A.C. POWER DISTRIBUTION
LONG LINE EQUIPMENT

CONTENTS

Reference should also be made to drawing CN 921
A.C. Power Distribution Board for L.L.E.

1. INTRODUCTION.

1.1 Objective. The purpose of this instruction is to establish suitable methods of providing A.C. power distribution facilities for long line equipment installations.

1.2 Scope. The instruction is concerned primarily with the distribution of A.C. power for equipment operation within the equipment room only, and assumes that power for this purpose is available at the "continuity" or "No-Break" busbar.

The methods described are to be followed in principle whether the work is done by Departmental staff authorised under State regulations or by a licensed electrical contractor. Throughout the installation, the workmanship and methods shall meet the requirements of the S.A.A. wiring rules or local wiring regulations.

1.3 Method Principles.

(i) As each equipment row is established a permanently cabled A.C. power feed should be provided to each active rack position in which A.C. operation is anticipated.

(ii) In rows containing both D.C. and A.C. operated racks, an endeavour should be made to segregate the rack types so that an orderly power distribution layout is possible.

(iii) The power cable is terminated on a commercial type 3-pin power outlet located over each rack position (as defined in (i)) and protected and controlled by a circuit breaker installed in a distribution board, generally at the end of each suite..

(iv) The power cable is enclosed in 3" x 2" metal duct with the rack power outlets fitted in the bottom or side of the duct. Smaller duct such as 2" x 2" may be suitable in some cases..

1.4 Application. Three distribution schemes are described, suitable for small, medium, and large installations.

Each scheme has been designed to safeguard personnel and equipment from electrical hazards, facilitate equipment installation and extension, provide adequate grading of the various protection devices, and permit their connection to station alarm systems for fault location.

2. DISTRIBUTION SCHEMES.

2.1 Scheme (1) - Small Installations (See Figs. 1 and 2). Where the available long line equipment floor area limits the number of A.C. operated equipment racks to approximately 15, one distribution board only, called the rack distribution board (RDB) shall be provided between the continuity busbar and the final sub-circuits. It must be located in the long line equipment area and will usually be wall mounted. A three-phase feed shall be cabled to the distribution board from the continuity busbar. The board will be equipped with single phase circuit breakers (C.B's) of rating suitable for the equipment (para. 3). This will generally mean 4 amp breakers for all circuits, except power feeding racks which will generally require a breaker of higher rating.

2.2 Scheme (2) - Medium Size Installations (See Figs. 3 and 4). This scheme caters for installations having an ultimate capacity of 120 A.C. operated equipment racks, located within a compact area, e.g., one room or floor of a medium size building.

In such an installation one suite distribution board (SDB) only, shall be provided and supplied by a 3 phase feed cabled from the continuity busbar. The circuit breakers in the suite distribution board should be single phase type rated at 12A, and the board is usually wall mounted. Rack distribution boards (RDB's), provided at the end of each equipment row or suite, shall each be supplied with a 3 phase feed from the SDB. The circuit breakers in the RDB's should be rated at 4A (para. 3).

2.3 Scheme (3) - Large Installations (See Figs. 5 and 6). Where the ultimate number of long line equipment suites will exceed 5 or 6, or where equipment is separated into defined areas, e.g., opposite ends of a large floor; separate rooms; or separate floors; additional suite distribution boards should be provided. Each suite distribution board should be installed adjacent to its associated suites. The individual suite boards will each be supplied with a 3 phase feed from a three pole isolating switch installed at the continuity busbar. The choice of cable size to each SDB is determined by the maximum total load of the SDB and these cables are protected by suitably rated HRC fuses mounted either in the overall bypass switch cubicle for the three machine set or within the N.B. plant for the two machine set. Two outlets per phase are provided which in most cases should allow adequate protection for a reduced size of cable to the SDB's.

3. CIRCUIT BREAKER RATINGS.

3.1 Consideration of the problem of discrimination between protection devices in tandem led to the adoption of the following breaker types :-

3.2 Rack Distribution

(i) German broadband equipment installations :-

4 amp Siemens breakers as supplied on equipment contracts.
These are fitted in the end of the group frame for each suite.

(ii) All other installations :-

4 amp Heinemann breakers; Series 0411; Curve 3, fitted with micro-switch alarm contacts.

It is expected that 4 amp breakers will meet the load requirement of any L.L.E. rack except remote power feeding equipment which should be wired directly to the Suite Distribution board.

3.3 Suite Distribution

(i) Breakers feeding Rack Distribution boards:-

12 amp Heinemann Series 0411; Curve 1, fitted with micro-switch alarm contacts.

The load on these breakers should not exceed 8 amps to ensure the prior operation of a lightly loaded 4 amp breaker in the event of a rack wiring fault.

(ii) Breaker feeding up to 8 test equipment power outlets, or a Remote Power feeding circuit load up to 2800 VA. (It should be noted that combinations of rack feeds and power outlets are not permitted under any circumstances):-

12 amp Heinemann Series 0411; Curve 1, fitted with micro-switch alarm contacts.

These breakers may be loaded up to 12 amps. Curve 1 has been specified to give uniformity with the requirements of (i).

(iii) Breaker feeding a Remote Power Feeding circuit load in excess of 2800 VA :-

Heinemann Series 0411, Standard Curve, fitted with micro-switch alarm contacts. Current rating to suit power feed load.

3.4 The Heinemann 12 amp Curve 1 breaker was selected to ensure the prior operation of Siemens 4 amp breakers supplied with German broadband equipment in the event of a rack wiring fault.

3.5 It is important that H.R.C. fuses fitted in the output of No-Break plant should be correctly rated so that the maximum possible degree of discrimination is available for the prior operation of distribution circuit breakers in the event of a fault.

The H.R.C. fuse ratings of the present types of N.B. plant are as follows :-

Plant Rating KVA	Type of N.B. Plant	N.B. Alternator Fuse
10	Three machine	20A
15	" "	30
20	" "	40
25	" "	50
47	" "	80
10	two "	25
15	" "	35
25	" "	50
40	" "	80

4. CABLING AND DUCTS.

4.1 The wiring between the continuity busbar and suite distribution boards, and between the suite distribution boards and rack distribution boards shall be protected by either duct or conduit as specified in S.A.A. wiring rules.

4.2 Within the equipment suites the wiring shall be run in 3" x 2" metal duct located at the outer edge of each equipment row. For German type equipment installations, the duct shall be installed with the 2" dimension horizontal and located within the row cabling duct at the outer edge. In all other installations, the duct shall be installed with the 3" dimension horizontal. It is desirable to fit 250 volt warning labels to ducts carrying A.C. power distribution cables.

4.3 The size of cable to be used between the continuity busbar and the suite distribution boards shall be determined by the maximum load requirement. Cable size connecting the suite distribution and rack distribution boards shall be 3/.036 stranded copper thermoplastic insulated cable coloured red, yellow and blue for the active conductors and black for the neutral. This cable size is suitable for loads up to 15 amps and shall be used also for wiring to test equipment power outlets and directly to power feeding racks.

4.4 The cable to be used between the rack distribution board and the rack position power outlets shall be 3/.029 copper thermoplastic insulted, coloured red for the active and black for the neutral.

4.5 Earth wiring shall be extended from the main power board earth to each distribution board in turn and finally to each power outlet or equipment rack. 7/.029 copper with green thermoplastic insulation shall be used. It should be noted that this earth protection system is provided to meet the requirements of the S.A.A. regulations and is independent of the station earthing system although the two earths should be interconnected.

5. CONNECTION TO RACKS.

5.1 As previously indicated, the permanent wiring to each active rack position is to be terminated in a flush mounting 3 flat pin, 10 amp socket such as Ring Grip 105W, fitted either on the lower horizontal surface or in the side of the row power duct. An insulating shield shown in Fig. 7 shall be mounted above the socket to ensure complete isolation from adjacent duct wiring. The socket shall be wired so that when viewed from the front the order shall be earth, active and neutral in a clock-wise direction. All outlets shall be tested with a power outlet test set (See para. 10).

Connection to the power input terminals of the rack shall be made by means of a short length of 3 core thermoplastic sheathed (T.P.S.) flexible cord (40/.0076) of 250V grade insulation, terminated in a 3-pin side entry plug such as HPM 105. If the socket is mounted in the bottom of the duct, a retaining clip such as shown in Fig.7 may be used to prevent accidental dislodgement of the plug. Alternatively a keeper like that in Fig. 8 but suitably dimensioned for the side entry plug may be used. This eliminates the need for drilling the duct. For German type broadband equipment installations a centre entry plug (such as Ring Grip PX53) with retaining keeper (Fig. 8) is suitable.

In the case of coaxial remote power feeding racks, the power feed and earth connection will be cabled directly from a circuit breaker in the suite distribution board, via the row duct and shall terminate directly on the power input terminals of the rack.

Certain other racks, e.g., Power Supply racks, may require additional feeds controlled by 4 amp breakers in the rack distribution board. These additional feeds will be terminated in additional outlets mounted in the duct at the Power Supply rack position. The circuit breakers for these feeds will generally be released by the provision of power feed direct from the Power Supply rack to other active equipment racks.

6. RACK AND SUITE DISTRIBUTION BOARDS.

6.1 Various types of distribution boards have been developed in the States, but the essential requirements of any board are:-

(i) A.C. terminations to be separated from the alarm contacts by a physical barrier.

(ii) Provision made for alarm cut-off.

(iii) Separately fused indicator lamps to be provided for each phase.

(iv) A neutral bar insulated from the box framework, and an earth bar to be provided.

(v) The layout of any distribution board installation must permit the rearrangement of phase loads which will be necessary to maintain balance on the phases of N.B. plant as the equipment installation is extended; the permissible unbalance of phase loads is 25%. it is desirable on RDB's to keep the equipment rack connected to the same circuit breaker at all times and this requirement makes necessary the use of phase distribution links on the supply side of the breaker wiring. In order to facilitate immediate access to circuit breakers under emergency conditions locking door handles should not be provided; where locking door handles have been provided in earlier models the key operated lock mechanism should be disabled.

6.2 Constructional detail of a board incorporating the above features and suitable for either rack or suite distribution use is shown in Drawing CN.921. It provides for the mounting of up to 30 Heinemann circuit breakers fitted with micro-switch alarm contacts. All A.C. cabling terminations are made in a section of the box separated by a barrier from the alarm contact wiring.

Provision has been made for the connection of any breaker to any of the three phases by use of connecting links on each phase. Indicator lamps are equipped for each phase as an aid to power fault location. The wiring to the phase lamps is fused so that a lamp can be changed without any necessity for removing power from the board.

An alarm cut-off key is provided which allows a distribution board alarm to be disabled if it is desired to deliberately operate a circuit breaker to the open circuit position, (see 7.3). This key can only be operated to the "alarm off" position with the distribution board door open; closing the door automatically operates it to the "alarm on" position.

6.3 Suite and Rack distribution boards shall be designated SDB1, SDB2 ....., RDB1, etc., as they are installed.

7. ALARMS.

7.1 As shown in Drawing CN.921, access to the circuit breaker alarm contacts is gained by swinging out the hinged CB mounting panel. Alarm cabling shall be anchored at the rear of the swinging section, and shall be of 250V grade insulation.

Suite Distribution Board Alarm (CN.921 Sh.4.) The alarm shall be connected into the general floor alarm bell and central lamp display system. In addition, a bell and lamp shall be installed at each board. If any circuit breaker operates, it will:-

(i) Ring the general floor alarm bell.

(ii) Light a lamp in the central display, directing attention to that particular board.

(iii) Operate the SDB bell and lamp.

7.2 Rack Distribution Board Alarm. For installations which use 4A Heinemann circuit breakers, i.e., those of other than German type, the RDB alarm system shall be similar to the SDB system of 7.1.

For German type installations, the RDB alarm system is normally supplied with the equipment.

7.3 The alarm cut-off key shown in CN.921 Sh. 4 allows the alarm system to be deliberately disabled only if the door of the box is open. Alarm disconnection should only be required if any breaker is operated to the off position for installation or maintenance purposes. At all other times, all breakers in each box should be kept in the on position. This will enable a breaker, operated by a fault condition to be quickly identified by the off normal toggle position.

8. DESIGNATION OF CIRCUIT BREAKERS.

8.1 Suite distribution board circuit breakers shall be numbered. A chart shall be mounted inside the SDB door relating these numbers to the equipment rows which the breaker controls.

RDB circuit breakers shall be numbered for rack and row, thus 1A serves rack A of row 1 etc. A chart shall be mounted inside the RDB door for any additional information.

9. TEST EQUIPMENT POWER OUTLETS.

9.1 These shall be mounted on racks or combining frame end pieces at both ends of each equipment row. They shall be used for test equipment only and are not intended for soldering irons, or portable tools such as drills, etc. As indicated in para. 3.3 up to eight of these outlets may be cabled directly from a breaker in the SDB.

10. GENERAL PURPOSE POWER OUTLETS.

10.1 These are normally wall mounted at frequent intervals throughout the equipment area for soldering irons, etc., and are cabled and protected separately from the distribution systems discussed in this E.I.; and under no circumstances can a General Purpose Outlet be supplied from a "No Break" A.C. Supply distribution beard. The provision is generally covered by the building contract. All power outlets shall be tested with a power outlet test set (Buildings, Engineering Services, Safety Precautions in the use of Electrical Equipment SP 0001) to ensure they are correctly wired and safe.

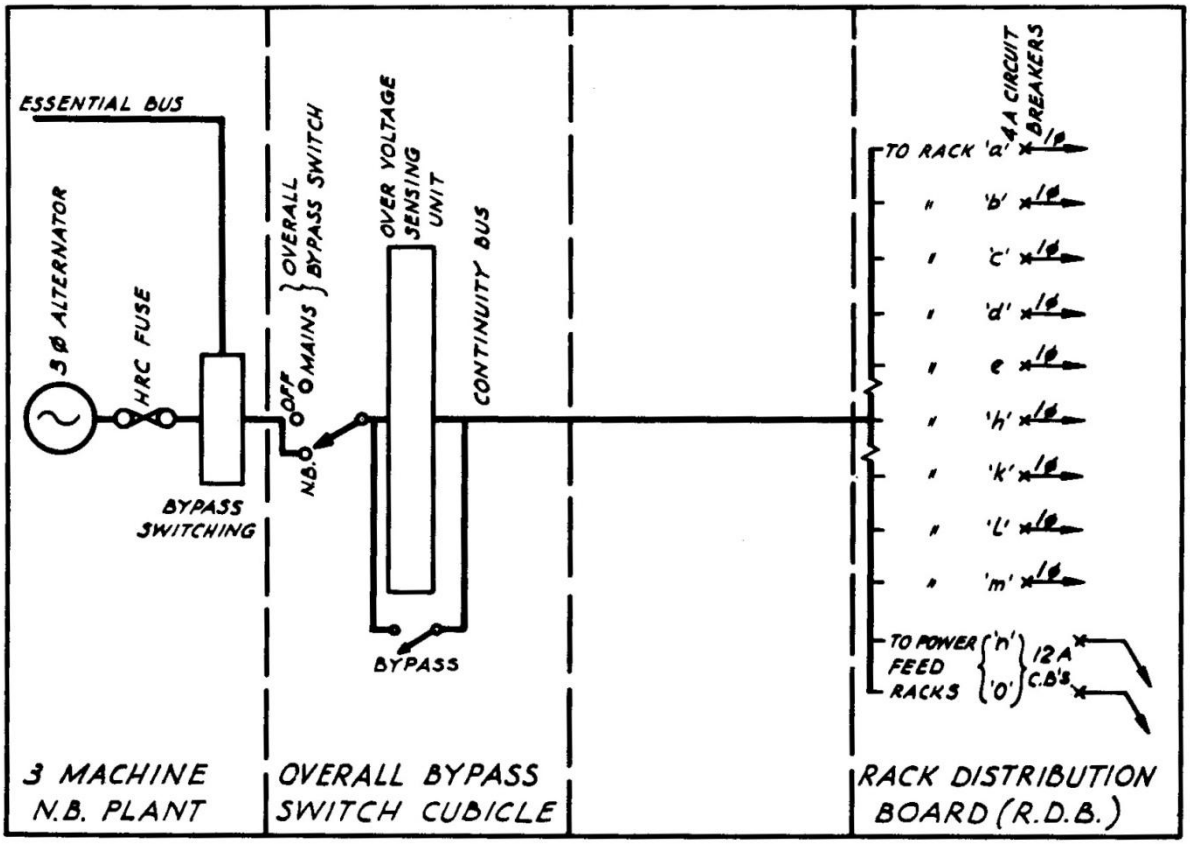

FIG. 1. DISTRIBUTION SCHEME - SMALL INSTALLATIONS (3 MACHINE).

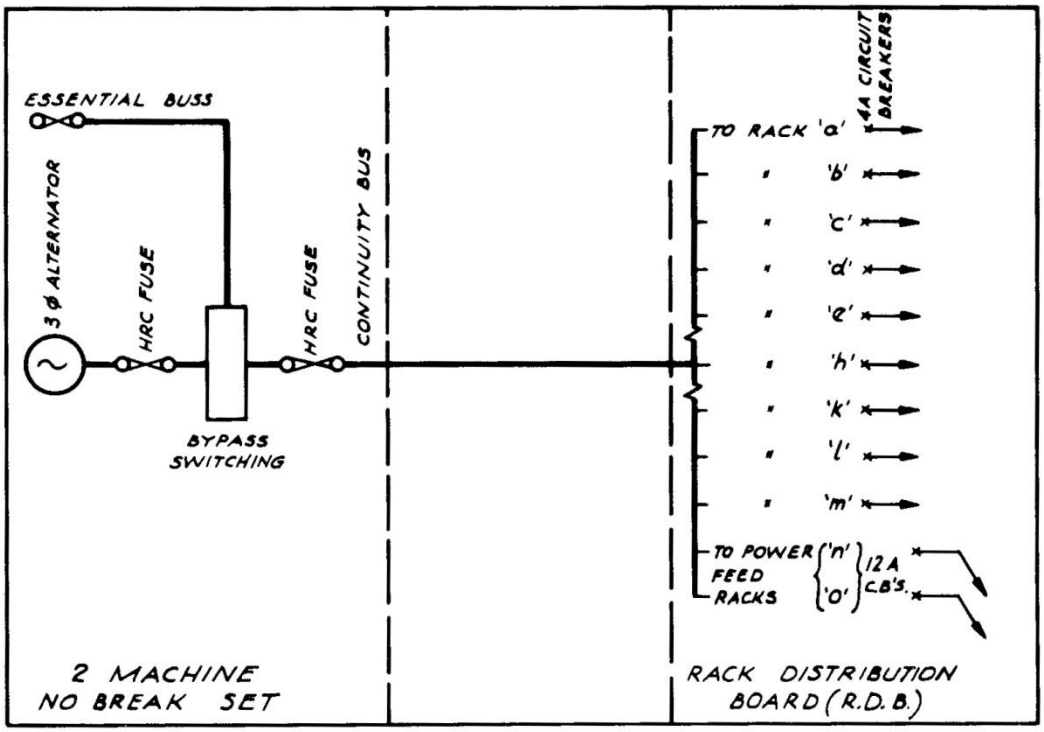

FIG. 2. DISTRIBUTION SCHEME – SMALL INSTALLATIONS (2 MACHINE).

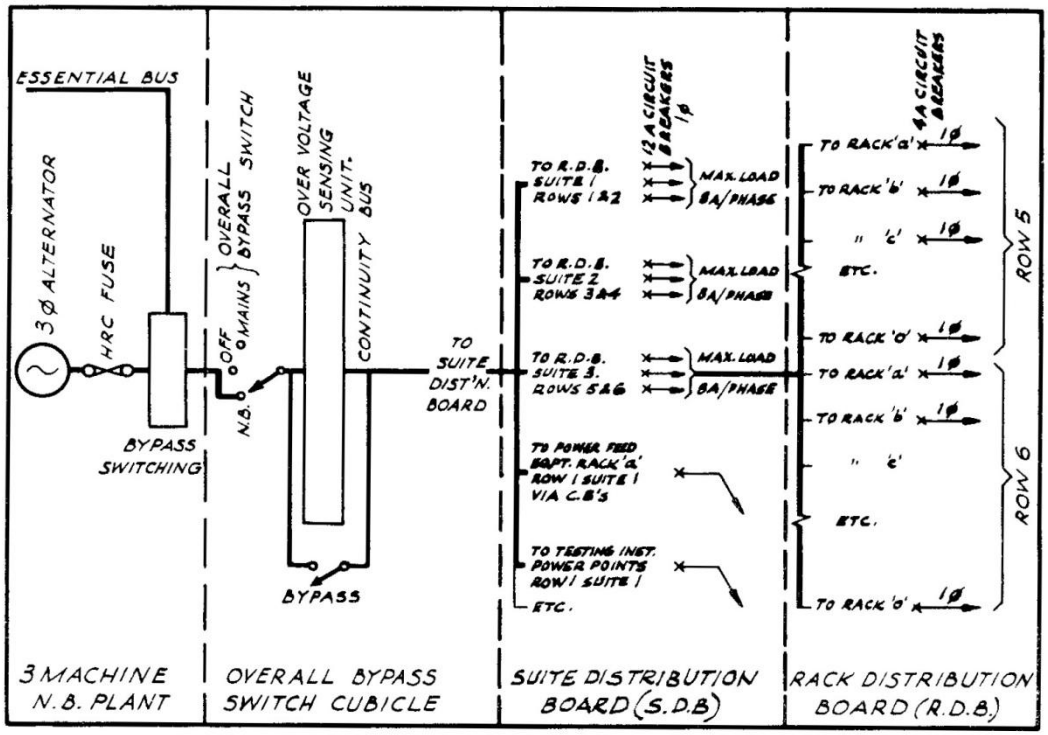

FIG. 3. DISTRIBUTION SCHEME – MEDIUM SIZE INSTALLATIONS (3 MACHINE).

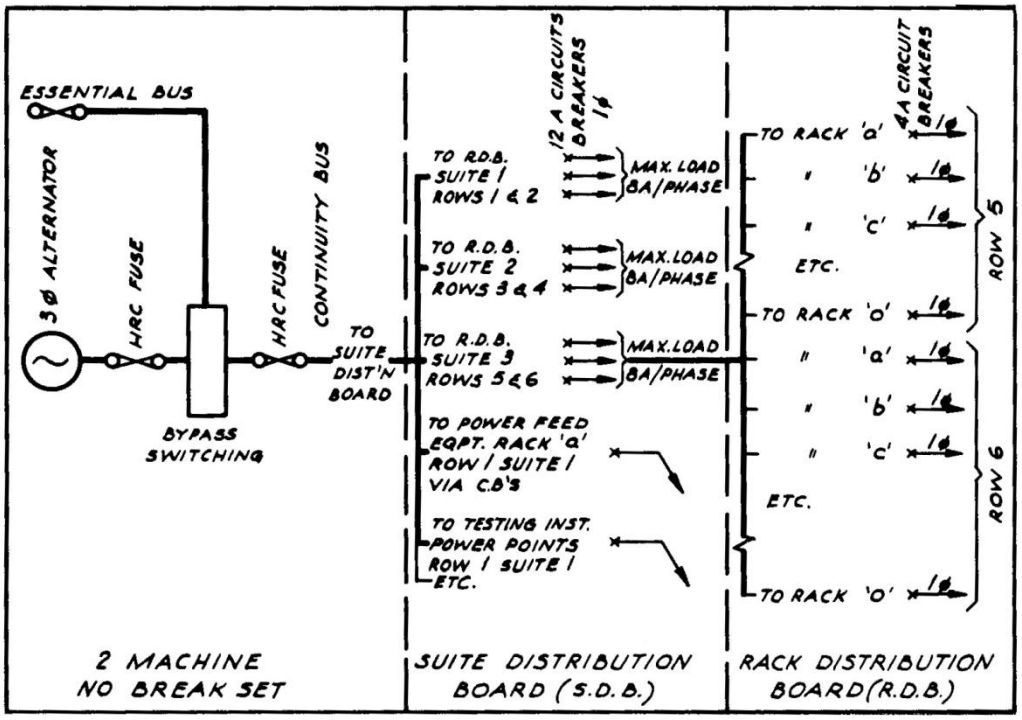

FIG. 4. DISTRIBUTION SCHEME – MEDIUM SIZE INSTALLATIONS (2 MACHINE).

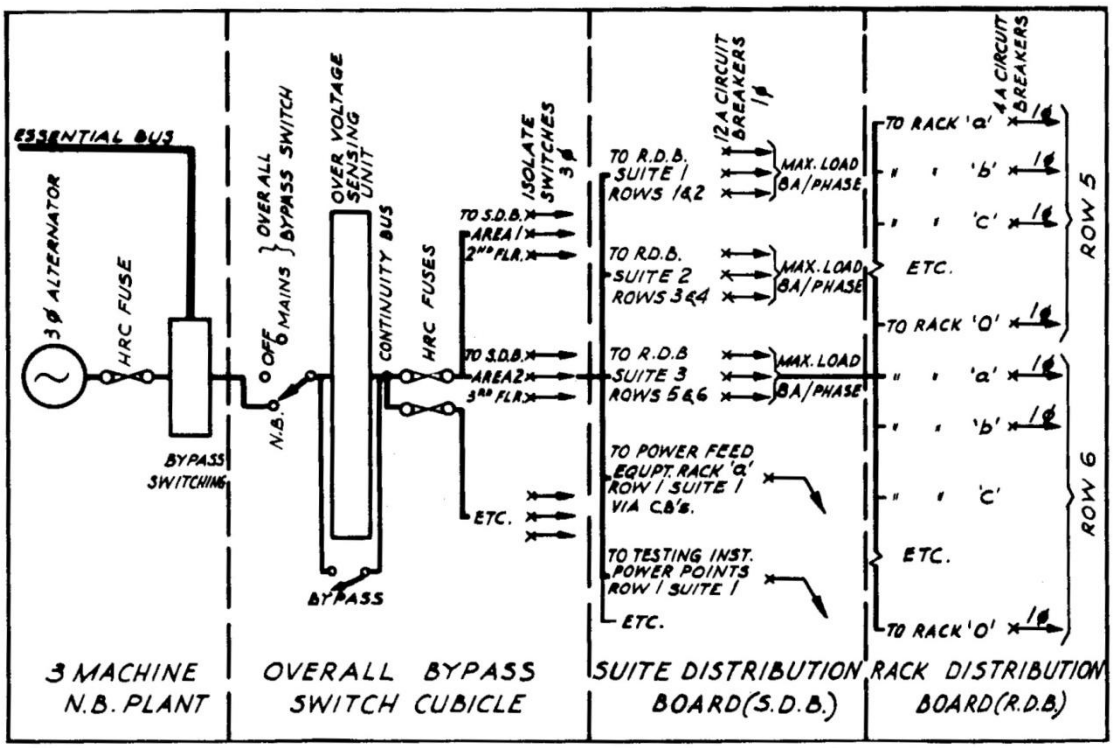

FIG. 5. DISTRIBUTION SCHEME – LARGE INSTALLATIONS (3 MACHINE).

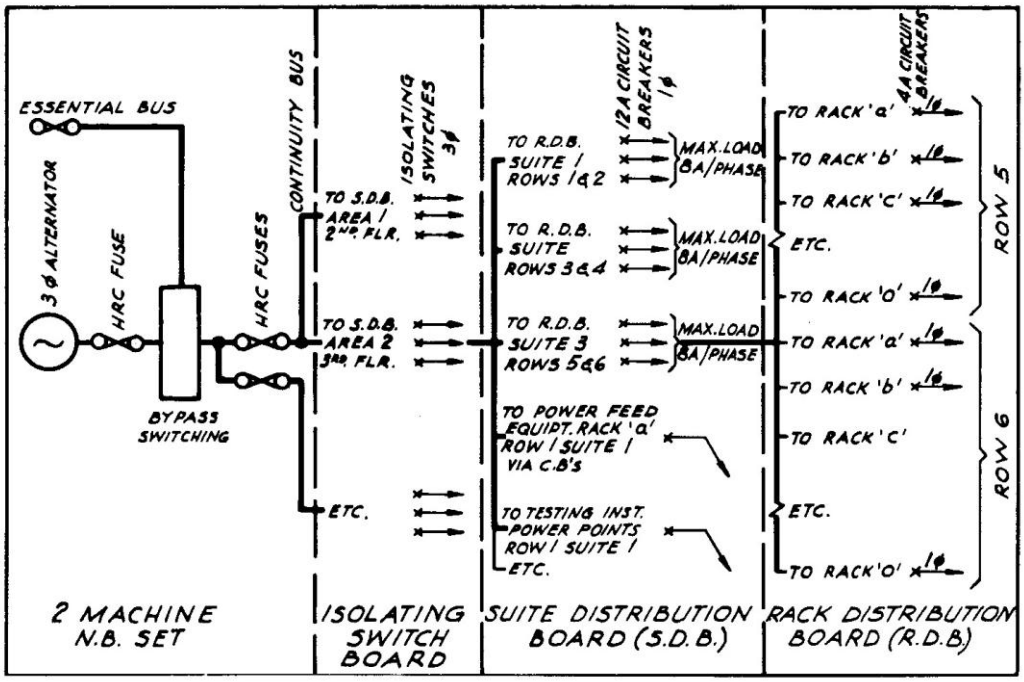

FIG. 6. DISTRIBUTION SCHEME – LARGE INSTALLATIONS (2 MACHINE).

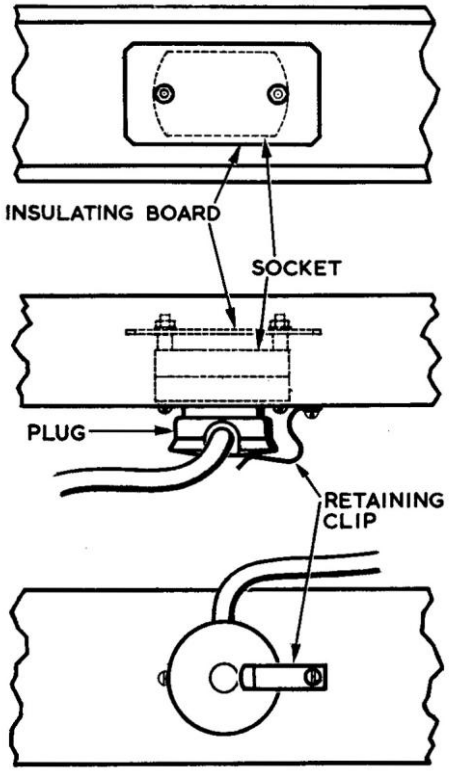

FIG. 7. POWER OUTLET DETAIL.

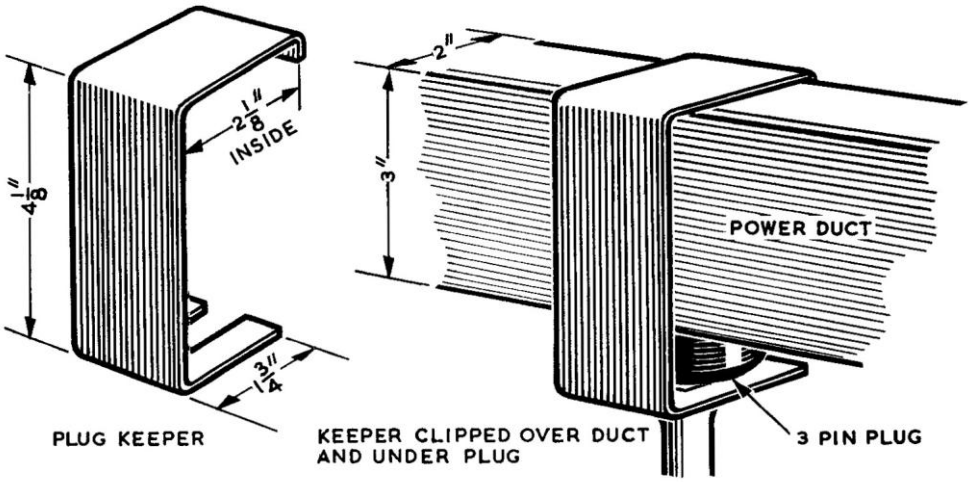

FIG. 8. POWER PLUG KEEPER. FOR CENTRE ENTRY PLUG.

END.