MAIN BUS-BAR SYSTEM INSTALLATION

This E.I. describes the methods of joining, positioning, handling and fixing main aluminium or copper bus-bars in power and battery rooms, through floors and in equipment rooms.

The work involves a comprehensive drafting outline of the configurations of the building and floors involved. Supporting fixtures may require either pre-fabrication or manufacture and assembly on the job.

See also E.I. INTERNAL PLANT INSTALLTION Practice P 3010 for details of fittings etc.

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1. GENERAL.

1.1 To install bus-bar efficiently it is essential to have:-

(i) Bending jigs.

(ii) Heating ovens to soften the bus-bar material.

(iii) Drilling jigs.

(iv) Surfacing equipment.

1.2 Where possible a survey should be made of the bus-bar route and drawings prepared. All lengths of bar can then be cut and bent in the Workshops, and suitable fittings manufactured to support the bars.

1.3 In cases, where a drafting survey for Workshop practices has not been arranged, reference points must be fixed so that the fittings and bus-bar sections can be measured and prepared on the job. All preparatory work must be done before lifting the bars into position. This obviates removal and the need for a second lift.

2. FIXING METHODS.

2.1 Due to the weight or length of the bus-bars and the positions in which these may be run, special fittings may have to be manufactured; these fittings will generally be used only as a support for standard clamps or supporting arrangements.

2.2 Under Ceilings. Where bus-bars are supported from the ceiling wooden beams must be laid across the ceiling joints and tie rods or angle-iron used to support the bus-bar fittings as in Figs. 1 and 7. Typical fittings used to hold the bars onto the supports are in Figs. 8 and 9.

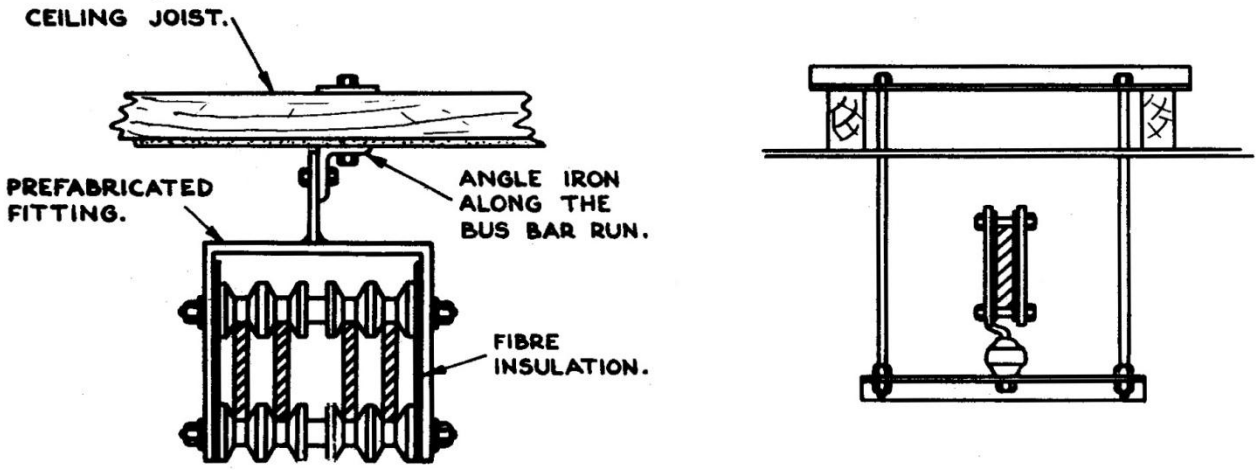


FIG. 1. SUPPORTING BUS-BAR FROM CEILING.

2.3 On walls; vertical run. The method in Fig. 2 may be used where the weight of the run is taken above and below the fitting which is used to keep the bars spaced and rigid.

On walls; horizontal run. The method in Fig. 3 can be used where a bus-bar installation is to run parallel and close to a wall.

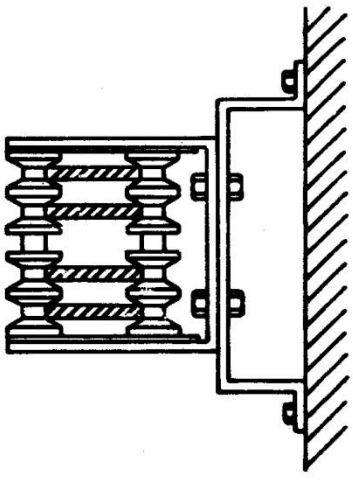


FIG. 2. FIXING BUS-BARS TO WALL. PLAN VIEW. (NOTE: Weight not taken by fitting.)

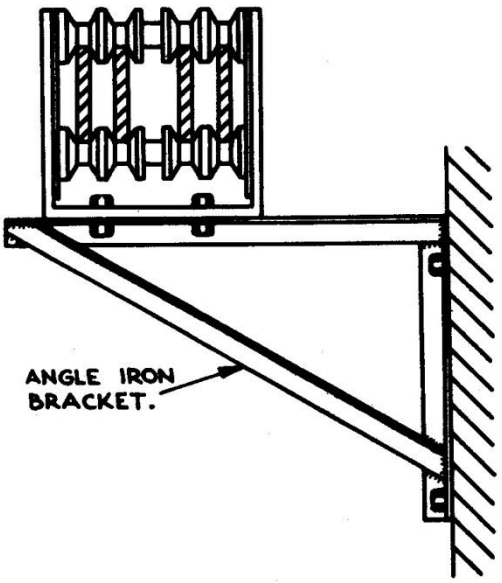
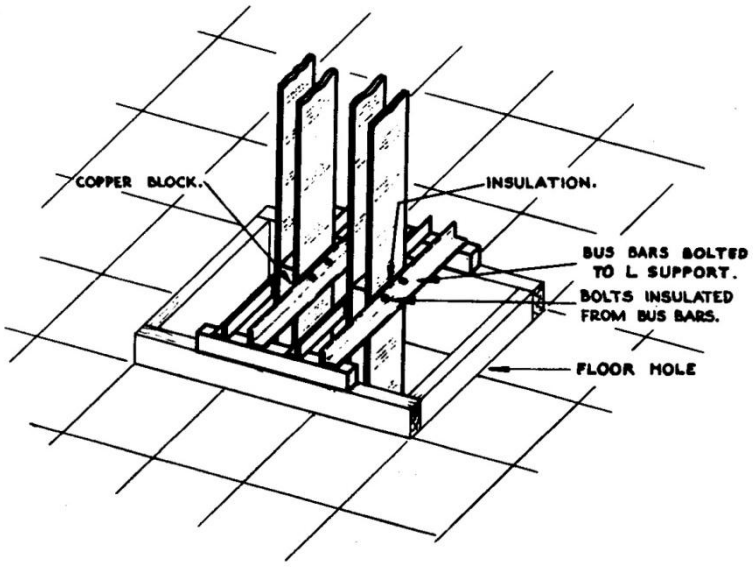


FIG. 3. SUPPORTING BUS-BAR FROM A WALL.

2.4 Through Walls. A method of supporting a large number of heavy section bus-bars is shown in Fig. 10.

2.5 Through Floors. Bus-bars may be bolted through and fixed to angle-iron supports laid across the opening. It is necessary to insulate the bus-bars from the angle-iron so that these supports are not "live". This arrangement is shown in Fig. 4 (a).

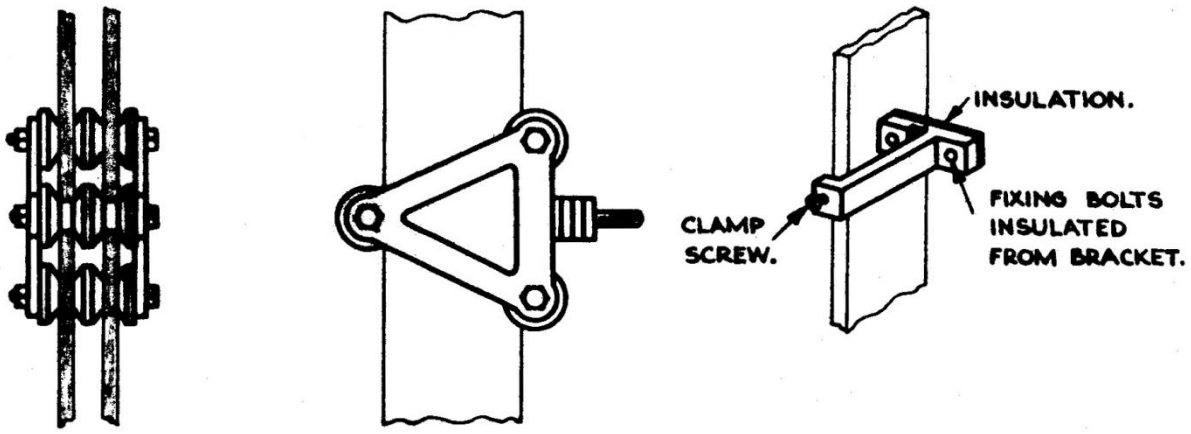


(a) Supporting Bus-Bars through a Floor.

Long vertical runs Of bus-bar will require the provision of adequate supports to overcome sagging and to distribute the weight throughout their length.

Figs. 4 (b) show methods for supporting bus-bars.

Protection against damage in open areas. Where bus-bars pass through floors, it may be necessary to provide for barricades to be built up to 6' from floor level to act as a protection against short circuiting or earthing of leads.



(b) Clamps used on long Vertical runs to distribute the weight.

FIG. 4. BUS-BAR CLAMPS AND SUPPORTS.

2.6 Support from Concrete Slabs. Tie rods must be fixed to the slab as shown in Fig. 5. The top plate is bedded in the floor surface and filled in to retain a level surface for the floor covering.

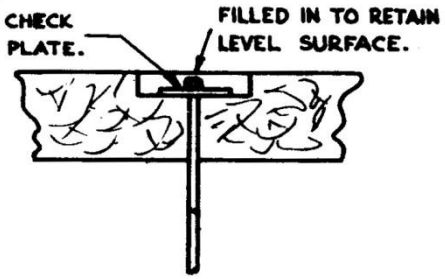
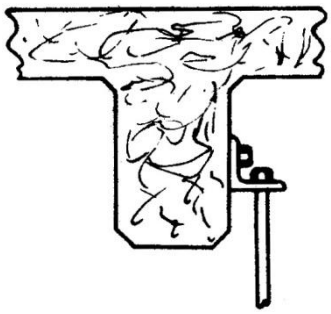
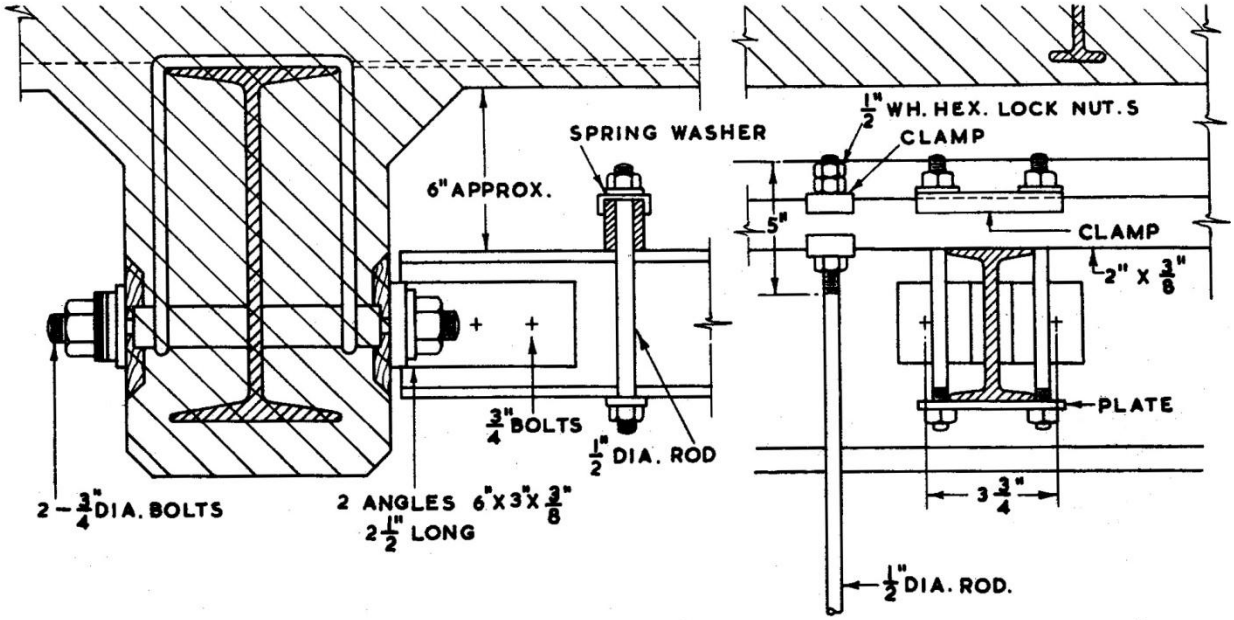


FIG. 5. SUPPORT FROM CONCRETE SLAB.

2.7 Support from beams or between beams. Side support may be arranged as in Fig. 6 (a). Fig. 6 (b) shows how brackets may be supported between beams by erecting auxiliary beams.



(a) Side of beam support.



(b) Between beams by the erection of auxiliary beams.

FIG. 6. SUPPORTING BRACKETS FROM AND BETWEEN BEAMS.

Where necessary arrangement should be made during the design of the building for the drilling of structural members for the fixing of a support as shown in Fig. 6.

2.8 In power rooms. Where a large number of bus-bars of various potentials are being installed, it may be necessary to manufacture welded structures to support the bus-bars. Typical instances are shown in Figs. 11 and 13.

2.9 The methods of treatment for holes and chutes in walls and floors, through which bus-bars may pass is described in E.I. INTERNAL PLANT INSTALLATION Practice T 3010.

3. TEMPORARY SUPPORT WHILST FIXING.

3.1 Make use of any aids which will assist the manoeuvring and supporting of heavy or long lengths of bus-bars while the fixing arrangements are being secured. Such aids are:-

Rope, pulley blocks and tackle.

Boards placed across the top of other equipment (racks, runway, etc.) on which the bars may be laid prior to the final lift into position.

Scaffolding for lifting up in steps, thus avoiding possible danger to staff due to a bar falling any considerable distance.

3.2 Lengths of bus-bar must be kept as near horizontally as possible when being raised into position with a sling. Take precautions so that the bar will not slip out of the sling in the event of one end of the bar being raised before the other. (See E.I. INTERNAL PLANT INSTALLATION H I010.)

When lifting bars by hand, take care to see that the man at the lower end does not take the full weight of the bar if it is tilted.

3.3 Sufficient bolts must be placed in position on the fittings so that immediately the bar is raised into position, nuts may be fitted. The weight must be taken on the supports.

4. JOINING METHODS.

4.1 The two methods of joining main bus-bars are by:-

(i) Clamp Fittings.

(ii) Bolts.

Clamps are preferred but in confined places, they create a congested appearance. Fig. 12 shows clamps behind a power board where there is ample space between the various bus-bars.

Bolts necessitate drilling the bus-bars with the result that the area of cross-section is reduced.

Fig. 13 shows an instance where bolts have been used to avoid a congested appearance as would be the case if clamps had been used.

4.2 All fixings to power boards must be bolted connections either by:-

(i) bolts and lock-nuts forming part of the switch gear, or

(ii) neatly arranged bolts to other terminating equipment such as earth bars and shunts.

All drillings in bus-bar for jointing purposes must be made with a drilling jig to permit the true centreing of the various holes.

Note that copper is a difficult metal to drill because the drill tends to "wander" and if not prevented the holes may require filing to allow the insertion of the fixing bolts.

4-3 All bus-bar areas to be jointed must be treated to remove oxidisation and to provide a true and flat surface. These surfaces must not be burnished. The lowest joint resistance is obtained when a slightly roughened but true face permits an interlinkage of the copper or aluminium under compression.

4.4 When bus-bar is prefabricated in the Workshops all surfaces to be joined must be machine finished and the ends so treated covered with

(i) vaseline to prevent oxidisation,

(ii) bagging to prevent damage to surfaces during transport and storage.

4.5 A machine process must be used when the power bus-bar assembly is manufactured on the installation and a large quantity of copper or aluminium bus bar is to be surfaced.

4.6 In smaller installations the surfacing must be done by draw filing using a vaseline paste to avoid scoring of the surfaces.

5. SHEATHING AND INSULATING METHODS.

5.1 Main bus-bars are insulated by one of the following types of insulation:-

Porcelain supports.

Insulating washers, ferrules and plates.

Plastic sheathing.

Cardboard sheathing and tape insulations.

Spraying and painting of enamel or coloured rubber solution.

5.2 Porcelain supports are used between the bus-bars and the iron frame-work of the fittings to space and keep the bus-bars rigid.

5.3 Fibre is used for ferrules, washers and plates on the fittings for the negative bus-bar to insulate any bolts or brackets, etc. which support it.

5.4 Sheathing (plastic or cardboard) is used on the negative bus-bar to insulate it throughout its length.

Plastic sheathing on large section bus-bars is provided by:-

(i) Spraying; or

(ii) arranging for the dipping of the bar into a bath of the covering material

(iii) tubing.

The spraying and dipping processes are done by the manufacturer and it is necessary to remove the sheathing wherever a joint is to be made. This can be done by cutting the sheath to the outline of the joint and then peeling off that portion not required.

Cardboard sheathing is used only when using up existing stocks of uncovered bus-bars.

Plastic tubing used to insulate bus-bars must provide a tight fit on the bar. Tubing should be placed on bus-bars only after first immersing it in a heated dilating fluid, and (where possible) after the bus-bar has been heated in a water bath. This is generally done at installations.

6. BUS-BAR INSTALLATION IN BATTERY ROOMB AND POWER ROOM.

6.1 Battery Rooms. Where possible, bus-bar installation in a battery room must be finished before setting up of the battery.

When it is necessary to install the bus-bar after the setting up of the battery, take care to prevent any material such as iron or copper filings or fittings falling into the cell containers or onto the top of the battery plates. Take care also to prevent paint falling into the containers when the bus-bars are painted. Tarpaulins, free of dust, must be placed over all the glass or wood containers. When drilling bus-bars or walls in the battery room, all waste material must be collected in a hanging cardboard box or a cloth. When drilling is done the cloth must be folded so as not to drop any of the material which it has collected.

Metal scaffolding must be insulated to prevent electrical contact with any cell or live battery bus-bar.

Fig. 14 shows a typical bus-bar installation in a battery room.

All bus-bar joints must be sealed against acid spray. This is generally done by the use of bolted connections, which must be painted with an acid resisting coating. The junctions between the copper bus-bar and the lead connecting plate must be sealed with vaseline.

6.2 Power Room. In setting up the bus-bar in power room areas take care to:-

Provide adequate scaffolding.

Place cover sheets over all. live equipment.

Avoid contact with live equipment either commercial supply or other exchange services.

Avoid a change in orientation of the bus-bar when placing long lengths in position.

Take special precautions when working over rotating machines to prevent iron, aluminium or copper filings or fittings falling into these machines.

Most of these problems will be overcome by erecting scaffolding and providing cover sheets. All supporting frames etc. must be firmly fixed in their true positions and no support should be free to move. The firm fitting of all supports will lessen any likelihood of damage to equipment or injury to staff during the operation, due to the bus-bars being displaced. The prefabrication of all bus-bars before erection eliminates the trial and error fabrication on-the-job method during which most of the damage to bus-bars is done.

7. FINAL APPEARANCE.

7.1 Take care during installation to avoid damage to the bus-bars fittings and insulation.

7.2 Insulation Material. Porcelain insulators are easily chipped and the bolts holding these must not be over-tightened.

Fibre insulation must not be subjected to strain. If washers and ferrules are cut out on the job take care to see that their dimensions are true, that they are neat in appearance and have clear cut edges.

Protect plastic or cardboard sheathing from cuts and abrasions and thus avoid otherwise unnecessary repairs to bring the appearance up to the required standard.

7.3 Fittings. All iron fittings and bolts must be painted grey (colour 832).

7.4 Bus-bar. All bus-bars and joints must be painted with the appropriate colour according to their potential.

8. NEW PRACTTCES.

8.1 New Practices:- A practice now being developed for the installation of bus-bars, to reduce the impedance of power leads will be described in an interim E.I. to be issued. In this method the bus-bars are installed, parallel and near to each other. The +ve bar is separated from the -ve bar by an insulating material of minimum thickness and slightly wider than the bus-bar. This arrangement is continued throughout the entire length of the main and sub-main feeders. As a result the methods for jointing and the supporting brackets differ from those described in this E.I.

8. TYPICAL BUS-BAR INSTALLATIONS. Typical installations are shown in the following pages.

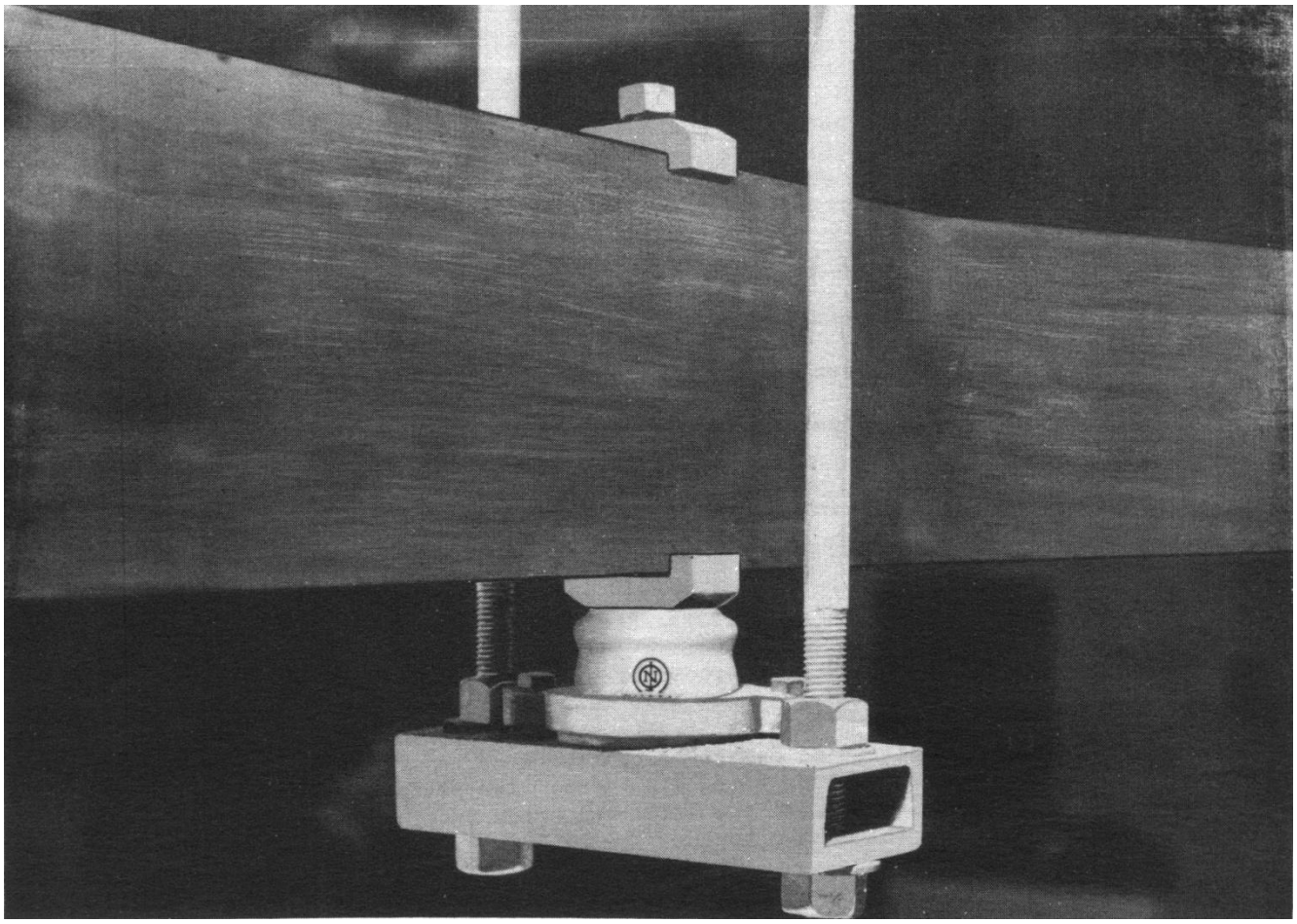
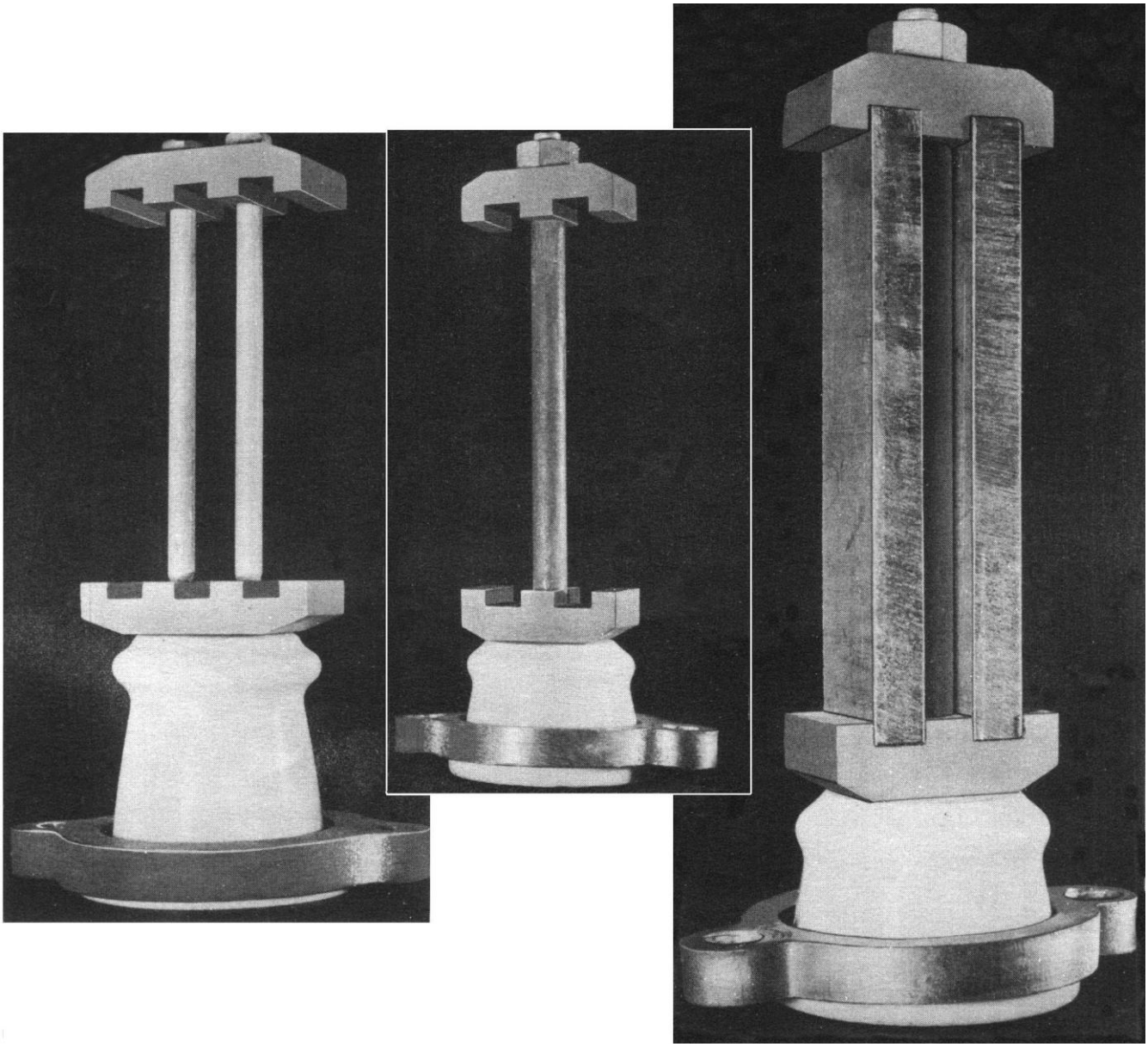


FIG. 7. BUS-BAR SUPPORTED FROM CEILING.



FIGS. 8 AND 9. INSULATED BUS-BAR SUPPORTS.

(Showing method of holding bus-bar.)

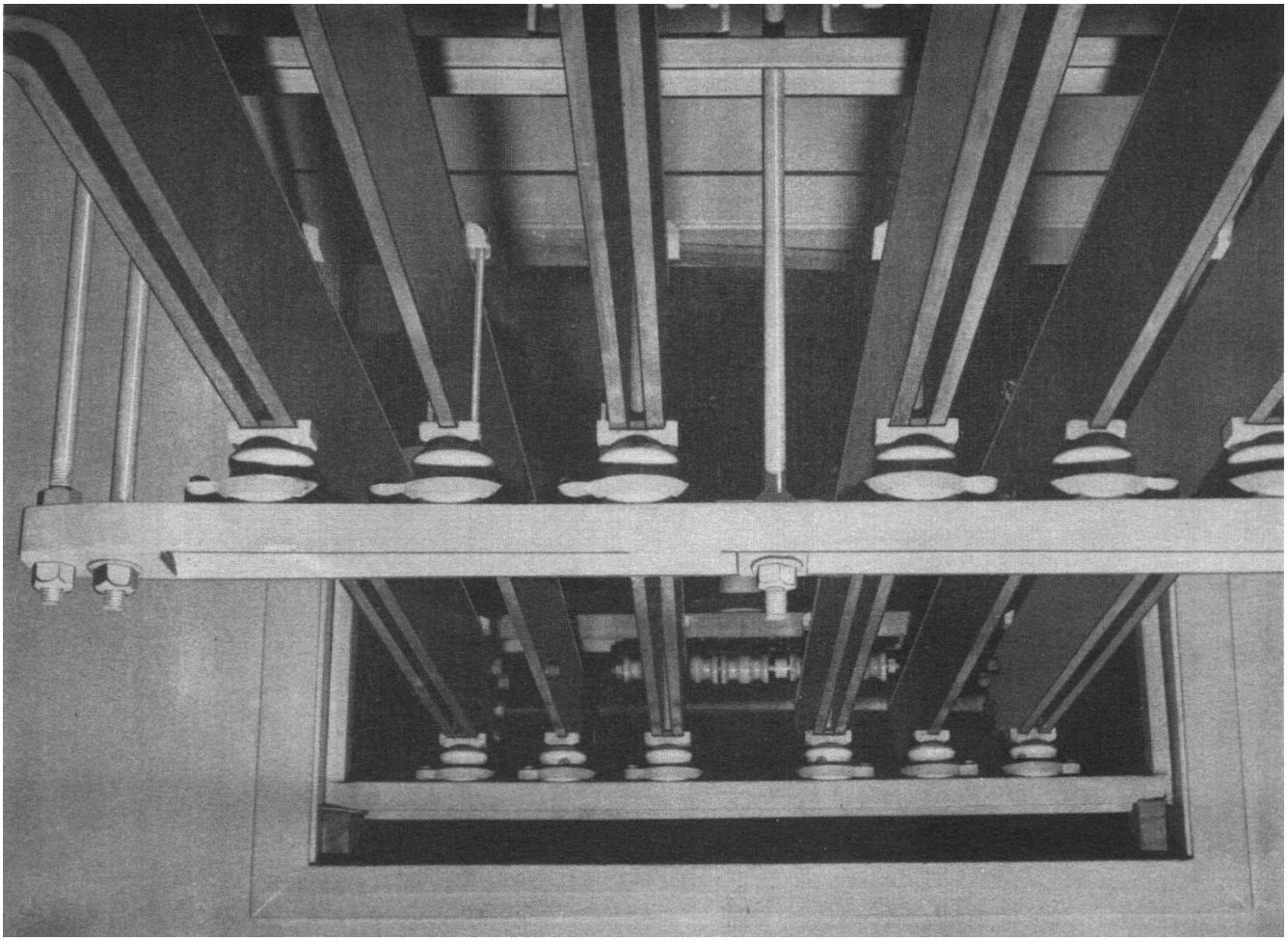


FIG. 10. HEAVY SECTION BUS-BARS PASSING THROUGH A WALL OPENING.

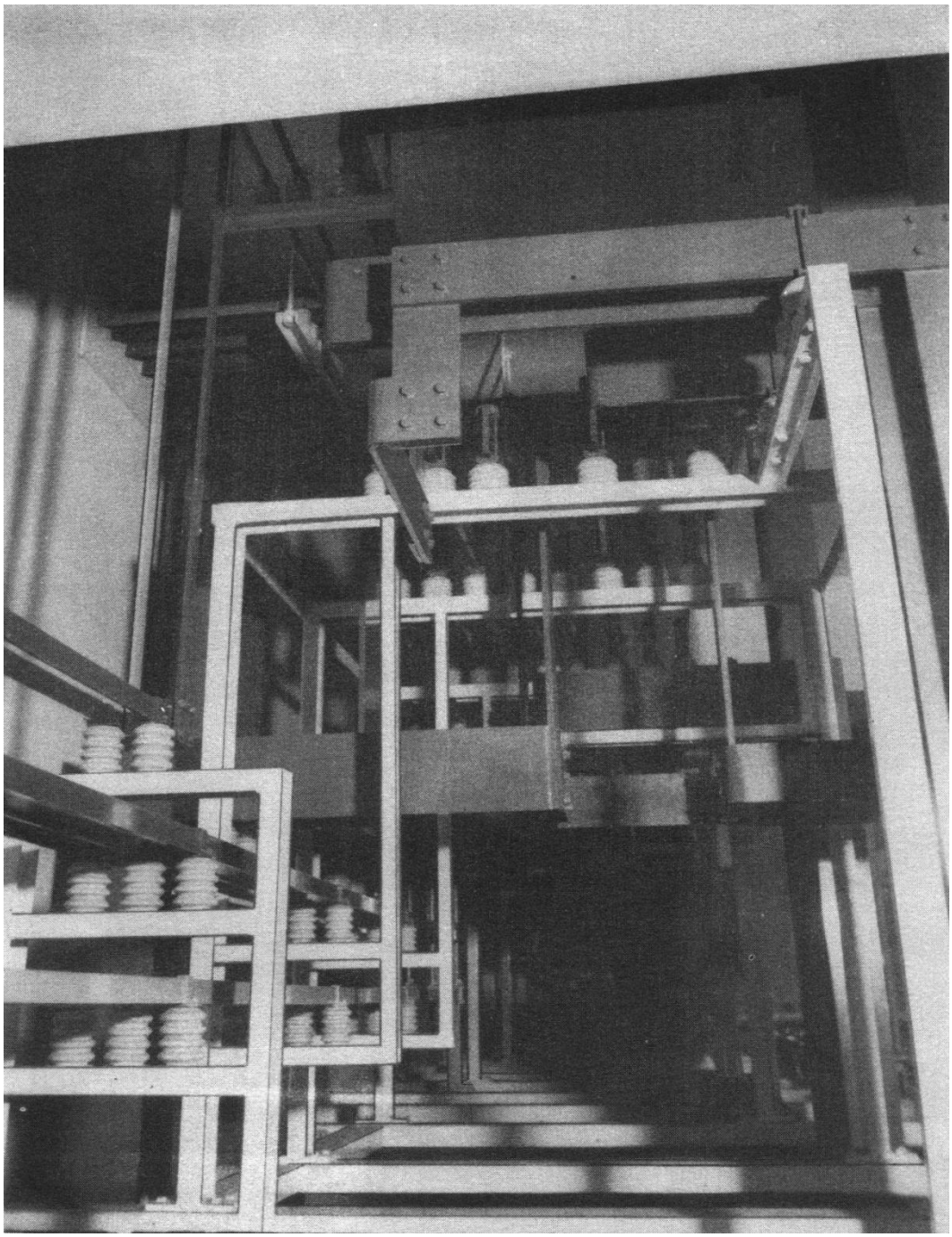


FIG. 11. WELDED STEEL STRUCTURE USED TO SUPPORT BUS-BARS.

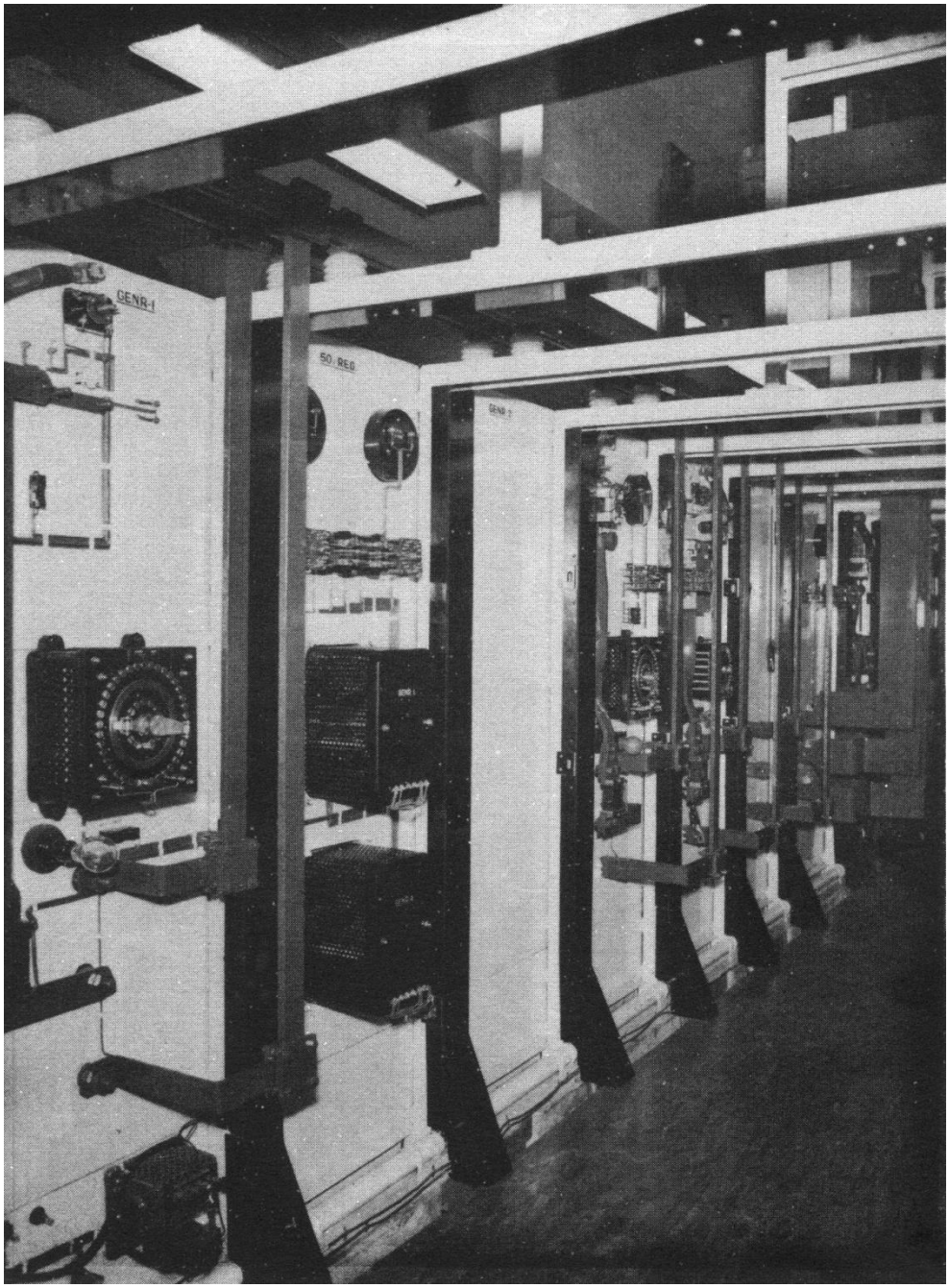


FIG. 12. REAR VIEW OF POWER BOARD SHOWING BUS-BAR CLAMPS.

Note:- Channel iron supports shown in Fig. 12 should be replaced by angle iron. Any surplus wiring such as shunt leads, etc. should be taken to the base of the panel and the slack taken up in a suitable boxing.

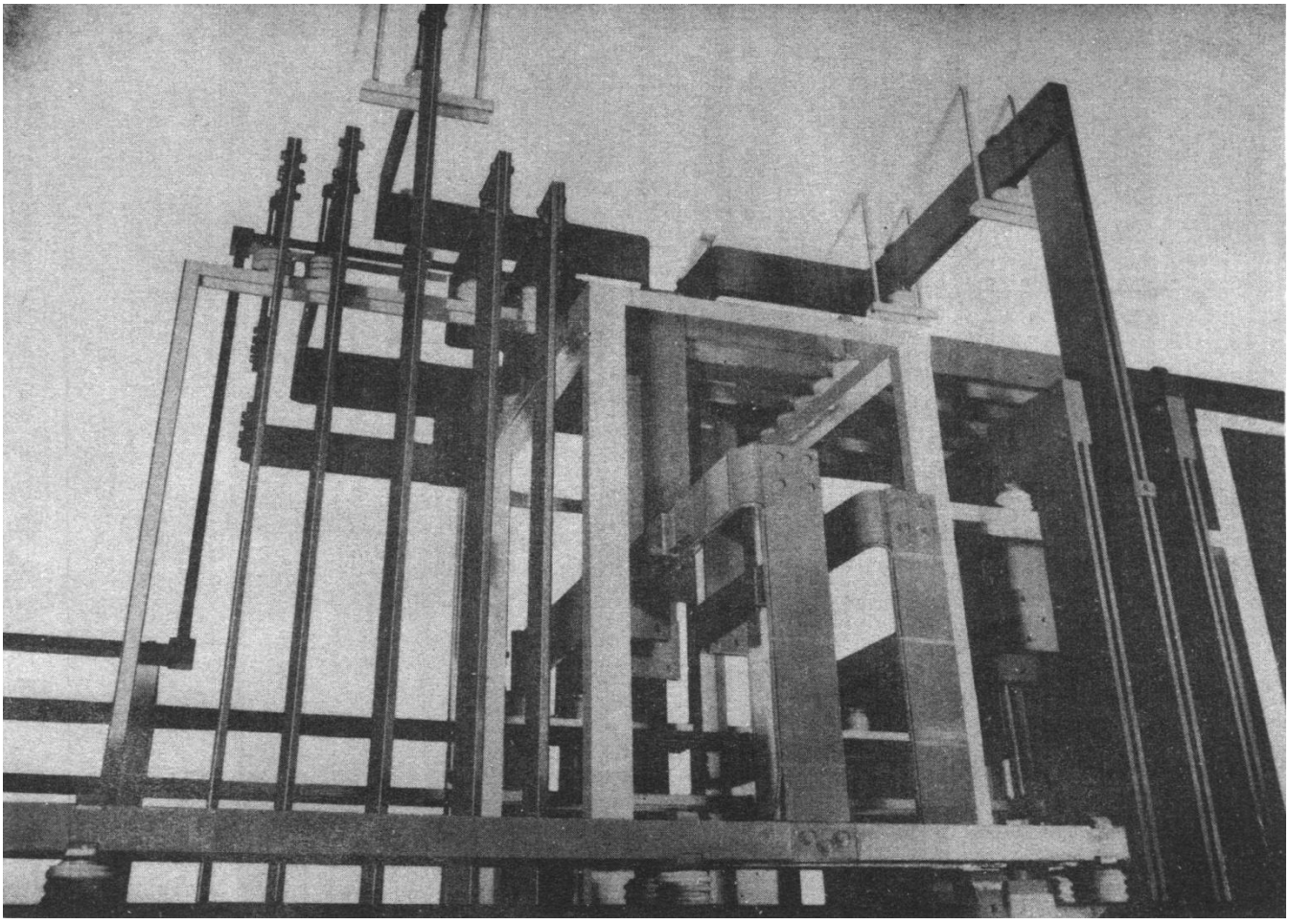


FIG. 13. BUS-BAR INSTALLATION USING BOLTED JOINTS.

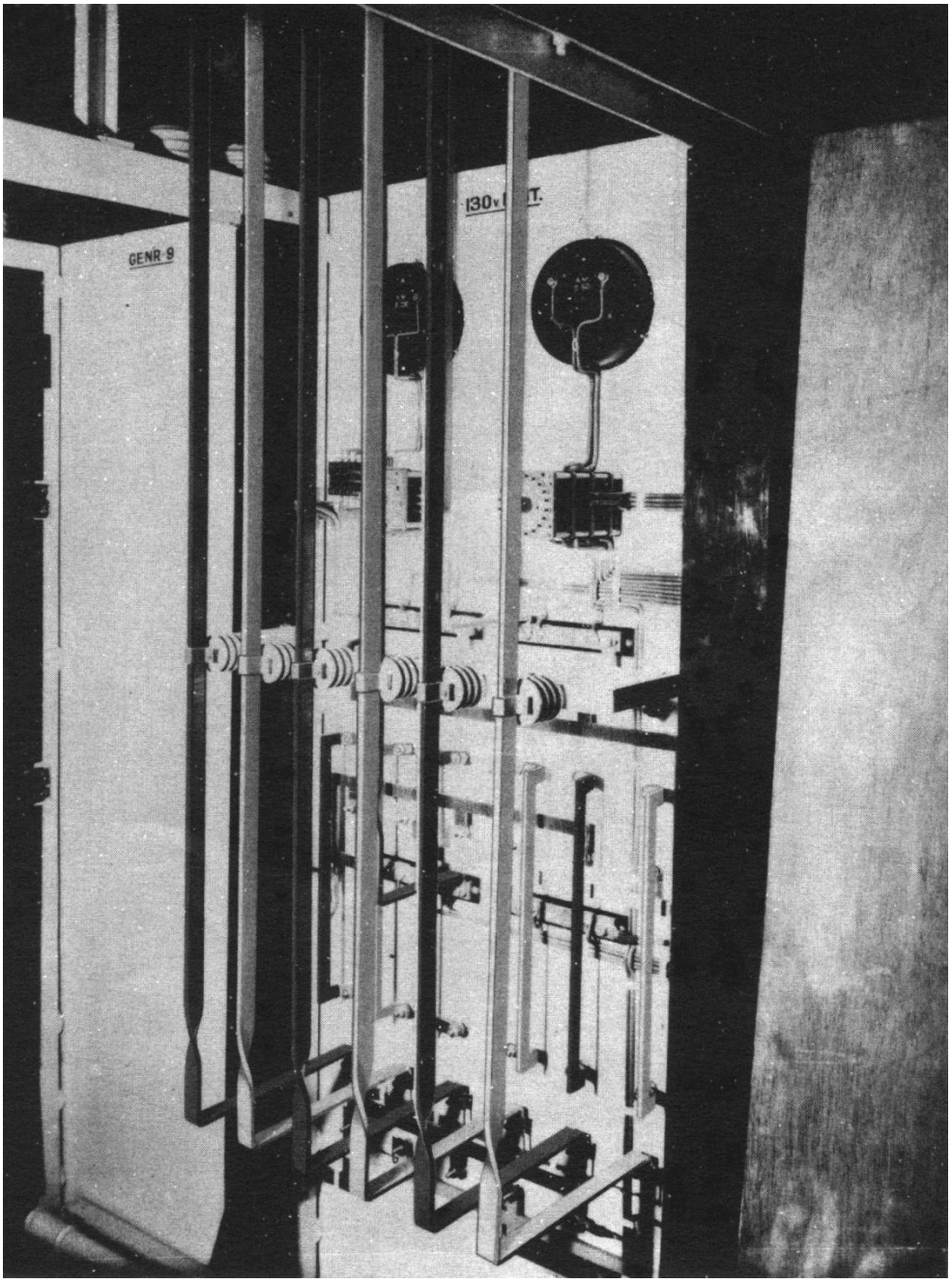


FIG. 14. REAR OF 130 VOLT POWER PANEL.

Note 1:- Note that a change of direction is obtained by twisting and bending of each bar. The use of Clamp Fittings is obviated.

Note 2:- Main bus-bar for the 130V. supply are generally lighter than those for 50V. and 24V. Distribution and may be installed at the power board as shown.

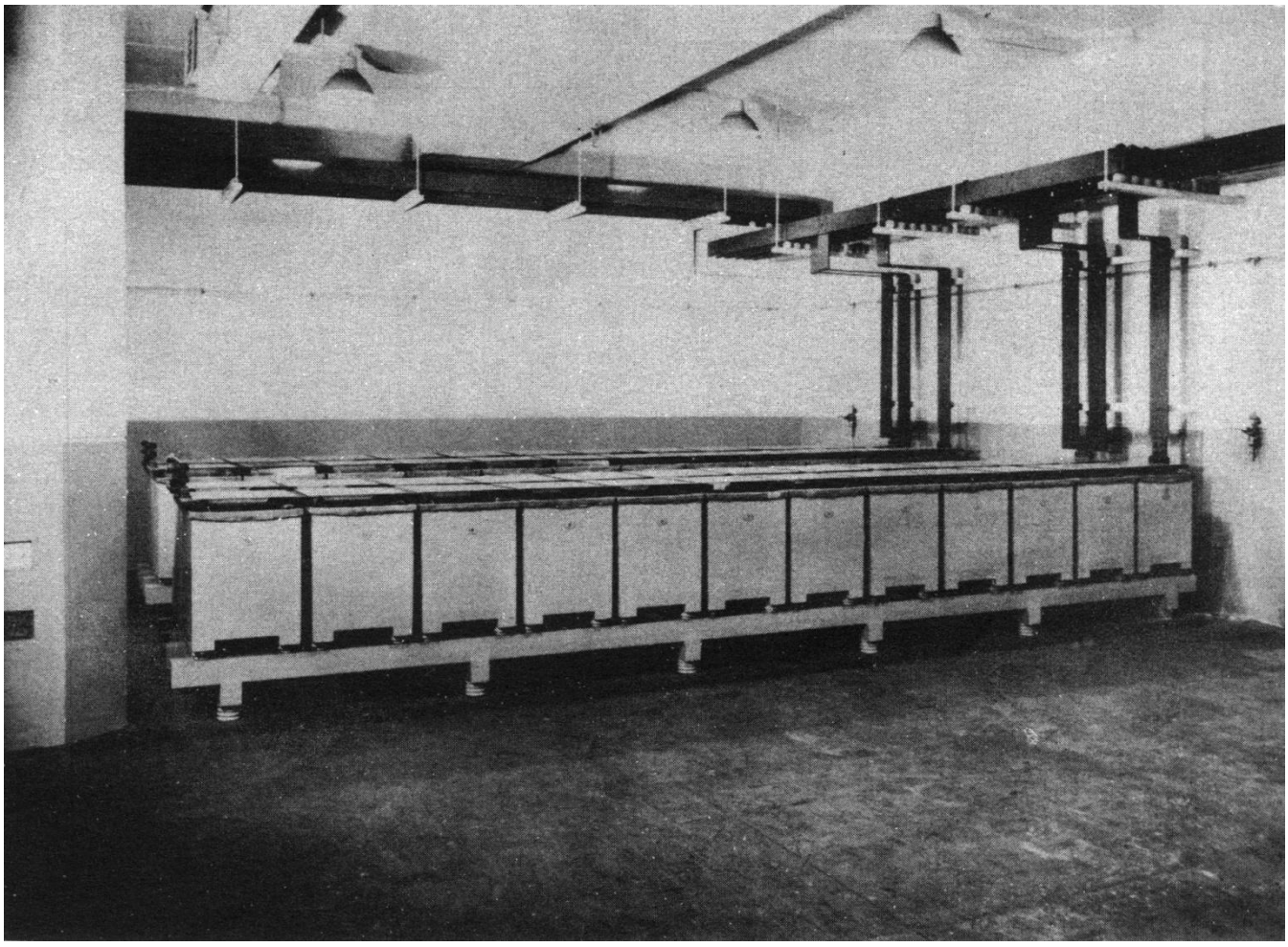


FIG. 15. TYPICAL BUS-BAR INSTALLATION IN A BATTERY ROOM.

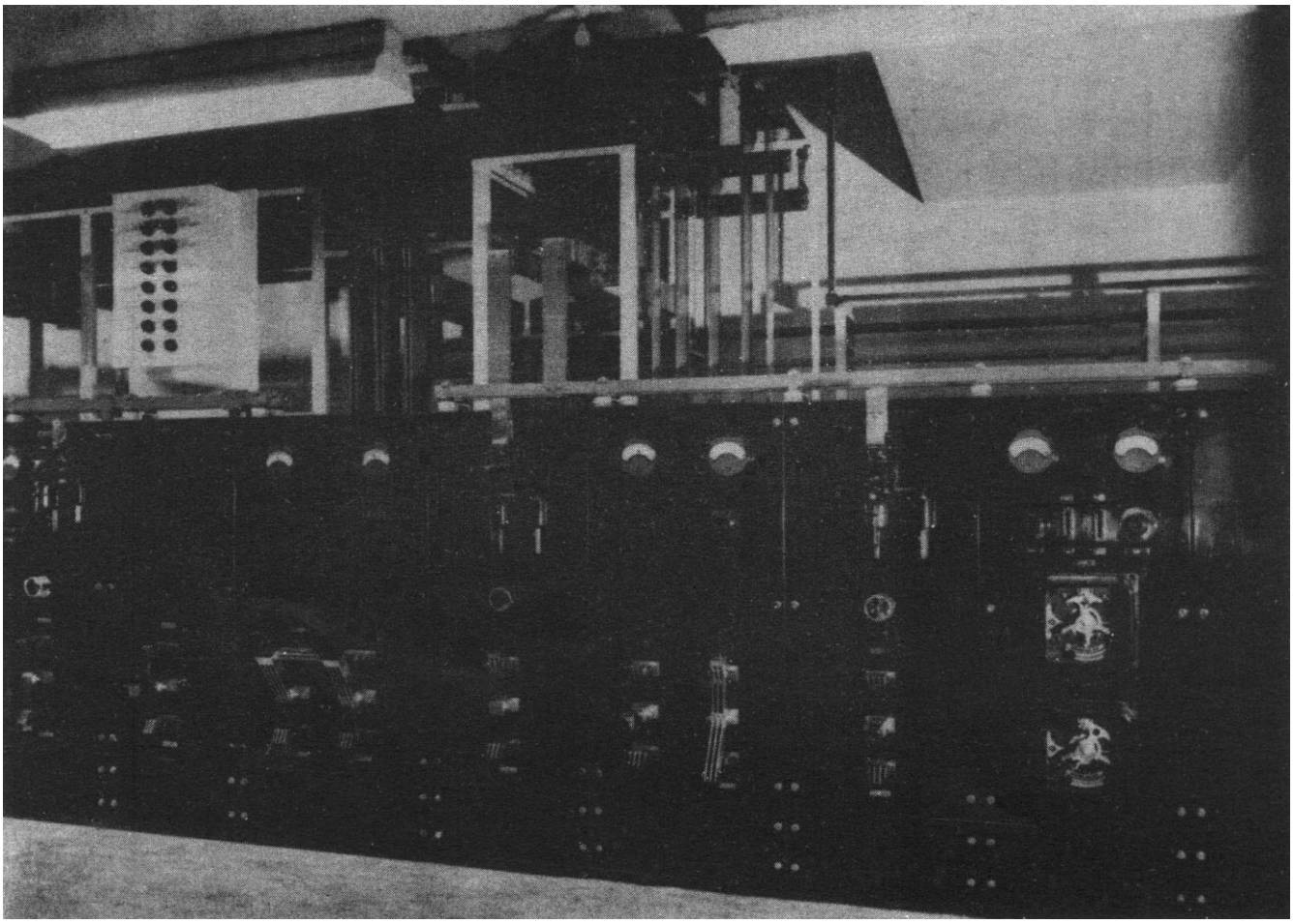


FIG. 16. TYPICAL POWER ROOM INSTALLATION.

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