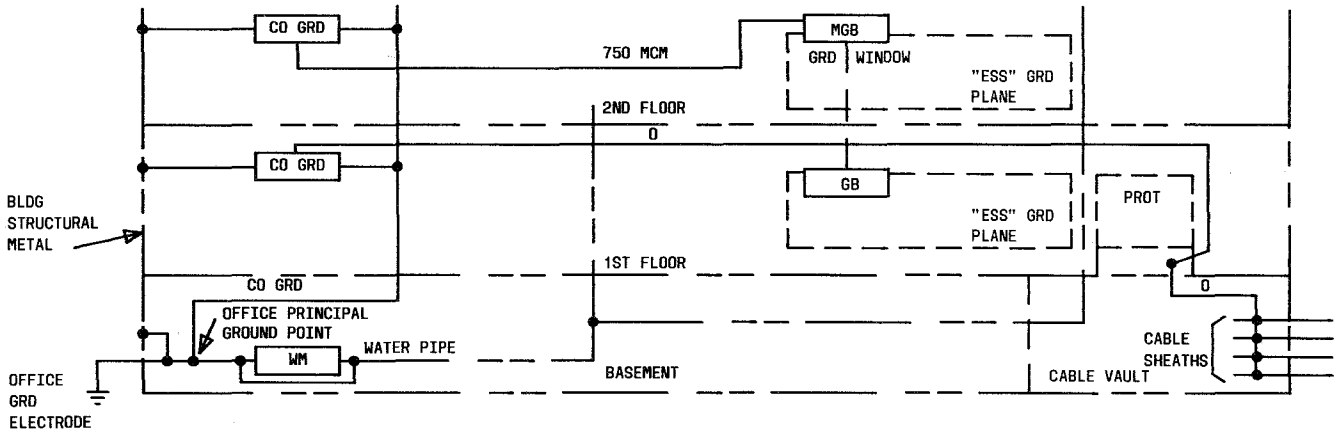
5. REFERENCES

5.01 The following listing provides further information concerning the power distribution system for the 1 and 1A ESS switches.

▶966-100-100	1ESS Switch General Description
167-217-100	111A (J86470)—Description
167-624-100	326-Type—Description
167-670-100	504B (J86617) Power Plant—Description
167-678-100	523A (J86641) Power Plant—1.5 KW AC—Description
167-679-100	524A (J86642) Power Plant—5.0 KW AC—Description
167-684-100	610B (J86801) DC-to-DC Converter—Description)
167-686-100	660-Type Converter Power Plant—+ or −130 Volts, 15 Amperes—Description
167-712-102	(J85527A) TRIPORT II Power Supply (120 Volt, 5.6 KVA) Operating Methods
167-724-331	806H (J86815A and J86815B)—Operating Methods
167-726-100	808A (J86834)—Description
167-727-105	Ringing and Tone Power Plant—812 (J87801)—Description
254-201-072	Power Conversion and Distribution Frame (J5A007C-1)—Description



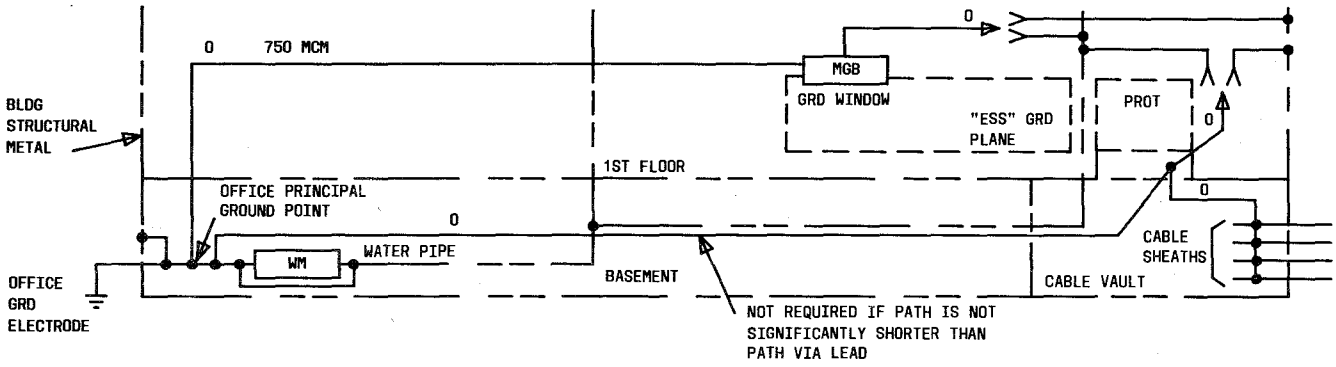
A - PROTECTOR FRAME AND GRD WINDOW ON SAME FLOOR, CO GRD EXISTS



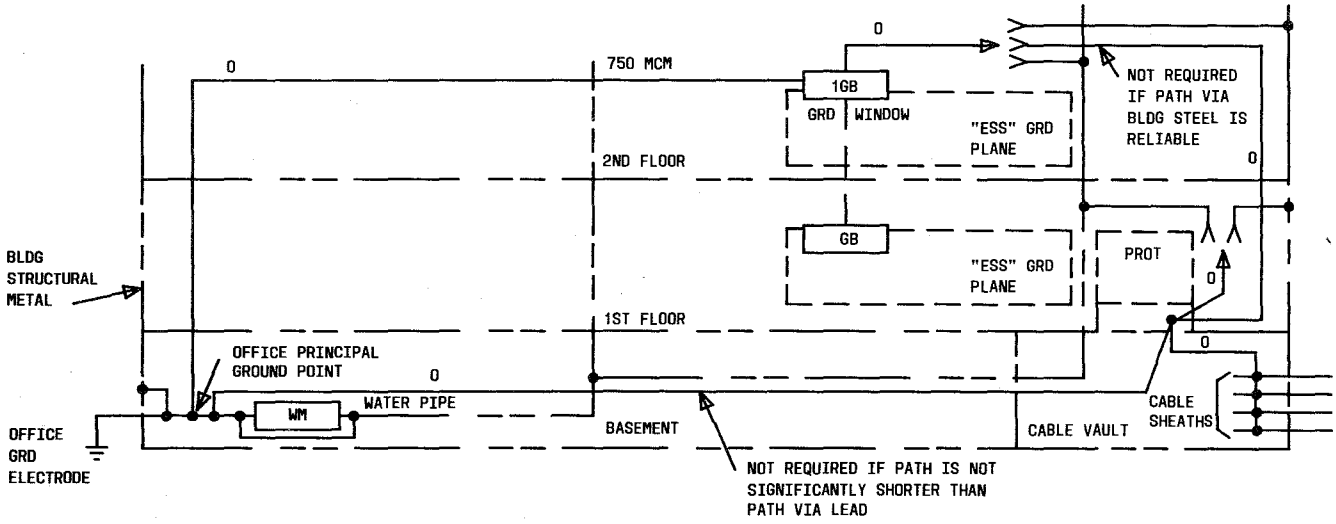
B - PROTECTOR FRAME AND GRD WINDOW ON SEPARATE FLOORS, CO GRD EXISTS

Fig. 20—Protector Frame Grounding Requirements in 1 and 1A ESS Switches (Sheet 1 of 2)

254-201-073	Power Conversion and Distribution Frame (J5A007C-1)—Theory
966-120-100	1A ESS Switch General Description
254-201-071	Power Conversion and Distribution Frame—Theory—1A Processor
254-201-070	Power Conversion and Distribution Frame—Description—1A Processor
SD-1A148-01	Electronic Switching Systems—Common—+24 Volt and −48 Volt Power Distributing Circuit
SD-5A022-01	ESS Switch 1A Processor +24V, −48V, and 110 Vac Power Distribution and Grounding Circuit
SD-1A213-01	Electronic Switching Systems Common—AC Power Distributing Circuit
SD-1A129-01	Miscellaneous Circuit.

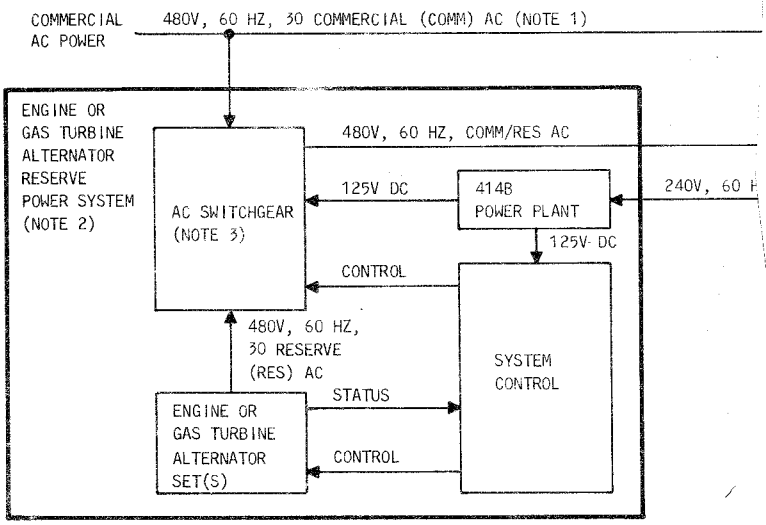


C - PROTECTOR FRAME AND GRD WINDOW ON SAME FLOOR, NO CO GRD



D - PROTECTOR FRAME AND GRD WINDOW ON SEPARATE FLOORS, NO CO GRD

Fig. 20—Protector Frame Grounding Requirements in 1 and 1A ESS Switches (Sheet 2 of 2)



NOTES:

1. SYSTEM CAN ALSO USE 208 OR 240V, 60 HZ, 30 AC INSTEAD OF 480V
2. ENGINE OR GAS TURBINE ALTERNATOR RESERVE POWER SYSTEMS MAY VARY IN DIFFERENT SYSTEMS. AN EXAMPLE IS J86646 AUTOMATIC RESERVE POWER PLANT (SD-81936-01) THAT USES 2 OR 3 KS-20460 2100/2500 KW GAS TURBINE DRIVEN ALTERNATOR SETS
3. THE COMPANY FURNISHED AC SWITCHGEAR IS ALSO PART OF THE POWER SERVICE CIRCUIT
4. CONFIGURATION OF POWER SERVICE CIRCUIT WILL VARY FOR DIFFERENT OFFICES

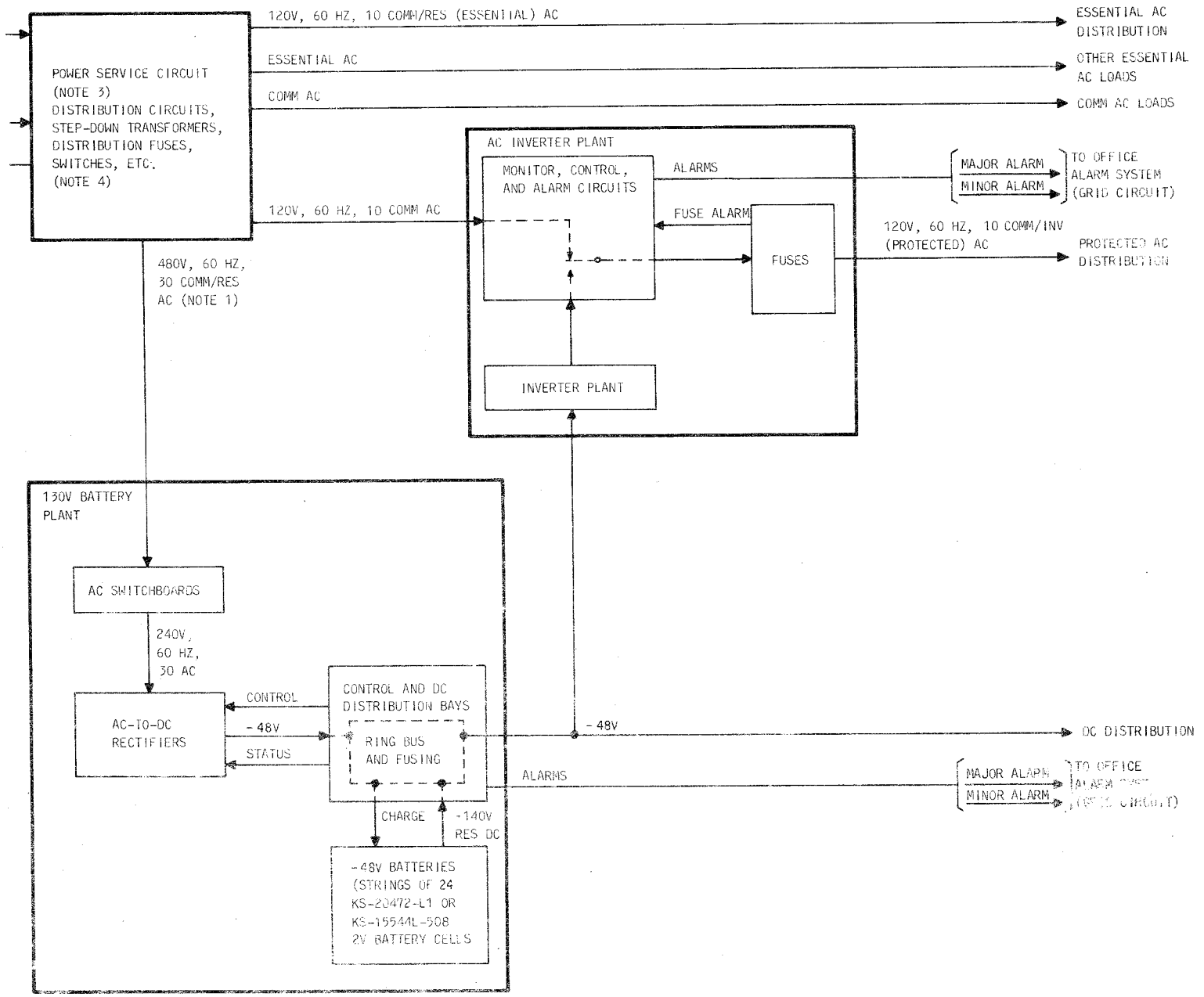


Fig. 21—Typical Normal and Reserve Power Sources for 1 and 1A ESS Switches—Functional Block Diagram