COMMONWEALTH OF AUSTRALIA

POSTMASTER-GENERAL'S DEPARTMENT

INSTALLATION CIRCULAR No. 4

[Distribution List H—(less Draftsmen, plus Chief Draftsman)—Serial No. 21.]

Installation Procedure for Subscribers' Telephone Facilities

TEXT AND DRAWINGS

Chief Engineer's Branch,
Postmaster-General's Department,
Treasury Gardens,
MELBOURNE, C.2.

Approved—
J. M. CRAWFORD,
Chief Engineer.
30/11/1954

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(DISTRIBUTION LIST "H"—LESS DRAFTSMEN PLUS CHIEF DRAFTSMAN—SERIAL No. 21.)

INSTALLATION PROCEDURE FOR SUBSCRIBERS' TELEPHONE FACILITIES.

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INSTALLATION CIRCULAR No. 4.

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AMENDMENTS.

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1				
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INSTALLATION CIRCULAR No. 4.

INDEX TO TEXT.

INDEX TO TEXT—*continued.*

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INDEX TO TEXT—*continued.*

SECTION 1.—GENERAL.

1. CANCELLATION.

1.1. The following are hereby cancelled :—

Engineering Circulars Nos. 43, 59, 93, 105, 150, 262, 278, 350, 361.

Engineering Memoranda Nos. 38, 84, 91.

1.2. E.I. No. 2, portion of which relates to the matters covered in this Circular, will be cancelled by separate Instruction.

2. PURPOSE OF INSTRUCTION.

2.1. This Circular relates to the material to be used and the methods to be adopted in subscribers' premises in installing subscribers' telephone facilities.

3. APPLICATION.

3.1. The existing equipment, cabling or wiring, is not to be altered to bring it into line with the standards covered by this Circular, unless extensive alterations are being effected, when, under the direction of an Engineer, working tending towards standardization may be carried out if economical and desirable from the viewpoint of elimination of excessive maintenance costs.

4. STANDARD MATERIAL.

4.1. Purchases of standard material are made collectively for the whole Commonwealth. The basis of the method is that material for telephone equipment purposes is divided into groups ; the items forming one group are related, e.g., receivers, earpieces, diaphragms, &c., and when so grouped are described as a Serial. To quote a definite example, all protective equipment is included in Serial 11, which covers complete protectors of all classes, fuses of all classes, and the components of protectors, such as heat coils, fuses, and arresters required for maintenance purposes.

5. UNSTANDARD MATERIAL.

5.1. On account of diversity of types, no attempt has been made in this Circular to cover features peculiar to the installation of reconditioned unstandard apparatus, but the instructions herein should be used as a basis.

6. OTHER RELEVANT INSTRUCTIONS.

6.1. Works Procedure and Cost Account Instructions.—Mechanics on subscribers' installation work should be acquainted with Section 6 in particular, and Appendices A and B of the above Instruction.

6.11. Officers in control of Installation Centres should be acquainted with the portions of the Works Procedure which deals with Work Order Routine, Stores Routine and Records, the Classified Accounts for Expenditure, Units of work and the instructions concerning Movable Plant.

6.2. Technical Instructions.—All employees concerned with the installation of subscribers' equipment should be familiar with the provisions of the following Circulars :—

G.E.C. 9	..	Protection of Telephone Services and miscellaneous plant.
G.E.C. 13	..	Provision of Power Leads for Private Branch Exchanges.
G.E.C. 22	..	Handset Telephones.
G.E.C. 23	..	Earth connexions at Public Exchanges, P.A.B.X.'s, P.B.X.'s, and R.A.X.'s.
I.C. 5	..	Cabling and Wiring of Equipment. (In course of preparation—30.11.34).
I.C. 7	..	Installation of Public Telephones.
I.C. 9	..	Equipment for Subscribers' Long Lines and Tie Lines. (Not yet issued.)
M.C. 17	..	Automatic Public Telephones, Post-payment Type—Adjustment Data.
M.C. 22	..	Manual Public Telephone Coin Attachments — Adjustments, Methods of Connexion, &c.

7. ORDER FOR WORK NECESSARY.

7.1. In no circumstances shall any installation work, alteration, rearrangement or removal of a subscriber's service be undertaken, unless the mechanic is in possession of a telephone order authorizing the work. Where work, varying that included in an order is required, a written agreement to pay the costs should be obtained from the subscriber, and the officer in control should be consulted by telephone.

7.2. The agreement should take the following general form :—

Address.....

Date.....

Telephone Service (Exch. No.).....

The Deputy Director, Posts and Telegraphs,

Please carry out the following work and charge to (our)/(my) account.

Details of work.....

.....

.....

Signature.....

7.3. The possession of an order number which has been telephoned to a mechanic by the officer in control, will suffice as authority to do the work.

8. SUBSCRIBERS' REQUIREMENTS TO BE MET.

8.1. In the location of equipment, the mechanic should be guided by the desires of the subscriber in so far as they are consistent with the relevant instructions contained in this Circular.

8.2. If for any reason the subscriber's desires cannot be met, the mechanic should explain the reasons, and if mutual satisfaction is not obtained, he should consult the officer in control before proceeding with the work.

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After paragraph 2.1, add the following:—

2.11. The installation of protective equipment in an exchange or in a subscriber's premises also reduces fire risk due to electrical hazards.

9. PROCEDURE IN CASE OF INSUFFICIENT INSTRUCTIONS.

9.1. When a mechanic, after arrival at a job, is in doubt as to the work which is to be carried out, or requires any instructions or information, he should telephone the officer in control for further instructions before returning.

10. INFORMATION TO ASSIST A SUBSCRIBER OR PROSPECTIVE SUBSCRIBER.

10.1. A mechanic executing subscribers' installation work should familiarize himself with the various standardized subscribers' services embodied in Drawing C.609 attached hereto. Particularly in country districts, a mechanic should be aware of the special features and tariffs applicable to the simpler services described in the handbook "Standard Telephone Facilities," so that, if requested, he may be in a position to furnish an approximate quotation. In passing on this information, the mechanic should emphasize that it is subject to confirmation by the Telephone Branch.

10.2. A mechanic should not voluntarily express to a subscriber opinions as to the advisability of changing any apparatus or facility, but where an alteration appears desirable from the viewpoints of economy and convenience to the Department, the matter should be reported in detail to the officer in control.

11. MECHANICS NOT TO BE SENT ON WORK BEFORE ARRIVAL OF APPARATUS.

11.1. It is essential that a mechanic responsible for the installation of apparatus should ascertain definitely before proceeding on his journey that the necessary material for installation is on hand. Should inquiry fail to reveal whether or not the material is available, the advice of the responsible engineer should be sought.

12. DAMAGE AND ACCIDENTS.

12.1. Every possible precaution must be taken to guard against damage to property.

12.2. Any damage to property, whether due to the Department's operations or not, which is caused or claimed to have been caused by the work of a mechanic, or by the wires, fixtures, or other property of the Department, should be the subject of a written report, and be reported by telephone, if practicable. A full explanation must be given in the written report, together with the names and addresses of any witnesses.

12.3. To avoid possible damage by storms, a broken window or skylight should be repaired or secured on the day of the accident.

12.4. When it is necessary to remove a flooring board or manhole cover, or open a trap door, &c., to permit of the running of cable or wire, or to do any other work, the opening must be guarded adequately whilst the work is proceeding, in order to prevent any person from falling into it. If it is necessary to leave the opening for any period, it should be closed either by replacing temporarily the flooring boards, manhole cover, trap door, &c., or by guarding with cases or similar articles which will cover the opening adequately.

13. BUILDING RULES.

13.1. Before starting work in a large building, such as an office building, an hotel, or a large block of flats, the person in charge of the building should be interviewed and informed generally of the particulars of the work to be done. Special rules which exist in any particular building should be carefully observed, unless they appear impracticable, in which case the advice of the officer in control should be sought.

14. PROXIMITY TO ELECTRIC LIGHTING OR POWER DISTRIBUTION RUNS, SPRINKLER OR GAS PIPES.

14.1. Except at a crossing, fixed telephone cabling or wiring shall be not less than 1 inch distant from electric lighting or power cables, conduits, sprinkler or gas pipes. A minimum separation of 2 inches is preferred.

14.2. Where the crossing of these obstacles is unavoidable, one of the methods shown in Fig. 4 should be used.

14.3. When working in a building, a mechanic should keep a sharp lookout for contact or unsatisfactory separation between telephone cables and other services. Where readily accomplished, the fault should be rectified temporarily at the time. The matter should be reported to the officer in control without delay.

15. SCRAP MATERIAL TO BE CLEARED UP.

15.1. Before leaving a subscriber's premises, all ends of cable, wire, and covering or other scrap matter, should be cleared up and an inspection made to see that small tools, staples, screws, &c., have not been left inside equipment.

15.2. When a job is left temporarily, such as for the lunch interval, all scrap and other material should be placed in such a position that no risk of accident exists, due to its presence.

16. VACANT BUILDING NOT TO BE ENTERED WITHOUT PERMISSION.

16.1. If permission from the owner or agent has not been secured, an employee must not enter a vacant or temporarily closed building, to work on, or remove, the telephone service. Obtaining entrance to a building through a window, or by any means other than the regular entrance, is not permitted.

17. NUMBER OF MEN ON JOB.

17.1. Only the minimum number of employees should remain on a subscriber's premises to perform the work required. If, during the progress of work, any reduction in staff appears desirable, it will be the duty of the senior man to instruct the surplus staff to report to the officer in control for other duty.

18. CONDUCT AND GRADE OF WORKMANSHIP.

18.1. While working in a building or public place a mechanic should conduct himself in such a manner as to give no cause for public complaint regarding slow or objectionable methods of work. The wiring and equipment in a subscriber's premises comes more directly under the observation of members of the public than does any other portion of telephone plant.

18.2. All installation work shall therefore be effected in a smart, workmanlike manner, and the co-operation of each officer is sought in the direction of avoiding discredit to the Department, which must result from careless and unsightly work.

19. TEMPORARY WORK.

19.1. Occasionally it is necessary to leave work unfinished. Temporary or incomplete work on a small job must be avoided whenever possible.

19.2. Except on a lengthy job, such as the cabling of a large building, the subscriber or occupant of the building should be informed of the unfinished condition of the job.

20. APPARATUS LEFT AT PRIVATE PREMISES.

20.1. Departmental apparatus must not be left at a subscriber's or other premises for a lengthy period. Pending installation, or after dismantling, it is sometimes necessary to allow an instrument to remain over-night at a subscriber's premises. The officer leaving it must see that it is placed in the most secure position available.

21. LOCAL PURCHASES.

21.1. Except in a case of extreme urgency, approval should be sought by the mechanic carrying out the work before expense is incurred in any local purchase.

22. TOOLS.

22.1. Tools should be maintained in good condition. They should be used only for the purpose for which they were designed. "Edged" tools should always be kept sharp and the edges or points protected. Broken and unserviceable tools should be replaced. Each screwdriver blade should be correctly shaped, so that the heads of screws will not be disfigured. "Sebco" or similar masonry drills should be returned for reconditioning as necessary.

23. SUFFICIENT MATERIAL TO BE OBTAINED.

23.1. Where practicable, sufficient apparatus and material should be taken from the store at the commencement of the day's work to avoid return trips to the store during the day.

24. SMALL STORES.

24.1. An adequate supply of small stores, such as flat clips, conduit clips, anchoring devices, staples, clouts, tacks, and screws of various sizes should be carried. The smaller items should be kept in, say, tin boxes and not mixed in the bottom of the tool bag.

24.2. Supplies, such as lacing twine, beeswax, and special anchoring devices should be obtained and carried whenever any reason for their use is anticipated.

24.3. Spare heat coils, fuses, and arrester carbons should be carried by the installing mechanic.

25. PAPERS TO BE KEPT TIDY.

25.1. Telephone Orders and other papers of instruction should be kept in a clean condition. If difficulty is anticipated in keeping papers clean, they should be placed in a strong " official " envelope. Entries should be made legibly. Figures on telephone orders should be particularly clear, and correction made by erasing or crossing out the original figures, and not by writing over them.

26. EQUIPMENT TO BE PROTECTED.

26.1. When carried from store to job, equipment should be enclosed securely in a stout sound canvas bag or waterproof cover to avoid damage by dampness.

27. STANDARD EQUIPMENT NOT TO BE ALTERED.

27.1. Alterations to the circuit arrangements or mechanical assembly of standard equipment must not be made without approval of the Engineer concerned. When circuit alterations are approved, the mechanic is responsible for ensuring that an amended or new circuit diagram is placed in the equipment.

28. SUBSCRIBERS' APPARATUS CARDS.

28.1. A card (Form E.M. 23) should be provided in each subscriber's telephone, subscriber's P.B.X. and public telephone, and appropriate entries inserted on the card in the positions set apart for exchange name and subscriber's number and name. In addition, the date of installation, the word " installed," and the initial of the installing mechanic should be placed in the appropriate columns.

28.2. Should a protector or equivalent terminal be difficult to locate due to concealed wiring, or for any other reason, the installing mechanic should place on the card a brief note to indicate the position.

29. BATTERIES.

29.1. Dry cells shall be installed in a vertical position with terminals on top. They should not be installed in damp or unusually hot places such as near stoves, radiators, or in direct sunlight, even when in a battery box.

30. BATTERY BOXES.

30.1. A battery box should be located so as to reduce the length of wiring run to a minimum, except that in a residence the box may be located so as to be inconspicuous and not subject to disturbance or damage from the feet of users. If desired, the box may be placed in a cupboard, provided it is accessible and lighting is available for inspection.

30.2. In a location where disturbance is possible, the box should be screwed to adjacent woodwork e.g., floor or skirting. One screw only is necessary, and for this purpose one hole is provided in the back of the standard box, and another in the bottom.

31. FORMING AND TERMINATING CABLES AND WIRES.

31.2. Standard methods of performing typical operations of these types are included in I.C. 5, " Cabling and Wiring of Equipment." The method of terminating in standard distributing boxes is shown in Figs. 10 and 16.

32. PUBLIC TELEPHONE CABINETS.

32.1. The standard public telephone cabinets are as follow :—

Head box (wooden).
Half length (wooden).
Full length (wooden).
Full length (concrete).

33. PUBLIC TELEPHONES.

33.1. The methods of installing the standard manual coin attachment and the standard automatic public telephone are shown in I.C. 7.

33.2. The methods of connexion of manual coin attachments are shown in Fig. 41.

33.3. The method of connexion of a magneto bell to an Automatic Public Telephone is shown in Fig. 40.

G.E.C. 9.—Amendment No. 5. Serial No. 7. C.E.2665/G. 5/8/35.

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After paragraph 8.0, add the following :—

9.0. LOCATION OF PROTECTIVE EQUIPMENT.

9.1. In Subscribers' Premises.—The instructions regarding the location of protective equipment in subscribers' premises are included in Section 4 of Installation Circular No. 4—" Installation Procedure for Subscribers' Telephone Facilities."

9.2. In Small Country Exchanges.—The location of protective equipment in small country exchanges is governed by the following two factors—

9.21. The type of " lead in " employed.
9.22. The type of protective equipment to be installed.

9.3. If the " lead in " from the aerial wire consists of twisted pair insulated outside distributing wire the protective equipment must be installed in an accessible position as close as practicable to the point of entry of the leading in wires. Consideration must be given to the following: —

9.31. The type of protective equipment to be used depends upon the number of pairs of wires led into the premises. Where more than 4 pairs of wires are in use, Protector HC and F.201, together with the required Protector Mounting 0/10 or 0/20, should be fitted. Should the number of lines requiring protection be four or less, individual protectors to S.P.588 should be installed.

9.32. Protective equipment must not be placed so low as to invite interference. An ideal position is about 7 feet from the floor level free from hanging curtains or other inflammable material.

9.33. Wherever suitable, protective equipment should be installed in a weatherproof position on a verandah or porch. Should such a position be unavailable the equipment must be installed on an inside wall in a position designed to reduce the use of covered wire to a minimum.

9.34. A location in which corrosive fumes are likely to be encountered must be avoided. Similarly, a vibrating wall or support must not be used. A damp wall also is an undesirable location, but should its use prove unavoidable, the protective equipment must be mounted on a backboard.

9.4. In cases in which cable " lead in " from the aerial wires is employed the inside protective equipment may be located adjacent to the switchboard or telephone if outside protectors are installed at the junction of the open wires and cable. If outside protectors are not installed, the provision of inside protective equipment must follow the principles mentioned in 9.3.

SECTION 2.—CHARACTERISTICS OF CABLE AND WIRE, STANDARD DISTRIBUTING BOXES AND FRAMES.

1. CABLES AND WIRES.

1.1. General.—Annealed copper conductors are used in all internal cables and wires. Conductors are tinned to facilitate soldering and as a protection against corrosion, particularly where the conductor is in contact with rubber. Brief descriptions and stores titles of the cable and wires generally used are as follows :—

1.2, Cable, C.1, L.C. : 1-pair and 2-pair.—In this cable the conductors weigh 10 lb. per mile, are enamel insulated, given one cotton lapping, then twinned and lead covered. At present this cable is available in 1-pair and 2-pair sizes only. This cable is the standard wiring material for the simpler subscribers' services.

In earlier supplies of 2-pair cable one wire of each pair had a white cotton lapping. Future supplies will have the following colour code :—

Pair 1—Blue with Blue–White mate.

„ 2—Orange with Orange–White mate.

This will assure identification of the " mate " wire of each pair and thus avoid the possibility of " split " pairs. The wire of the pair or pairs which includes white cotton in its lapping should be used for the " A " side of a circuit. (See definition in Section 4a, paragraph 4.)

1.3. Cable, SWBD., L.C. : (Various Sizes).—This cable has conductors of enamelled tinned copper. The conductors are provided with a double silk lapping, and a further single cotton lapping, each successive lapping in the opposite direction. The cable is beeswaxed and lead-sheathed. It is used for terminating twin paper insulated cable in exchanges. Generally the conductors are 10 lb. per mile. The cotton lappings of the conductors are coloured in accordance with the following tables for purposes of identification and methodical terminating. The " mate " wire should be used for the " A " side of a circuit :—

TABLE No. 1.

COLOUR CODE OF CABLES MADE UP OF SINGLE PAIRS.

Pair No.	Column I.—Code Wire.	Column II.—Mate.	Pair No.	Column III.—Code Wire.	Column IV.—Mate.	Pair No.	Column V.—Code Wire.	Column VI.—Mate.
1	Blue	White Mates.	41	Blue	Red–Blue Mates.	81	Blue	Red Mates.
2	Orange ..		42	Orange ..		82	Orange ..	
3	Green		43	Green		83	Green	
4	Brown ..		44	Brown ..		84	Brown ..	
5	Slate		45	Slate		85	Slate	
6	Blue–White ..		46	Blue–White ..		86	Blue–White ..	
7	Blue–Orange ..		47	Blue–Orange ..		87	Blue–Orange ..	
8	Blue–Green ..		48	Blue–Green ..		88	Blue–Green ..	
9	Blue–Brown ..		49	Blue–Brown ..		89	Blue–Brown ..	
10	Blue–Slate ..		50	Blue–Slate ..		90	Blue–Slate ..	
11	Orange–White ..		51	Orange–White ..		91	Orange–White ..	
12	Orange–Green ..		52	Orange–Green ..		92	Orange–Green ..	
13	Orange–Brown ..		53	Orange–Brown ..		93	Orange–Brown ..	
14	Orange–Slate ..		54	Orange–Slate ..		94	Orange–Slate ..	
15	Green–White ..		55	Green–White ..		95	Green–White ..	
16	Green–Brown ..		56	Green–Brown ..		96	Green–Brown ..	
17	Green–Slate ..		57	Green–Slate ..		97	Green–Slate ..	
18	Brown–White ..		58	Brown–White ..		98	Brown–White ..	
19	Brown–Slate ..		59	Brown–Slate ..		99	Brown–Slate ..	
20	Slate–White ..		60	Slate–White ..		100	Slate–White ..	
21	Blue	Red–White Mates.	61	Blue	Red–Orange Mates.			
22	Orange ..		62	Orange ..				
23	Green		63	Green				
24	Brown ..		64	Brown ..				
25	Slate		65	Slate				
26	Blue–White ..		66	Blue–White ..				
27	Blue–Orange ..		67	Blue–Orange ..				
28	Blue–Green ..		68	Blue–Green ..				
29	Blue–Brown ..		69	Blue–Brown ..				
30	Blue–Slate ..		70	Blue–Slate ..				
31	Orange–White ..		71	Orange–White ..				
32	Orange–Green ..		72	Orange–Green ..				
33	Orange–Brown ..		73	Orange–Brown ..				
34	Orange–Slate ..		74	Orange–Slate ..				
35	Green–White ..		75	Green–White ..				
36	Green–Brown ..		76	Green–Brown ..				
37	Green–Slate ..		77	Green–Slate ..				
38	Brown–White ..		78	Brown–White ..				
39	Brown–Slate ..		79	Brown–Slate ..				
40	Slate–White ..		80	Slate–White ..				

Note (*Table No.* 2).—For sizes over 100 pairs repeat the code thus—
Pair 101, blue with white mate.
Pair 102, orange with white mate, &c.

1.32. **TABLE No. 2.**

ASSEMBLY OF SINGLE PAIR CABLES.

No. of Pairs of Conductors in Cable.	Colour Code.	Make Up. No. of Pairs in Centre and Surrounding Layers.					
		Centre.	1st.	2nd.	3rd.	4th.	5th.
4	Column 1 with Column 2 (pairs 1–4 inclusive) ..	4	..	..	..	..	..
7	Column 1 with Column 2 (pairs 1–7 inclusive) ..	1	6	..	..	..	..
10	Column 1 with Column 2 (pairs 1–10 inclusive) ..	2	8	..	..	..	..
15	Column 1 with Column 2 (pairs 1–15 inclusive) ..	4	11	..	..	..	..
20	Column 1 with Column 2 (pairs 1–20 inclusive) ..	1	6	13	..	..	..
25	Column 1 with Column 2 (pairs 1–25 inclusive) ..	2	8	15	..	..	..
35	Column 1 with Column 2 (pairs 1–35 inclusive) ..	1	6	11	17	..	..
50	Column 1 with Column 2 (pairs 1–40 inclusive) ..	3	9	16	22	..	..
	Column 3 with Column 4 (pairs 41–50 inclusive) ..						
100	Column 1 with Column 2 (pairs 1–40 inclusive) ..	2	8	14	20	25	31
	Column 3 with Column 4 (pairs 41–80 inclusive) ..						
	Column 5 with Column 6 (pairs 81–100 inclusive)..						

1.33. The maximum specified conductor resistance per mile of the 10-lb. conductors in these cables is 90.54 ohms, and the standard capacities, i.e., number of pairs, are as shown in Table 2 above.

1.34. Since 1932 purchases have been made of lead-covered cable similar to that described above, but with the silk lappings omitted. It is intended, subject to continued satisfactory experience, that this cable be used for building cabling work, after any surplus stocks of cable with silk lappings have been used.

1.4. Wire, R.I., Internal : 1/12.5 and 2/12.5.—This wire consists of a tinned conductor weighing 12.5 lb. per mile, surrounded by a layer of pure rubber, a layer of vulcanized rubber, and then cotton braided. Braiding in the case of the single conductor is black, and in the case of the twinned wire, is one red and one black. This wire should be used only where cable is not suitable, and in general, only when the work is temporary. It should never be exposed to the weather. Twinned wire should be used for speaking circuits. The red braided wire of the pair should be used for the " A " side of a circuit.

1.5. Wire, Jumper : 2/12.5.—This wire is to be used for all jumpering on main distributing frames and distributing boxes larger than 40/40. It has conductors 12½ lb. per mile. The conductors are tinned and enamelled, covered with a double silk lapping, the second being moisture proofed, a further lapping of cotton and then cotton braiding. The braiding is flame-proofed to reduce the risk of fire. The colour of the braiding in the twinned wire normally used in subscribers' premises is one red and one white. The white wire of the pair should be used for the " A " side of a circuit.

1.51. Jumpering on 40/40 distributing boxes should be carried out by means of scrap tinned cable conductors, enamel insulated, silk and cotton covered.

2. DISTRIBUTING FRAMES, WALL TYPE.

2.1. The standard wall type distributing frame for use in subscribers' premises is shown generally by Fig. 22. The frames are stocked in parts for assembly at the time of installation. The components consist of brackets and verticals. Brackets have a maximum capacity of 3, 5 or 7 verticals, and are known as Bracket, distributing frame, 100/300, 100/500, or 100/700 respectively. The verticals may consist of complete 100-pair terminal strips, or, alternatively, where necessary to provide protection, one or more verticals may consist of complete protectors. Each protector vertical will accommodate two Protectors 20/20 and one Protector 10/10, i.e., protectors for 50 metallic circuits.

DISTRIBUTING BOXES.

3.1. Generally the final distribution of cabling in a large building will be by means of Blocks, Terminal, No. 6 (10 pairs). In a few instances, Boxes, Distributing, 40/40, will be necessary where accommodation for two smaller boxes cannot be obtained.

3.2. Standard distributing boxes are in the following capacities :—

Stores Title.	Capacity.	Type of Terminal.
Block, Terminal, No. 3	4 pairs ..	Screw
Block, Terminal, No. 6	10 ,, ..	Screw
Box, Distributing, Internal, 40/40	40 ,, ..	Soldered
Box, Distributing, Internal, 80/80	80 ,, ..	Soldered
Box, Distributing, Internal, 160/160	160 ,, ..	Soldered
Box, Distributing, Internal, 240/240	240 ,, ..	Soldered

The figures given for capacity of the boxes indicate the total number of pairs of terminals provided. The figures given in fractional form in the stores title indicate that the box is fully equipped with terminals, i.e , a box with a capacity of 80 terminals, which is equipped fully with 80, is known as Box, Distributing, Internal, 80/80.

3.3. For normal final distribution of cables in a large building, the maximum size used should be 40 40.

3.4. Boxes of the larger sizes are provided for use as a main distributing point—for example—in association with a floor type P.B.X. switchboard or for main distribution in a small building.

3.5. Circuits requiring protection are jumpered via a protector mounting 0/10 or 0/20. This mounting is fitted at the side of the distributing box. Details of the method of installation and jumpering are given in Section 4*b*, paragraph 5, and in Figs. 20 and 21.

SECTION 3, PART a.—INSTALLATION OF SUBSCRIBERS' EQUIPMENT: SIMPLE SERVICES.

1. GENERAL.

1.1. Except in unusual circumstances, the instructions in telephone orders will be based on Drawing No. C.609, "Standardized Subscribers' Services"; forming part hereof. Departures—at the request of a subscriber—from the instructions embodied in a telephone order and which would involve the installation of an unstandard service, shall not be made, but the officer-in-control should be informed—by telephone—and his advice sought. The approval to be obtained by the officer-in-control will depend on the nature of the request. Unstandard services shall not be installed without the prior approval of an Engineer.

2. INSTRUMENTS TO BE VERTICAL.

2.1. Each instrument shall be fitted truly vertical. Should any mechanic find difficulty in ensuring accuracy, he should make a simple "plumb" line, using a piece of cord, and a weight consisting of a short length of cable sheath.

3. SUPPLY OF TELEPHONE DIRECTORY.

3.1. A copy of the current Telephone Directory for the area concerned shall be supplied by the mechanic for each new telephone station which can be connected to the exchange system.

4. LOCATIONS—CHOICE OF.

4.1. **General.**—It is essential that the location of an instrument be carefully chosen, particularly in the case of automatic equipment. Good natural or artificial lighting is necessary both for satisfactory operation and inspection by maintenance staff. Equipment should not be installed where the subscriber, installation or maintenance mechanic, or the equipment itself, would be exposed to the risk of injury.

4.2. A location in which the instrument is likely to be exposed to direct sunlight should be avoided if possible. This is particularly important for a magneto instrument containing primary cells, the efficiency of which may be adversely affected.

4.3. **Hazardous Surroundings.**—Likely sources of hazard are :—

4.31. Stairs leading down near the set, a trap-door or other hazard where a person may be injured if he does not use care in approaching or leaving the telephone.

4.32. Electric light or power wires, switches, lamp-holders, &c. (If avoidable, instruments should not be placed within 6 feet of such possible sources of danger.)

4.33. Doors and piled merchandise or other movable objects.

4.34. Possibility of the instrument encroaching outward from the wall over a space which is used for the handling of heavy merchandise likely to damage the instrument.

4.35. Cord extending across a passage way.

4.36. The placing of a wall telephone too close to a side wall or other object which would obstruct the ready removal of the receiver (or operation of the generator handle, where fitted), or opening of the telephone for inspection.

4.37. A table telephone placed on an unstable support or where it would be likely to fall.

4.38. A position where, by a receiver falling, a glass showcase or similar property of the subscriber would be injured.

4.4. **Bell to be Audible.**—A telephone should be placed where the bell will be plainly heard by a subscriber.

4.41. In some table telephone installations, the use of an extension bell may be avoided if the bell set is installed in an adjacent room. Triple or quadruple wiring as required, usually 2-pair cable, should be extended to a terminal block to which the "pedestal to bell set" cord will be connected. (Maximum length of wiring permitted in this case is 4 yards, unless the additional installation cost is borne by the subscriber.) The bell set must not be installed in an unsuitable location, such as a cupboard.

This method of installing is not applicable to a magneto table set, as it is necessary to fit the generator in close proximity to the pedestal.

4.5. Damp Situations.

4.51. Apparatus should not be located in a damp position, such as on a damp wall or close to a window which may be left open and expose the equipment (especially the cords) to rain or moisture.

4.52. When adequate protection is not available to prevent damage to the apparatus, the subscriber should be advised to obtain a small cabinet. The officer-in-control should report the case to the Equipment Engineer concerned, who will arrange to have forwarded to the subscriber a copy of a Specification and Drawing of a suitable cabinet.

4.6. Locations Subject to Corrosive Fumes.—Occasionally it is necessary to install an instrument where corrosive fumes, &c., may damage it. In such an instance, and unless the conditions are extreme, the instrument should be installed in a position in which the minimum damage is likely to occur. In every case the officer-in-control should be advised of the circumstances. If it is reasonable to expect that damage will occur, i.e., that conditions are extreme, he should be advised before the installation is effected.

4.7. Proximity to Earthed Objects.—An instrument must not be located over or near an earthed metallic object such as a radiator, sink, bath-tub, water or steam pipe, &c. Preferably an instrument should not be installed on the same table or desk as a portable electric lamp. This instruction is of particular importance in a switchboard installation. An unstandard instrument of the type which has one connexion of the transmitter on the frame thereof, should not be installed on a wall above a damp brick or concrete or metal floor.

4.8. Floor Wiring.—Unless provision has been made for satisfactory "under-floor" wiring with appropriate outlets, the position of the instrument should be such that, as far as possible, wiring on, or under, the floor will not be necessary.

4.9. Excessive Vibration or Noise.—A position where equipment would be exposed to vibration should be avoided.

4.91. If no other support is available, and if the vibration is not sufficient to cause the bell to tinkle, a bell set associated with a table telephone may be placed on a vibrating support. The standard C.B. extension switch which is equipped with a relay should not, however, be fitted on a vibrating support. If there is no other alternative but to place a wall telephone or a standard extension switch on a vibrating support, the installation mechanic should consult the officer-in-control before fitting the equipment. An outside wall adjacent to the street alignment in a street subject to heavy traffic—trams, &c.—should be avoided.

4.92. Except where no other position is available, a telephone must not be installed in a noisy place. If the subscriber experiences transmission difficulty in using the instrument during test after installation, the circumstances should be reported by telephone, and subsequently in writing if necessary.

5. DISPOSITION OF BELL SET.

5.1. A bell set associated with a table telephone should be fitted with the gongs uppermost, except where difficulty would be experienced in opening the door of the bell set. In such a case the bell set may be fitted with the gongs beneath. This should be avoided wherever possible. In no circumstances should the bell set be installed on its side, i.e., with the bell armature vertical.

5.2. A bell set should not be installed on a skirting unless the height of the skirting is so great that the top mounting screws enter the skirting and permit of a minimum clearance of 5 inches between the bottom of the door of the bell set and the floor. A skirting of this depth will rarely be encountered.

6. LONG INSTRUMENT CORDS.

6.1. Instrument cords longer than standard should not be supplied unless a telephone order is held to cover the work. The standard lengths of cord to connect a bell set to a pedestal are 6, 8, and 10 feet. The 10-feet cord is not intended for use with a handset telephone.

7. HEIGHT OF WALL TELEPHONE.

7.1. Generally a wall telephone should be installed with the centre of the transmitter (face vertical) 4 ft. 8½ in. above floor level. Thus the height of the uppermost support of the various types of standard telephones will be as follows :—

Magneto wall telephone	Approximately 5 feet.
C.B. and automatic wall telephone ..	Approximately 4 ft. 9 in.
Automatic public telephone ..	Approximately 4 ft. 9 in. (Top mounting holes at back of mechanism compartment.)

7.2. Should a subscriber desire an instrument erected at a height differing from that above mentioned, his wishes should be met. The height of a handset telephone arranged as a wall instrument is not critical. The subscriber should, however, be consulted with reference to the height before installation.

8. CARE IN PLUGGING WALLS.

8.1. When fitting equipment to the surface of, or when cutting a hole in, a floor or wall, the maximum care must be exercised to avoid damage to the structure or to any hidden pipe, cable, or wire. Similarly, if inquiry fails to establish the nature of the construction of a wall on which apparatus is to be fitted, e.g., whether hollow or of concrete, &c., the drilling of the first hole should be effected with extreme care, the drill being carefully rotated to avoid breaking up plaster. When it is suspected that the wall is hollow e.g., terra-cotta lumber, the drill should be hit lightly to avoid " flaking " out portion of the inner surface of the hollow section.

8.2. When it is found necessary to erect a telephone on a single brick wall, or on glazed or hard tiles, the attention of the lessee of the telephone is to be drawn to the liability of damage being done to the wall. Before commencing work, the subscriber should be requested to sign a copy of Form S.E. 80; relieving the Department of the responsibility for any damage, other than that due to carelessness, which may be caused. A mechanic should have a supply of forms always available for this purpose. Should the subscriber decline to give the required undertaking, the officer-in-control is to be asked by telephone for instructions.

8.3. When there is no option but to install equipment on a surface of glazed or other hard tiles, do not attempt to use a " star " drill. A " twist " drill and holder for use with standard screw anchors should be used. Extreme care is necessary in locating the positions for the holes and also in the use of the hammer, which should be applied lightly to the drill until it has passed through the tile.

8.4. In an instance where apparatus is to be erected on a wall constructed of special material such as steel, lath and plaster, terra-cotta lumber, &c., and *difficulty is anticipated*, the mechanic should discuss the matter with the officer-in-control.

9. METHODS OF SECURING TELEPHONE, EXTENSION SWITCH, AND MISCELLANEOUS APPARATUS.

9.1. Apparatus should be so secured that it will not become loose. The methods shown in Appendix " B " should be followed, and wherever practicable, the anchoring devices specified should be used. Generally, three securing screws for an instrument or backboard will be satisfactory. Should any doubt exist as to the safety of the apparatus, four screws should be used where provision is made for the fourth. Should a bell set be fitted to a panelled desk, the three screws should be so disposed that they enter the stiles and rails, and the screw which would normally enter the panel should be omitted.

10. BACKBOARDS.

10.1. When a wall telephone, or an extension switch, with or without a generator, is being installed on a plaster surface on laths, a backboard should be used. On a sound plaster surface on laths, a bell set, protector, or other miscellaneous equipment, not subject to mechanical force during use, may be fitted direct on the plaster without the use of a backboard. Care should be taken that the force used in screwing a bell set to a lath and plaster wall does not cause the " buttons " to crush and enter the plaster.

10.2. On a surface other than plaster where the mounting centres of apparatus are suitable, a backboard should not be used.

10.3. On a plastered brick wall where wooden plugs are used (see Appendix "B") they should be cut flush with the surface of the plaster, and, where practicable, backboard should be omitted.

10.4. If dampness is suspected and the use of the location cannot be avoided, a backboard should be used, and wiring run between the backboard and the instrument—not between the backboard and the wall.

10.5. If the surface of edges or ends of a backboard differ in quality of finish, the surfaces having the best finish shall be those most visible.

11. CONNEXIONS OF APPARATUS.

11.1. The terminal connexions for a number of services referred to in simple form in Drawing C. 609 (Standardized Subscribers' Services), are shown in Figs. 25 to 42. The simpler services, the connexions of which are obvious, have not been included.

12. FLEXIBLE TELEPHONE ARMS.

12.1. Flexible telephone arms are available with brackets for attachment to (*a*) a horizontal surface, such as a table top ; and (*b*) a vertical surface, such as table leg or a wall. The type for the specific job should be requisitioned for, i.e., Arm, Telephone, Flexible : H.S. or V.S., as required, having regard to the mounting surface available. When fitting a flexible telephone arm to a table or wall, care should be taken that the wishes of the subscriber are met in respect of the available field of movement of the telephone when fitted.

12.2. The mounting bracket is to be well secured to its support by means of black japanned R.H. steel screws 1¼ inches or 1½ inches, No. 10, depending on thickness of table or other support.

12.3. Instrument cords must be passed through the eyelets provided, and so regulated that no portion of the cord is subject to excessive tension, or to risk of damage by shearing.

13. ADDITIONAL RECEIVER.

13.1. The standard telephone is equipped with one receiver only. When a telephone order is received for an additional receiver, it should be fitted, together with a receiver hook of appropriate type. In standard or similar equipment the receiver should be connected in parallel with that existing. In direct current telephones and in early types of series magneto instruments, the two receivers should be connected in series.

13.2. In addition to the receiver of the telephone, one set of two head receivers or a single head receiver may be connected. A set of two head receivers should be connected in series, the combination then being placed in parallel with the receiver of the telephone. A single head receiver should be connected in parallel with the receiver of the telephone. Each head receiver shall be of 60 ohms resistance.

14. EXTENSION TELEPHONE AND EXTENSION SWITCH (PLAN No. 4).

14.1. Frequently no inter-communication is required between the main and a single indoor extension. This applies particularly when the telephones are fitted in reasonably close proximity, and where parallel telephones (i.e., Plan No. 6) do not meet the requirements from the signalling viewpoint. In these circumstances, on C.B. and automatic services, a dry cell "talking" battery need not be installed, and the battery terminals on the extension switch should be strapped. On a single indoor extension service requiring inter-communication, four dry cells should be installed.

14.2. The following table shows the number of cells required on an outdoor single extension service to give reasonably satisfactory transmission for the approximate loop resistances (extension line only) mentioned :—

100 ohms	6 cells.
200 „	8 „
300 „	10 „

14.3. The standard extension switch is equipped with a slow release "indicator-relay." In addition to providing an engaged signal at the main when the extension loops the exchange line, the relay contacts disconnect the bell of the extension switch to eliminate tinkling during dialling, and also to reduce distortion of the impulse ratio.

14.4. When it is necessary to utilize a generator, not already equipped with a condenser, at an extension station connected to a standard extension switch equipped with a relay, a 2-M.F. condenser must be connected in series with the generator at the time of installation. This will permit the extension to operate the bell on the switch at the main, when the extension generator is operated. The condenser is necessary to prevent operation of the relay in the extension switch, when in the " through " position, due to the loop which otherwise would be given by the generator, when operated.

15. DRY CELLS IN LOCAL BATTERY TELEPHONE.

15.1. Under no circumstances are three dry cells to be installed in a local battery telephone. If transmission, with standard equipment in good order, is not satisfactory, the matter should be reported to the Engineer.

16. TREMBLING BELLS.

16.1. For a trembling bell used as an alarm bell and operated by a local battery, the following particulars govern the number of dry cells to be provided :—

Bell with gong—	*No. of cells.*
2½ inches (Standard type—with 50-ohm coils connected in parallel or 25-ohm buzzer)	2
4 ,,	3
6 ,,	4
8 ,,	5
10 ,,	6

16.2. A bell should be installed at a height which will make interference unlikely. The case should be above the gong, and should be vertical.

17. LOCATION OF BELLS.

17.1. A bell of weatherproof type is designed for use in outside situations, but it should not be placed in a position in which it is exposed directly to the effects of the weather. An open verandah is suitable, providing that the bell is so placed that it is out of the reach of direct rain. When placed on an exterior wall or on a post, a simple cowl or cabinet should be provided by the subscriber for the reasonable protection of the bell.

17.2. A trembling bell of large size, but not weatherproof, is sometimes required to be installed in an outside situation, but the bell must not be placed in a position which is exposed to the weather.

18. LOUD SOUNDING ALARM.

18.1. Under Plan 17, Drawing C. 609, a subscriber may be provided with a loud sounding alarm unit consisting of a motor car type horn, operated by transformer and rectifier supplied from the commercial A.C. supply.

18.2. The power switch and " three-pin " outlet, together with the plug, will be supplied by the subscriber. The earthing pin on the power plug shall be used to earth the frame and cover of the unit by means of the terminal provided.

18.3. If it is necessary to install the " horn " at a point remote from the unit, 2-pair cable, with the conductors in parallel, shall be used if the length of cable does not exceed 15 yards. When this distance will be exceeded, Wire, TPH., R.I.W.P. (outdoor distributing wire) may be used up to a distance of 70 yards. Over this distance Cable R.I.B.R., 600 Meg., ·003 sq. in. Tw. C. (3/20 electric power cable twinned) up to a distance of 120 yards should be used.

19. TELEPHONES WITH DIALS No. 8 (4-POINT).

19.1. Unstandard telephones with 4-point dials, when reconditioned in the Workshops, are fitted with standard dials No. 10 (5-point). No telephones equipped with 4-point dials (otherwise similar to standard) should be installed except under special direction.

SECTION 3, PART b.—INSTALLATION OF SUBSCRIBERS' EQUIPMENT: P.B.X. SERVICES.

1. PRELIMINARY SURVEY.

1.1. A small switchboard, e.g., C.B. or magneto cordless type, will in general be installed by a mechanic without an advance preliminary survey, the location being selected by the subscriber and the installing mechanic at the time of installation. The position for a cord type, floor pattern switchboard will generally be selected after an advance preliminary survey by another officer. In odd cases, however, it may be necessary for the installing mechanic to make the selection. In the former case the mechanic will receive sufficient detailed information regarding the proposed layout, to enable him to determine readily the location of the switchboard, the distributing boxes, and the extension telephones.

1.2. The information in paragraphs 2 and 3 is given as a guide to those whose duties may involve consideration of proposed alternative positions for a P.B.X. switchboard.

2. CHOICE OF ROOM.

2.1. The main factors to be considered in selecting a room for a large private branch exchange, and as far as applicable, for a small private branch exchange, are as follows :—

2.11. Sufficient room for the switchboard and the telephonist.

2.12. Space for maintenance and extension of equipment.

2.13. Provision for natural lighting (also artificial lighting if necessary) for face equipment and apparatus to be maintained. A lamp signalling switchboard requires lighting that does not interfere with the visibility of the lamps.

2.14. Provision for batteries, if necessary.

2.15. Ventilation, freedom from dampness, fumes, draughts, &c.

2.16. Absence of vibration or noise.

2.17. A floor pattern switchboard is usually of such weight that care should be taken that the floor will support the switchboard safely.

2.18. Location, from the viewpoint of economy ; as regards the length of cable and wiring required.

2.2. In the majority of instances it will be necessary to effect a compromise, i.e., all the desirable features outlined above will not be evident in a room made available by the subscriber. However, from the viewpoint of ultimate satisfaction to the subscriber and the switchboard telephonist, the best possible conditions should be striven for.

2.3. When improvement from any evident office rearrangement may result, this should be suggested to the subscriber during the course of the preliminary survey. In some instances suitable compliance with conditions not otherwise capable of being fulfilled, may be secured by the erection, by the subscriber, of a partition, or by slight rearrangement of the fittings of the office or room.

2.4. When the installation of a standard C.B. floor pattern switchboard, of 100-line maximum capacity, is proposed, ensure that a doorway or other opening is available, of such size as to admit the switchboard without damage. Opening the keyboard to the vertical position reduces the width of the P.B.X. and facilitates its passage through a narrow doorway. A keyboard opened for this purpose should be secured.

3. CHOICE OF POSITION FOR SWITCHBOARD.

3.1. The room having been chosen, the following points in addition should be considered in the choice of a position for a wall type switchboard. In each case the wishes of the subscriber should be met, as far as practicable, without important variation from the conditions set down.

3.2. Wall Type Switchboards.

3.21. As these switchboards, particularly of the C.B. cordless type, possess considerable weight the wall chosen for mounting should be sound.

3.22. The height of the switchboard should be such that it can be operated as desired by the subscriber. In some instances the telephonist may desire to remain seated while operating the switchboard, and a suitable height should be chosen by agreement.

3.23. If a magneto wall type switchboard, with fixed transmitter, is to be operated in the standing position, the height of the centre of the transmitter with its face vertical should be approximately 56½ inches (4 ft. 8½ in.), unless for particular reasons the subscriber desires the switchboard erected at a height more suitable to his requirements.

3.24. The position on the wall should be such that the switchboard may be opened readily, and the interior made accessible for maintenance purposes.

4. CAPACITY OF SWITCHBOARDS.

4.1. The ultimate capacity of the switchboard and the initial equipment will be specified on the telephone order.

5. ANCHORING WALL TYPE SWITCHBOARDS.

5.1. A switchboard shall be fitted truly vertical. The methods to be adopted in anchoring wall type switchboards (including $\frac{1+3}{4}$ and $\frac{2+4}{6}$ and $\frac{3+9}{12}$ table type C.B. cordless switchboards when fitted to a wall) are as shown in Appendix " B." On account of the weight of a $\frac{3+9}{12}$ C.B. cordless switchboard, great care should be taken that the wall chosen will support the load. If it will not, the provision by the subscriber of a suitable strong bench or table should be insisted upon. This is a highly important matter.

5.2. The bench or table shall be secured firmly to the floor or wall with angle brackets of about ½-inch x ⅛-inch mild steel, each leg being approximately 3 inches in length. To avoid a special visit to the subscribers' premises, two brackets should be included in the supplies carried by a mechanic installing such switchboards.

6. ANCHORING FLOOR TYPE SWITCHBOARDS.

6.1. Reference to Appendix " B " will also indicate typical methods of anchoring floor type switchboards.

7. EARTHED OBJECTS—PROXIMITY TO.

7.1. Particular attention should be paid to the terms of Section 3a, paragraph 4.7, regarding earthed objects and the proximity to the proposed switchboard location.

8. BUSY EXTENSIONS NOT TO BE CONCENTRATED.

8.1. In order to minimize congestion of plugs and cords, the extensions likely to be busy should be distributed over the extension field, and on jacks as far as possible from the exchange line jacks. This applies particularly to C.B. switchboards, $\frac{10+40}{100}$, and larger.

9. POWER LEAD PROVISION.

9.1. Reference should be made to G.E.C. 13 for particulars of methods of providing power to C.B.—P.B.X. switchboards.

10. FORMING AND TERMINATING CABLES.

10.1. For typical methods of forming, lacing and terminating cables, refer to I.C. 5.

10.2. The standard colour code of lead-covered cables for internal purposes is shown in Section 2, paragraph 1.3 of this Circular.

11. TESTS ON COMPLETED P.B.X. INSTALLATIONS.

11.1. For details of the tests to be imposed on completed P.B.X. installations, see Section 5 of this Circular.

12. SPECIAL FACILITIES ON SWITCHBOARDS.

12.1. Telephonist's Telephone on a Cordless Switchboard.

12.11. If a cordless switchboard is to be equipped with a telephonist's telephone (head and breast type) a large cup hook should be screwed into the side of the switchboard cabinet, to provide support for the instrument when not in use, the object being to ensure that the transmitter is kept in a vertical position to minimize the liability to burning of the polished carbon electrodes of the transmtter. The telephone should be connected as shown in Fig. 37.

12.12. The attention of the telephonist should be drawn to the need to restore the speaking key to normal when the telephone is not in use.

12.2. Handsets or Handset Telephones on Switchboards.

12.21. Upon receipt of a telephone order a Handset No. 5 or Telephone 566 may be installed on a switchboard. The procedure will be as follows :—

12.22. Cordless Switchboards.

12.221. On a switchboard equipped with a Telephone 509, replace by a Telephone 566.

12.322. On a cordless board equipped with a fixed transmitter, proceed generally as for a cord type switchboard.

12.23. Cord Type Switchboards.

12.231. If the fixed transmitter is to be *replaced* by a handset, extend the transmitter wiring to Connexion Plates No. 7 fitted one on each side of the receiver terminals, i.e., in the following order—M.R.R.M. Pass the handset cord via receiver cord bush and terminate on the connexion plates. Then replace the Hook, Receiver : F., by Hook, Receiver : M.

12.232. If the handset is intended as an *alternative* to a telephonist's telephone, terminate the handset cord on a Plug, Instrument : 4277., or 4457., as required, and fit Hook, Receiver : N., to support the handset.

12.3 Emergency Dial on a Cord Type Switchboard.

12.31. Provision is made in the standard switchboard for the accommodation and connexion of an emergency dial. Upon receipt of an order for a second dial, the dial and changeover key should be fitted and connected as shown in the circuit diagram.

12.32. The method of connexion of a second dial and the associated changeover key in an unstandard switchboard should be as shown in Drawing C.354, Sheet 2.

SECTION 4, PART a.—CABLING AND WIRING: SIMPLE SERVICES.

1. LEADING-IN ARRANGEMENTS.

1.1. General.—Subject to modification in special circumstances, the line of demarcation between the activities of the Lines and Equipment Sections respectively is regarded as the protector—or its equivalent terminal. The arrangements for leading-in and wiring generally shall be such that ready means of opening the circuit for test purposes shall be provided at the point of entry to the building, i.e., at the junction of the " leading-in " cable or wire, and the interior cabling or wiring.

1.2. The methods generally employed for " leading in " subscribers' circuits may be summarized as follows :—

1.21.

Type of Building.	Type of Lead-in.	How Terminated.	Remarks.
A residence, shop or factory, &c., which is isolated	(For " lead-in " from aerial wire) Wire, Tph., R.I.W.P. (Wire, twisted pair, outside distributing), or Cable C.I.L.C., 1-pair (1-pair Cable)	On substation protector	The line party will provide, inside the point of entry, a length of twin wire or cable sufficient to reach the protector without jointing and, in addition, a 3/036" (3/20 S.W.G.) stranded copper wire connected to an earth
A concentrated group of semi-detached shops or a small group of offices not justifying an internal distribution scheme. Also isolated residences under appropriate conditions	(For block distribution not exposed to electrical hazards). Cable, Tph., underground P.I.L.C., small sizes up to 5-pair Alternatively, Cable C.I.L.C., 1- or 2-pair, or Cable, Swbd., L.C., 4-pair, may be used	On " Block, Terminal, No. 1, No. 2, or No. 3 "	Sufficient cable will be provided inside point of entry to permit connexion to the Terminal Block, in which the cable, if paper insulated, is sealed by compound. No earth wire will be provided in these instances
Self-contained multi-office or multi-residence building, in which an internal distribution scheme is the most economical form of cabling and wiring. Also P.B.X. or P.A.B.X. installation served by U.G. cable, led into building	Cable, Tph., underground, P.I.L.C., twin, various sizes, jointed to Cable, Swbd., L.C., twin, various sizes	On distributing box or frame of suitable capacity	The line party will provide a length of enamelled switchboard cable, sufficient for termination on the distributing frame or box. Unless uneconomical, termination will be effected by a mechanic

1.3. Wiring of Residences, Shops, Small Factories for Simple Services.

1.31. In an isolated residence, the line party will provide the " lead-in " at a point convenient for association with the indoor wiring. As a great length of run of twin wire in bridle rings, in conspicuous places, would disfigure the outer walls of a residence, the line party will consider this. In every case the length of " lead in " should reach to a point where the terminal block or protector can be installed and be readily accessible. A bathroom or lavatory, i.e., a convenience, should always be avoided.

2. LOCATION OF SUBSTATION PROTECTOR.

2.1. The following factors should govern the position chosen for a protector :—

2.11. Accessibility for Maintenance Purposes.—An ideal position is about 7 feet from floor level, free from hanging curtains or other inflammable material.

2.12. It should be installed on an inside wall surface, unless a *weatherproof* position on a verandah or porch is available. A position under eaves of a roof or above the ceiling is not suitable and should not be used.

2.13. Security from Interference.—In a residence the protector should not be placed so low as to invite interference by children. In a small building housing a group of subscribers the protector should preferably be installed in the room of the subscriber, unless a run of wiring exceeding 30 feet is involved.

2.14. Avoid a damp location or one where corrosive fumes are likely. Do not install on a damp wall unless unavoidable, in which case use a backboard.

2.15. Do not install on a vibrating wall or other vibratory support.

3. SUBSTATION PROTECTOR—PRECAUTIONS IN INSTALLING.

3.1. Mounting the protector horizontally shall be resorted to only when vertical mounting will be unreasonably difficult. In a dusty location the protector should not be mounted in a horizontal position. If the micas are of a " U " section, they should be so disposed that the limbs of the " U " do not point upwards.

3.2. Line terminals preferably should be uppermost.

3.3. Where an internal run is concealed, or for other reasons the position of a protector or an equivalent terminal is difficult to locate, the installing mechanic should place on card E.M. 23 a brief note to indicate the position—e.g., " Prot. on N. wall of kitchen."

4. DISPOSITION OF WIRES OF A PAIR.

4.1. For purposes of uniformity in future work, the positive wire of a C.B. or Auto. telephone pair shall be designated as the " A " wire, and the negative the " B " wire. In a magneto installation the " tip " or " L1 " wire shall be known as the " A " wire. The " ring " or " L2 " wire will be the " B " wire. Each circuit shall be so connected that no transposition occurs, i.e., the " A " line shall be connected throughout to the " A " side of equipment and vice versa.

4.2. To avoid " splitting " the pairs at a joint in 2-pair cable having white mates to each pair, the sheath must be removed for a distance sufficient to determine the " lay " of each pair. The conductor having a white covering, or one including a white lapping, should be used for the " A " side of a circuit.

5. LINE NOT IN USE TO BE GROUNDED.

5.1. When it is necessary to leave in a subscriber's premises the " lead-in " wires of an exposed line—not connected to apparatus—the two wires in the case of a metallic circuit, or a single wire in the case of an earth circuit, must be earthed by being connected temporarily but securely to the earth wire.

6. WIRING BEHIND REMOVABLE FURNITURE.

6.1. When wiring is required to be run at the back of a removable cupboard or other furniture, the subscriber should be requested to provide access for the work by removing such furniture as is necessary. Should the subscriber decline to remove an article, the removal of which is actually necessary, and if the work of removing is considerable or is attended with any risk, the matter should be reported by telephone, and that portion of the work suspended. If, however, the work of removal is inconsiderable and no serious risk or special labour is involved, or if the subscriber requests that the mechanic should do what is necessary, the work should be done, but the subscriber should be advised courteously that it will be done at his risk.

7. USE OF LADDER.

7.1. When the cost or inconvenience of obtaining a departmental ladder is unreasonable, a ladder, the property of the subscriber or other person, may be used.

7.2. The mechanic should see that the ladder obtained is free from weakness likely to cause accident.

7.3. When it is necessary to mount a ladder in a public corridor, &c., or on a polished or otherwise dangerous floor surface, or in any location considered dangerous, the mechanic should seek the assistance of another officer to " foot " and support the ladder whilst it is in use.

8. WORK UNIT TO BE USED FOR "WIRING."

8.1. For the purposes of this instruction the running of 1-pair and 2-pair cable shall be designated as "wiring," and where not chargeable to the Work Units covering the fitting of Magneto, C.B. and automatic telephones and subsidiary apparatus, shall be charged to the Unit for "Internal *Wiring*" (not cabling) of subscribers' premises.

9. USE OF CONDUIT.

9.1. Occasionally mechanical protection of wiring is necessary over a lengthy section involving the use of a surface conduit, including the fitting of a number of conduit fittings, i.e., bends, elbows, tees, &c. In such a case—of infrequent occurrence—internal wire (Wire, R.I., Internal, 2/12·5) should be used instead of lead-covered cable.

9.2. The maximum number of pairs of this wire which may be drawn safely into conduit of sizes given is as follows :—

Size of Conduit.	Maximum Number of Pairs.	
	Plain Conduit.	Screwed Conduit, with Inspection Elbows, &c.
½"	5	..
⅝"	7	4
¾"	9	7

10. WIRE FOR TEMPORARY WORK.

10.1. Temporary wiring should be avoided wherever practicable, but when necessary, Wire, R.I., Internal, 2/12·5, should be used. Temporary work should be carried out in a neat manner, consistent with economy. The wire should be secured at a number of points sufficient to prevent it being a possible cause of accident.

11. SURVEY OF JOB.

11.1. Before work on an installation is commenced, the officer carrying out the job should make a survey to determine the best method of routing the wiring.

12. SURFACE WIRING STANDARD.

12.1. Surface wiring is to be regarded as the standard method, except where suitable concealed runs are provided. The wiring in a residence or in a location with a well finished or decorated interior should be run as inconspicuously as possible.

13. WIRING ON CEILING.

13.1. In a residence of one floor access may be readily available to the "above ceiling" space. If time will be saved, long runs of wiring may be taken across the ceiling from an entry hole made in the ceiling above the protector or equivalent. At a convenient position, preferably immediately above the instrument, the wiring should be taken through the ceiling at its junction with the wall surface, and supported as shown in Fig. 3.

13.2. If wiring in a ceiling is run at right angles to the line of the ceiling joists, there is a possibility that the householder may damage it accidently at a later date. To reduce this risk to a minimum, the wiring run should, as far as reasonable, follow the joists. Protection may also be obtained in many cases by the laying of the ceiling wiring close to the hanger beam supporting the ceiling joists, or along the top of the external wall until a set of ceiling joists running in the required direction is encountered. In ceilings having plaster sheets on battens, the wiring will be protected if laid on the sheets, after being pushed along in the space between sheets and joists. To save time in ceiling work and to avoid damage to plaster work stapling should be reduced to the absolute minimum necessary to result in a satisfactory job.

13.3. When carrying out work over ceilings, extreme care should be exercised to avoid stepping on and damaging the ceiling fabric. When necessary, a portable electric lamp of approved type should be used.

14. USE OF SKIRTINGS AND OTHER WOODWORK.

14.1. Wherever possible in a residence, wiring should be run in the depression above the picture rail, or on the upper face of the " china " rail. In soft timber it should be secured by staples lightly tapped in at intervals of approximately 3 feet. In hard timber, if difficulty is experienced in driving staples, at each 3 feet interval a small hole should be drilled, and countersunk steel screws (say ½ inch No. 6) used to clamp the wiring against the wall. A simple typical method of ensuring a neat exit of the wiring from a picture rail is shown in Fig. 5. If the rail cannot be used, or is not provided, the wiring should be run along the skirting board and on the edges of architraves. Typical positions are as shown in Fig. 2.

14.2. A flat cable clip, secured by a tack or an escutcheon pin, should be used in preference to a staple where appearance is important, timber is exceptionally hard, or where timber is loosely supported and is likely to damage plaster if considerable force is necessary to drive staples.

14.3. Wiring exposed to disturbance, such as on a skirting board, should be anchored at intervals of 1 ft. 6 in. On a vertical run 3-ft. spacing will suffice generally.

15. DAMAGE TO PLASTER.

15.1. The utmost care should be taken to avoid damaging a plaster surface to an extent greater than that absolutely necessary to install and wire the equipment.

16. WIRING PASSING FROM ROOM TO ROOM.

16.1. Where it is necessary to route wiring from room to room, e.g., from a passage or hall to a room, &c., the entry should be made at an inconspicuous point, preferably by means of a hole drilled in the wall fabric. For instance, if the picture rail, china rail or skirting is being used, a small hole should be drilled at a suitable point, immediately adjacent to the woodwork. This method is preferable to that of wiring partly across the face of an architrave and drilling a hole through the wall, from architrave to architrave. A hole through a single brick wall can be started most readily by means of " pricking " the wall surface at a convenient spot, until a horizontal or vertical joint is located and portion of the seam extracted.

16.2. In a timber dwelling, the hole should be taken through the wall with a small auger or bit. In every case extreme care will be necessary to avoid " flaking " the plaster on the remote side of the wall. To achieve this, the hole should be finished in the direction opposite to that in which it was commenced, immediately evidence of the exact location on the remote side of the wall is obtained by movement or by piercing of the plaster.

17. JOINTS IN WIRING.

17.1. Whenever possible, joints in 1-pair and 2-pair cable should be avoided. A length of wiring not exceeding 5 yards should be re-run when a joint would otherwise be necessary in its extension. Under no circumstances is there to be a joint of wiring in a length enclosed in conduit. Methods of preparing and finishing a joint in 1- and 2-pair cable are shown in Fig. 1.

17.2. The " paper sleeve " method shown in Fig. 1 should be used in a dry situation where electrical continuity of the lead sheath is not necessary. The joint should be in a position where it can be supported as shown. In a damp situation, or where the lead sheath must be continuous, the lead sleeve is to be used.

17.3. The use of adhesive insulating tape should be confined strictly to temporary wiring, or to binding the sheath of cable for purposes of mechanical protection.

18. WIRING TELEPHONES FITTED TO ISOLATED TABLES.

18.1. It is frequently necessary to install on an isolated table., e.g., in an office ; a pedestal, with or without a bell set. (See Fig. 44.) The following methods of wiring are available :—

18.12. Fit the bell set or a terminal strip No. 1 at approximately table top height on the wall and connect the cord to the pedestal or bell set, direct from the wall to the table. This method should be used only where the distance between the table and the wall does not exceed 18 inches, and there is no pedestrian traffic along the space between the wall and the table. The arrangement should be provided only in those instances where a subscriber indicates that the table concerned is not likely to be moved further from the wall.

18.13. Run wiring to a terminal strip No. 1 on the ceiling at a point immediately above the back edge of the table. Connect a flexible cable of the appropriate number of conductors between the ceiling terminal strip and the bell set or another terminal strip connected to the pedestal, and secure it to the table with a leather cleat, screw and washer. Provide approximately 2 inches slack, and then run to the position of the bell set or terminal strip on the table. The drop should be accurately vertical, as otherwise several installations in one room would become unsightly. The flexible cable to be used is Cordage, Instrument, 2,000, 3,000 or 4,000, with the braiding " made off " neatly by binding.

18.14. Where an " overall " carpet is provided, the wiring may be run down the wall and along the floor under the carpet. It should pass through a hole poked, not cut, through the carpet, adjacent to one of the rear legs of the table, and thence to the bell set. Before the hole is poked through the carpet, the approval of the subscriber must be obtained. This arrangement should be provided only in those instances where a subscriber indicates that a change of position of the table concerned is extremely unlikely.

18.15. By means of suitable " under-floor " conduit or duct run, outlets are provided at convenient points beneath tables for the exit of wiring. Details of the methods involved in these circumstances will be found in the section dealing with the cabling and wiring of business buildings. (Section 4c.)

19. WIRING NOT TO BE RUN DIAGONALLY.

19.1. When it is necessary to cross a " plane " surface, e.g., a plaster or brick wall, any change of direction shall be made at right angles. In no instance shall the wiring on such a surface be run other than horizontally or vertically.

20. ANCHORING ON MASONRY AND PLASTER.

20.1. For a masonry wall the methods of anchoring are as shown in Appendix " B." In no circumstances shall wiring be secured by driving staples into plaster. On a plaster surface over laths, the flat cable clip shall be used, with a round head steel screw (1 inch No. 3), to engage a lath. For a short run such as between a picture rail or skirting board and the instrument, the cable should be secured and protected by means of metal cover strip, using the methods shown in Figs. 5 and 6.

20.2. In other instances, where cable must cross the wall surface in a position where it is likely to be pulled away from the surface of the wall or otherwise damaged, similar protection should be provided.

21. WIRING RUN TO BE AS SHORT AS POSSIBLE.

21.1. Consistent with the conditions outlined in the preceding paragraphs, the wiring run should be of the minimum possible length.

22. EARTH WIRES.

22.1. Every protector must be efficiently earthed. (See Section 5, paragraph 8.27.) When it is necessary for a mechanic to provide an earth connexion, the provisions of G.E.C. 23 should be observed. For a C.B. key control or a party line service in a residence, the wiring between the protector and instrument should be 1-pair cable as usual, the sheath being used for the earth connexion to the instrument, a wire being soldered to each end.

23. HANDLING WIRING DURING INSTALLATION.

23.1. The coil of wire should be rolled to avoid kinking. When wiring is being stapled or otherwise secured, it should be run from right to left, in order that it can be held taut with the left hand while the anchoring device is being driven with the right. Wiring in a vertical run should be run from top to bottom for a similar reason.

24. TERMINATING WIRES.

24.1. The ends of wires and cables should be made off neatly and tidily, and should be free from frayed ends of insulation. The bared cleaned ends of the wire should not be longer than necessary, and should be scrupulously clean and free from enamel. In removing the enamel from tinned conductors, care should be taken to remove only the minimum amount of tin. The methods of stripping and terminating, and approximate lengths of terminations, are as shown in I.C. 5. The ends of 1-pair and 2-pair unwaxed cable should be waxed to seal up the ends of the lead sheath, and to prevent the unravelling of the cotton lapping.

24.2. When connected under a screw or nut type terminal, the wire should be taken round in a clockwise direction, so that the action of screwing will tend to draw the wire into greater contact. In no circumstances should the wire be crossed under a screw, nut, or washer. (See I.C. 5.)

24.3. To ensure maximum security, the final tightening of a nut should be done with a spanner. The methods of terminating wires on soldered tags are as shown in Fig. 16 for standard distributing boxes. Terminations on standard terminal strips, of the type used on a subscriber's M.D.F., are referred to in I.C. 5.

24.4. Entry to Instrument or Battery Box.—The sheath of 1-pair and 2-pair cable should enter an instrument or battery box and project inside for approximately 1 inch only. In an instrument a length of approximately 4 inches of spare unsheathed conductor should be provided, and in a battery box the length should be sufficient to permit of the removal of the cells without disconnexion of the wires. In a standard battery box, i.e., with the sliding front, the length of wire in excess of that necessary to reach the terminals, should be approximately 9 inches where a single row of cells is provided, and 12 inches with a double row. Provision is made for the entry of wiring at four points, one at each side, near the back, and along the back of the box. The spare lengths should not be spiralled, but should be pushed back clear of terminals in the form of a flat loop, without sharp kinks or bends.

25. WIRING IN ADVANCE OF BUILDING COMPLETION

25.1. Before setting out to commence work on an " advance wiring " job, a mechanic must ensure that definite positions have been allocated, or can, without delay, be determined, for the protector and instruments. The wiring shall not be installed prior to the completion of the roof and exterior walls ; preferably within a few days before the commencement of plastering or similar operations.

25.2. As much as possible of the wiring should be so installed that it can be withdrawn and replaced if necessary due to the later development of a defect.

25.3. If, in a timber residence, the plaster has not been placed over the laths, the wiring in a vertical run should be taken in the space in the partition wall and then horizontally along the ceiling members, the precautions outlined in paragraph 13 being observed. (See Fig. 3.)

25.4. At each point of exit from the laths, the cable should be coiled up and wrapped in a piece of sacking or hessian to render it conspicuous and minimize possibility of damage from a plasterer's trowel.

25.5. In a brick structure, the horizontal run of wiring should be taken, where possible, along the ceiling members. On a vertical run to be plastered over, the wiring should be in conduit, of flat or oval section. The conduit should be secured by flat clips, not those of the normal conduit type. In this case, also, the wiring at the exit point should be roughly protected by a piece of hessian, as outlined, or by a temporary, protruding plug of wood to indicate the presence of the wiring.

26. WIRING IN A FACTORY, ETC.

26.1. General.—A number of the preceding paragraphs relate particularly to wiring in a residence. Where reasonable, the instructions therein should be followed in wiring a factory or other building, where appearance is not relatively important, except that care in concealing wiring need not be exercised to the same extent. On exposed woodwork, staples may be used to secure wiring, suitable flat clips or conduit clips, with clouts or screws being used for larger cables. (See Section 4c, paragraph 4.2, for size of clips.) On a masonry surface the methods outlined in Appendix " B " should be used.

26.11. In a large workshop or factory, it is occasionally necessary to carry wiring along wooden principals, tie beams, posts supporting the roof, &c., among machinery. The mechanic should not submit himself to danger due to moving shafting, belts, &c. In circumstances involving danger, he should arrange for the machinery to be stopped, or if this is not reasonable, this class of work should be done at a time when plant is stationary, i.e., lunch time or before or after normal working hours.

26.2. Wiring on Steel Girders.—In a steel-framed factory, every effort is to be made to avoid the necessity of securing cabling, wiring, or an instrument to a steel girder or other steelwork. If there is no alternative to running wiring on girders, &c., there are several methods of carrying out the work, and the most suitable and economical should be selected, having regard to the local circumstances and the tools available. The suggested alternatives are :—

26.21. The use of a running strip of wood secured to the building framework by the subscriber, the wiring being secured to the strip by staples. This cannot be done, of course, where, owing to fire risk, the building has been constructed entirely of metal.

26.22. Small reel or button insulators could be tied by G.I. wire to the framework and Wire, Tph., R.I.W.P. (outdoor distributing wire) pulled through the insulators and supported at centres not exceeding 6 feet.

26.23. Obtain an electric drill. Then drill and tap steel work to accommodate screws supporting clips to hold the cabling or wiring.

26.24. Places at intervals on the iron work may be filed clean, and with the aid of blow lamp flat cable clips sweated thereto, the cable or wire being secured in the clips.

SECTION 4, PART b.—CABLING AND WIRING: P.B.X. SERVICES.

1. DISTRIBUTION TO EXTENSIONS.

1.1. The wiring to a switchboard of a size not exceeding six lines (exchange plus extension) should be taken direct to the switchboard terminals, except where the distribution centre of the majority of the extensions is remote from the switchboard position. It is desirable, in the latter circumstances, to cable to a distributing box at the distribution centre.

1.2. For a wall or table type switchboard exceeding six lines, and for floor type installation, a distributing box or frame should generally be fitted, to avoid the unsightly bunching of numerous small cables at the switchboard. This should be in close proximity to the switchboard, preferably in the same room, in a position at which any work carried out will not interfere with the work of the telephonist.

1.3. Invariably the extensions connected to a switchboard of greater capacity than 30 lines, will require a distributing scheme involving distributing boxes at convenient points approximating the distribution centre of each of the various groups of extensions. In all P.A.B.X. installations an M.D.F. of suitable capacity will be installed in close proximity to the switchboard.

2. TYPICAL DISTRIBUTION SCHEME.

2.1. A typical distribution scheme for a P.B.X. installation is shown in portion of Fig. 12.

3. CABLING METHODS.

3.1. A cable leading to the terminals of a floor pattern switchboard preferably should enter at the bottom. Where practicable it should be run under the floor or floor coverings. In a location where the cable cannot be run economically from the wall to the switchboard, under the surface of the floor, the cable may be run over its surface if the space, over which the cable passes, is not used as an avenue for traffic. Where a cable is placed on the floor surface, it shall be protected immediately after installation by shaped boards as shown in Fig. 7. In most instances the protection will be provided by the subscriber, if a carpenter is available in the building. This should be arranged where possible.

3.2. It may be necessary to run the cable or cables overhead, to enter the switchboard at the top. This should be avoided wherever possible, but, if necessary for a standard installation, a cable runway consisting of a single length of flat mild steel, not exceeding 2 inches by $\frac{1}{4}$ inch in section, suitably bent and drilled, should be used. With one cable, lace it to the runway at 6-in. intervals. With a number of cables greater than one, lace at 4-in. intervals.

3.3. The extension cabling—between the distributing frame or box and a *standard* switchboard—should terminate on the A and B extension tags, i.e., those to which the *straps only* are connected.

3.4. Further particulars of the methods to be adopted in distributing extension cabling and wiring from P.B.X. switchboards are embodied in Section 4c of this Circular, which relates to the internal cabling and wiring of large buildings.

4. METHODS OF TERMINATING.

4.1. The methods of preparing and lacing forms, and terminating, are shown in I.C. 5. Forms connected to switchboard and other terminals should be made on the lines indicated therein.

5. PROTECTION OF CIRCUITS CONNECTED TO P.B.X. SWITCHBOARDS.

5.1. The provisions of G.E.C. 9 shall apply. As indicated in that Circular, all circuits which are partly or wholly aerial shall be given full protection, i.e., fuses, arresters, and heat coils, with the exception that heat coils should be replaced by dummies in power leads. Where the number of circuits likely to require protection at any point is not greater than four, Protectors, H.C. & F. 2/2, should be utilized.

5.2. When the number of circuits requiring protection is anticipated to be between 5 and 10; Mountings, Protector, 0/10 or 0/20 should be used. The method of use is as indicated generally in Fig. 19, where no distributing box is necessary. Figs. 20 and 21 show the protector mountings in association with a distributing box.

5.3. For circuits wholly underground, G.E.C. 9 provides for protection of circuits connected to switchboards which have power leads connected. The protection will not be provided for cordless switchboards, but for cord type switchboards only, and at the distributing box or frame directly associated with the switchboard. A protector mounting or mountings, 0/10 or 0/20, will be installed alongside the distributing box, and will be equipped with Protectors, H.C. & F. 201 as required. The general arrangement will be as indicated in Figs. 20 and 21.

5.4. The protectors will be connected by jumpers, the exchange lines in use being jumpered through protectors in numerical order, similar to that of the appearance of the exchange line termination on the switchboard, i.e., No. 1 exchange line, No. 1 protector, &c. As tie lines appear in the exchange field, the same order of connexion will apply to them. No. 1 protector is at the bottom of the mounting. Outdoor extensions and power leads should be connected to protectors in *reverse* numerical order, i.e., by using the protectors at the top of the mounting. Thus, accommodation will be conserved for the exchange lines and tie lines, and permit them to be connected sequentially as far as practicable. This arrangement is necessary, as frequently the total number of protectors installed will not permit of the reservation of sufficient protectors for the ultimate capacity of the switchboard, e.g., a 10 + 40 switchboard might be equipped with ten protectors only, as the anticipated development for exchange lines and tie lines would not exceed seven, leaving three protectors for a D.C. power lead and possibly two outdoor extensions.

5.5. Where the total capacity of a Box, Distributing, 240/240, is insufficient to accommodate the total cable pairs required for a floor pattern switchboard, or where two protector mountings 0/20 used in association with the box would not provide sufficient protectors, a wall type distributing frame of the type shown in Fig. 22 should be installed, the protection being arranged by jumpering the lines concerned via Protectors H.C. & F. 20/20 or 40/40 installed on Fanning Strip No. 4. The sequence of connexion of protectors should be on the basis outlined in paragraph 5.4.

5.6. Should an increase in the equipment of a switchboard render necessary the installation of additional protectors, the jumpers should be re-arranged, to provide for the maintenance of the exchange and " tie " line sequence at the protectors.

6. NIGHT SWITCHING FACILITIES.

6.1. Access to the exchange from selected extensions, during hours when a standard C.B. floor type P.B.X. switchboard is unattended, is given by means of night switching keys, one per exchange line. Refer to Fig. 42.

6.2. In a switchboard similar to standard, but equipped with only two tags per extension on the terminal strip, the following methods of connexion for night switching are available :—

6.21. Where, at the time of installation, definite extensions have been selected for night switching and from inquiry, *future alterations appear unlikely* :—

6.211. The cable skinners from the selected extensions should be formed out to the " out " N.S. terminals of the respective exchange lines and connected thereto in lieu of the regular extension terminals.

6.212. A jumper, consisting of enamelled cable pair, should then be connected from the " in " N.S. terminals to the regular extension terminals.

6.22. Where *transfer* of the night switching facility at random among the extensions *is likely*, the above method is undesirable owing to the necessary disturbance to the cable skinners at the extension terminals in the switchboard.

6.23. When *alterations are likely*, interference with fixed wiring may be avoided by providing cable pairs between the " out " N.S. terminals in the switchboard and the distributing frame or box, the relative terminals of which should be suitably identified by entry in the associated cable record. The additional pairs should be provided only under direction. (See Fig. 42b.) In these circumstances, the night switching arrangement will be as follows :—

6.231. Terminate all extension cabling between the frame and switchboard on the extension terminals,

6.232. By means of a jumper at the box or frame, the extension requiring to be " night switched " should be connected via the special cable pairs to the " out " N.S. terminals of the exchange line concerned, in lieu of the regular extension line terminals.

6.233. At the terminal strips in the switchboard, the " in " N.S. terminals should be jumpered to the regular extension line terminals.

6.24. It will be seen that under this arrangement transfers can be effected by alterations to jumpers at the box or frame and in the switchboard. The method in use at any particular switchboard can be ascertained by inspection of the records and also of the " out " N.S. terminals in the switchboard.

6.3. In the standard switchboard, five tags have been provided on the extension terminal strip for each extension. Bare wire straps are provided between two pairs of tags A—A1, B—B1, in order that by cutting straps, alteration for night switching can be effected without disturbance to the cable form.

6.31. Arrangements for night switching on a switchboard of this type will be as follows (see Fig. 42a) :—

6.311. Terminate the extension cabling on extension terminals A and B.

6.312. On extensions which require night switching, cut away cleanly the bare wire straps connecting A—A1 and B—B1.

6.313. By means of jumpers connect A and B of the extension to " out " N.S. terminals and A1 and B1 of the extension to " in " N.S. terminals.

7. LONG LINE AND TIE LINE EQUIPMENT.

7.1. Detailed instructions concerning the fitting and wiring of this equipment are embodied in I.C. 9 (not yet issued).

7.2. Recent additions to the standard switchboard include wiring between the sleeve of each line jack and a tag " C " on a terminal strip. This is provided to make the sleeve connexion accessible to prevent access to the exchange from tie lines and also from extension lines with transmission characteristics beyond certain limits to be defined.

8. PYRAMID TYPE SWITCHBOARDS—EXCHANGE LINE CONNEXIONS.

8.1. When only one exchange line is to be connected to a pyramid type magneto switchboard, the indicator on the exchange line circuit should be connected permanently to the line, by wire straps at the jack.

8.2. If a second or later exchange line is being connected, the straps are to be removed from the first exchange line.

SECTION 4, PART c.—CABLING AND WIRING: LARGE BUSINESS BUILDINGS.

1. DISTRIBUTION SCHEME.

1.1. The cable distribution scheme, together with the proposed location of the M.D.F. and distributing boxes, will generally be furnished by means of sketches and floor plans, in which the standard symbols shown in Appendix " C " will be used.

2. USE OF CONCEALED RUNS.

2.1. Where accommodation is available in special concealed runs on partitions, or in floors, &c., wiring *shall not be placed on the surface.*

2.2. Should a mechanic be unable to determine the route of concealed runs in a building with which he is not familiar, he should make inquiry from the officer in control.

3. HANDLING LEAD-COVERED CABLE.

3.1. Particular care should be exercised in working with lead-covered cable. Avoid putting soiled hands to the mouth. The hands should be very thoroughly cleansed before eating.

3.2. Every effort should be made to prevent damage to the sheath. Cable should not be dragged without support, unless the floor is smooth and free from projections. It should be carefully supported past a projection or round a corner. Cable should not be walked on, and its cylindrical form should be preserved, as far as practicable, throughout the length of run.

4. RUNNING CABLE.

4.1. Cable should be concealed if possible, but, except under direction, should not be placed in such a position that it will be " plastered " over, except at a bend around an outside corner, where, to obtain a bend of reasonable radius, it is necessary to cut into the wall. Advantage should be taken of any suitable routes where minimum plugging or cutting through thick walls is required.

4.2. Clips or saddles used to secure runs of individual cable should be as follow :—

Size of Lead-covered Cable—Pairs.		Clips or Saddles.	
Cotton or Silk and Cotton Insulated.	Paper Insulated.	Type for use with Tack, Nail, or Screw.	Type for use with Metal Drive Anchor.
1	..	Clip, cable, flat, $\frac{3}{4}$"	Clip, cable, anchor, 1"
2 and 4	..	Clip, cable, flat, $1\frac{1}{4}$"	Clip, cable, anchor, $1\frac{5}{16}$"
7 and 10	..	Clip, cable, flat, $1\frac{3}{4}$"	Clip, conduit, galvd., $\frac{3}{8}$"
15 and 20	..	Clip, cable, flat, $1\frac{3}{4}$"	Clip, conduit, galvd., $\frac{1}{2}$"
20 and 25	..	Clip, cable, flat, $2\frac{1}{4}$"	Clip, conduit, galvd., $\frac{5}{8}$"
25 and 35	..	Clip, conduit, galvd., $\frac{5}{8}$"	Clip, conduit, galvd., $\frac{5}{8}$"
50	50	Clip, conduit, galvd., $\frac{3}{4}$"	Clip, conduit, galvd., $\frac{3}{4}$"
..	75 and 100	Clip, conduit, galvd., 1"	Clip, conduit, galvd., 1"
100	..	Saddle, conduit, galvd., $1\frac{1}{4}$" ..	Saddle, conduit, galvd., $1\frac{1}{4}$"

4.3. The flat cable clip is for use in cabling or wiring, in positions where neatness is of such importance that a conduit clip would not be suitable, e.g., for an exposed run of cable on an office wall or polished partition. An example of the use in residences of the small clips for 1-pair and 2-pair cable, in lieu of staples, is shown in Fig. 2.

4.4. In no circumstances should a clip or saddle crush the lead sheath of cable. To secure the cable with light pressure on the sheath, it may be necessary to " set " a conduit clip. This should be done by a blow with a hammer. Where several cables are being run side by side, they should be secured by a longer flat clip or by metal tape $\frac{3}{8}$" x 28 S.W.G. (Tape, metal), of suitable length to clip the cables and admit the anchoring device. A clip of metal tape should be trimmed neatly at each end.

4.5. Typical methods of anchoring are shown in Appendix "B." Where possible, the standard "Drive Anchor" should be used to anchor cable on a masonry wall. A wooden plug should be used only in instances where the wall fabric is not suitable for the standard. Unless unavoidable, a cable should not be on a partition or other portion of a building likely to be demolished.

5. CHANGES IN DIRECTION OF ROUTE.

5.1. The minimum *radius* of bend of average cables of the sizes shown below should be approximately as follows :—

Size of Cable in pairs.	*Radius of Bend.*
4 or 5	1″
7	1¼″
10	1½″
15	2″
20	2½″
25	3″
35	3½″
50	5″
100	10″

5.2. If appearance is not relatively important, a bend of greater radius should be made. As an aid to bending cables of the larger sizes where a short bend is necessary, the cable may be warmed to a limited extent before bending. The heating, for which a blow lamp is suitable, should be sufficient only to melt the wax.

6. DISTANCES BETWEEN SUPPORTS.

6.1. Anchors for cable on a horizontal run should be at 1 ft. 6 in. centres, unless supported partly by a moulding, when the points of support may be at 3-ft. centres unless the cable is likely to be disturbed. Anchors on a vertical run should be at 3-ft. centres, except where disturbance is possible. Cable should be anchored within 9 inches from the centre of a bend.

6.2. To preserve neatness, anchors on a clear run should be spaced at equal distances.

7. CABLES IN A RISER SHAFT.

7.1. When cable in a vertical riser between floors is being run, it should be dropped from the upper to the lower floors, except where the total length of an individual cable does not exceed 40 feet. In this latter case the cable may, if more convenient, be pulled from a lower floor up the riser shaft. Where the only riser shaft available is common to electric power and other distribution systems, the maximum possible separation of cables from other services should be provided.

7.2. Cable supports should be at 3-ft. intervals, except in a "built-in" riser shaft with a partially closed front. In this case the supports should be as close as possible, but not less than 3 feet, and special care should be taken that adequate, firm support is given at the upper and lower anchors of a run unsupported greatly in excess of 3 feet.

8. PROTECTION OF SURFACE CABLE.

8.1. Cable on the surface of a wall and passing from floor to floor through a hole in the floor should be protected by conduit of suitable dimensions in the floor and for a minimum distance of 18 inches above. This does not apply to cable in a riser shaft. Conduit should also be used where damage at other points, from ladders, cases, &c., is likely.

8.2. Cable passing through a new concrete wall, or in an old wall where a damp condition is suspected, should be protected by a short length of conduit, of length approximately equal to the thickness of the wall. Alternatively, the cable may be coated with bituminous paint and wrapped with a double layer of adhesive tape.

8.3. When appearance is important, or where necessary to exclude rodents, a hole through which cable passes should be filled in with a "lean" cement mortar, say, one cement to eight sand. The cement should be kept out of contact with the cable sheath as indicated in the previous paragraph. If necessary to fill the space between the conduit and the cable, adhesive tape should be wrapped round the cable and worked, by means of a handle of pliers or a blunt screwdriver, between the sheath and the conduit.

9. CABLES IN "MOULDING" RUNS.

9.1. To preserve neatness and facilitate the provision of services without hammering, &c., in large office buildings, Architects are being encouraged to furnish moulding runs, generally of timber or pressed steel, for the accommodation of cables and wires, particularly where appearance is an important factor. It is emphasized that the maximum possible use must be made of these runs to conceal cable, &c. Entry to and exit from the mouldings must be effected neatly, and concealed as far as practicable.

9.2. A typical entry to a moulding run is shown in Fig. 9. Where an opening has not already been provided to route wiring out of a run of this type, to a position below the moulding, a cut or drilling should be made in the moulding, if possible, at a point close to the wall surface, in such a manner that the wiring is not brought over and secured to the outside surface of the moulding. To conserve accommodation in the moulding, cables should be run straight and packed together neatly.

9.3. If the moulding is such as to require the removal of detachable covers of wood or metal, extreme care should be taken to avoid damage to the covers or to their finished surfaces. The covers must be replaced neatly and properly secured.

9.4. Cabling and wiring abandoned because of defects in insulation, continuity, &c., should, wherever practicable, be withdrawn from a moulding.

10. CABLES IN FLOOR CONDUITS AND DUCTS.

10.1. To make pairs available at isolated positions on a large floor area, where partitions and pillars are not available, conduits or ducts with appropriate outlets and draw boxes are provided in some instances by the Architect. Access from distributing boxes to these runs is arranged. Where the accommodation has been provided, the conduit or duct must be used to conceal cable and wire.

10.2. Cable or wire should not be placed into floor conduits or ducts until the building operations have reached a stage where damage is not likely.

10.3. In the majority of instances fish wires will be used to draw cable into conduits, &c., which have been in position for some time. These conduits, including draw boxes, &c., will invariably be provided by the Architect or builder. During progress of work, mechanics should co-operate, if possible, in placing fish wires in difficult runs during their installation. The open ends of conduits, which otherwise may become blocked, should be plugged temporarily.

10.4. Capacity of Circular Conduits.

10.41. The following table will form a general guide to the size and/or number of cables which may be drawn safely *at one time* into a straight conduit or into one with a very slight bend.

10.42. The dimensions shown are of the outside diameter of the standard circular screwed conduit.

10.43. Owing to the variation of external diameters of lead-covered cables, only approximate figures are given :—

10.44.

Size of Cable.	External Diameter of Screwed Conduit.						
Pairs.	½".	⅝".	¾".	1".	1¼".	1½".	2".
1 ..	2	3	4	7	Use larger cables		
2 ..	1	1	2	5	,,	,,	,,
4 ..	1	1	1	1	2	2	3
7 ..	..	..	1	1	1	2	3
10 ..	..	..	1	1	1	2	2
15 ..	..	..	..	1	1	2	2
20 ..	..	..	..	1	1	1	2
25 ..	..	..	..	1	1	1	2
35 ..	..	..	..	..	1	1	2
50 ..	..	..	..	..	1	1	1

10.45. The free application of petroleum jelly will facilitate the drawing of cable, if difficulty is experienced.

10.5. Cable should not be drawn through a length of conduit greater than necessary, i.e., each " draw " should be between adjacent draw-boxes. Unless draw-boxes on a straight run are at " centres " of less than 10 feet, and ample accommodation is available in the run for free movement of cable, the cable should not be drawn, through two successive sections, past a draw box.

10.6. Fish Wire.

10.61. The fish wire should be of steel, of diameter not less than 0.048 inches (18 S.W.G.). Before introduction by pushing into the run, the end should be turned back in a flat loop to reduce to the minimum the possibility of detention by internal projections.

10.62. Methods of securing cable to a fish wire for drawing purposes is shown in Fig. 8.

10.7. When drawing cable into a run, in which additional cables may be accommodated later, a fish wire should always be pulled with the cable into the run between each draw-box, a length of approximately 2 feet being left at each end, coiled neatly and pushed into the draw-box.

10.8. Cable should be drawn by a steady pull and not jerked. Care should be exercised to avoid sharp kinks or bends in the cable as it enters the run, and the sheath should be guided clear of any sharp edges.

11. OUTLETS FROM CONDUITS AND DUCTS.

11.1. Where outlets are provided between draw-boxes for distribution purposes, these should be used, due regard being given to any means possible to prevent ingress of water, &c., into the duct. Generally, when a particular outlet is placed into use, the outlet fitting will include a means of protection for the cable for a short distance above the floor. (See Fig. 24 (I) for a typical outlet fitting.)

11.2. Floor ducts, which have a removable cover, may be encountered. An exit from ducts of this type should be made in a manner which will not render difficult the later removal or replacement of the removable cover strip. In every instance the cover should be securely replaced by the means provided.

11.3. Outlets from Fibre Ducts Fitted after Installation.

11.31. Where fibre ducts have been installed by an Architect to admit wiring after the completion of a building, and which require the subsequent installation of outlet fittings, it will be necessary to adopt the methods shown typically in Fig. 24. Suitable tools and outlet fittings will be made available when such an installation is to be undertaken.

12. MULTIPLING OF CABLING.

12.1. Cables should not be connected in multiple in distributing boxes, except under direction. Detailed typical methods of actual connexions for multipling are shown in Figs. 13, 14, and 15.

13. FORMING AND TERMINATING.

13.1. Details regarding forming, terminating, and jumpering on standard distributing boxes and frames for use in subscribers' buildings are shown in sketch form in Figs. 16 to 22 of this Circular. Further detailed information regarding terminating is included in I.C. 5.

13.2. In a distributing box or frame, in which the forms are likely to be disturbed by the process of jumpering, there should be one lacing stitch per pair of skinners.

13.3. Cables leading into a box or frame should be anchored as closely as possible to the butt, preferably before lacing and terminating is completed.

13.4. Pairs should be connected to a frame or box in **ascending** numerical order, commencing at the lower end of a vertical terminal strip, or at the left-hand end—facing the strip—on a horizontal strip, e.g., when terminal block No. 6 is mounted with its greatest dimension horizontal.

13.5. In boxes with pairs in part multiple, the pairs individual to the box must be taken into use before pairs which are multipled into another box are used.

14. WAXING OF CABLE.

14.1. With the exception of 1-pair and 2-pair cable, all lead-covered cable provided with cotton or silk and cotton insulation is wax impregnated. Generally, further waxing of forms will not be necessary. If, in the opinion of the mechanic, the condition of impregnation of any particular cable appears to warrant additional waxing of forms, the officer-in-control should be consulted. For any waxing necessary the methods and precautions outlined in I.C. 5 should be observed. Forms should not be varnished.

15. DISTRIBUTING FRAME AND BOXES.

15.1. For a large building cabling job, the locations of the distributing frame and boxes will generally be included in the instructions received.

The underground cable will be brought by the Lines staff to the position of the main distributing frame, and will be provided with a " tail " of silk and cotton cable for termination by the mechanic.

15.2. The method of erection, cabling, and jumpering of a standard M.D.F. is covered generally by Fig. 22. Except in a riser shaft, where no cover is necessary, a minimum space of 1 foot should be available on each side of an M.D.F. In every instance, the position of the frame should permit of ready access for jumpering. Preferably the underground cable should terminate on vertical " A," at the left. Where the frame is not to be cabled initially to its maximum capacity, and space is left on the iron brackets for future installation of verticals, the verticals should be arranged as shown typically in Fig. 22. This will provide for the grouping of underground cable on adjacent verticals. The position of the power distributing panel should preferably be at the lower end of a vertical, disposed centrally in relation to the verticals on which internal cables terminate.

15.3. A cover will not be fitted over a distributing frame unless definite instructions are received. The method of installation of the standard metal cover is shown in Fig. 23. Where, in the opinion of the mechanic, a cover is considered necessary and no instructions for its provision are held, the matter should be represented to the officer in control.

15.4. In those instances in which the choice of a location for a distributing box is left to the mechanic, the following factors should be the bases of choice, as far as practicable :—

15.41. Reasonable proximity to the distribution centre of the area which it is to supply, and also to an available run.

15.42. Availability of reasonable natural or artificial light.

15.43. Freedom from dampness or excessive dust.

15.44. Selection of a wall not likely to be demolished.

15.45. Except when associated with a P.B.X. as a main distributing point, the box should be in the public portion of a building, i.e., where work at a box does not disturb a subscriber other than the one for whom work is being performed.

15.46. Wherever possible, the height of the uppermost terminal of the box should be such that operations may be carried out by a mechanic of average height standing on the floor.

15.47. The distance between a proposed distributing box and a power or lighting switchboard should preferably exceed 6 feet.

15.5. Where a position for a box is available on the wall on which an associated moulding " run " is available, the box should preferably be installed below the moulding, the cable and wiring being led into the top of the box. Usually, arrangements can be made for an aperture to be left at the bottom of the moulding. (See Fig. 9.)

15.6. If the estimated total number of pairs to be terminated ultimately does not exceed 240 pairs, one of the larger sizes of distributing boxes may be used as a main distribution point. Where necessary to cater for the distribution of power leads from one of these boxes, a power distributing panel may be fitted in place of one of the terminal strips, generally as indicated for the M.D.F. in Fig. 22.

16. ENTRY TO DISTRIBUTING BOX.

16.1. In the placing of cable and wiring at the point of entry to a distributing box, the maximum care should be exercised to preserve neatness. Where necessary, small cables should be bunched parallel to each other and secured with metal tape. (See Figs. 17, 18, 20, and 21.)

17. SCREWS IN A DISTRIBUTING BOX.

17.1. The standard distributing box (Block, Terminal No. 2, 3, or 6), having a capacity of 10 pairs and less, is provided with screw terminals. The main purpose of this choice of standard is to facilitate installation and maintenance operations, by eliminating the need for soldering where it is inconvenient and difficult.

17.2. It is essential that terminating in this type of box be done with care. The bared conductor should be well cleaned, taken in a clockwise direction under the screw head, and the screw should be well tightened. As indicated in I.C. 5, a conductor should **not be crossed** under the head of a screw.

18. SOLDERING.

18.1. Terminations on solder type tags should be soldered securely. When work is being performed on a distributing box or frame, any defective soldering observed should be made satisfactory.

19. PROCEDURE WHEN CABLE ACCOMMODATION IS EXHAUSTED.

19.1. If, after the connexion of a service to a distributing box, only one vacant pair remains, a mechanic must report the fact briefly to the officer-in-control, with particulars of the name of building, the floor and box number. Similar steps should be taken when it is apparent that a run, provided for concealed wiring, is becoming congested.

20. BONDING CABLE SHEATHS.

20.1. The lead sheath of cable in a large city building is to be utilized for the earth return for direct current power leads. The sheaths of all distribution cables, except 1-pair or 2-pair cable not associated with a power lead, should be bonded together and bonded finally to the sheath of the underground cable. A typical method of bonding is shown in Fig. 11.

20.2. The sheath of the underground cable and all distribution cables should not come in electrical contact with the ironwork of an M.D.F. *equipped with protectors.* For this purpose, a spacing block of wood or other suitable material should be taped to the ironwork.

21. DISTRIBUTING FRAME AND BOX RECORDS.

21.1. Verticals of terminal strips on a distributing frame or box should be identified by means of letters, for the purpose of record, as indicated in Appendix " C." If the ultimate number of verticals will exceed two, each vertical should be lettered by means of a water slide transfer in the approximate position shown in Figs. 21 and 22. In a distributing box, the left vertical shall be " A." The lettering on a distributing frame shall also commence with " A " at the left vertical, except in those rare instances in which the direction of expansion of the frame must be from right to left. On a frame which is partly equipped, the lettering shall be so disposed as to admit of the proper sequence of lettering when further verticals are installed.

21.2. On a distributing frame the relative position in the vertical of the numbered terminals should be shown by means of a water slide transfer placed at the top of each group of twenty pairs of terminals on the front face of the ebonite. (See Fig. 22.)

21.3. Water slide transfers are obtainable from stock, and may be applied readily to a reasonably smooth surface as follows :—

21.32. Cut required portion of transfer neatly, and immerse in clean water.

21.33. Clean the surface to which transfer is to be applied.

21.34. Press transfer firmly into contact with surface, and then wet backing paper thoroughly.

21.35. Allow transfer to remain two or three minutes, then lift or slide backing paper away from film left on surface.

21.4. The particulars identifying a distributing box, i.e., the box number, should not be placed actually on the box, the entry in the appropriate position on the record card being sufficient.

21.5. In every existing installation, where the standard method of numbering boxes and M.D.F. verticals can be applied, steps should be taken, when new record cards or boxes are necessary, to adopt the standard system of identification. If, for example, a new record card is required for only one box, the appropriate vertical lettering and numbering should be given to the box on the new record card, unless the installation concerned has some boxes in full multiple, in which case the numbering system cannot satisfactorily be used.

21.6. Particulars of the forms required for the purpose of recording the connexions on terminating equipment in a large building are shown below :—

Form No.	Title of Form.	Used for—	Where Placed.
S.E. 515 (card) ..	Distributing box record (10-pair)	10-pair and 4-pair box ..	In standard screw type box, in pocket in lid of box
S.E. 516 (card) ..	Distributing box record	Box larger than 10 pairs and for a small frame	In standard box, under clip in lid ; with small frame, in metal or wooden pocket screwed to wall adjacent to frame
S.E. 517 (book) ..	Subscriber's M.D.F. record	Distributing frame or large box at U.G. terminal or at P.B.X.	Hung by loop of tape or string on wall at back of frame, or placed in clip in cover of box
S.E. 518 (card) ..	Distributing box record, P.B.X. services	Large distributing box or small distributing frame used as a **main** distribution point at a P.B.X.	In standard box, under clip in lid ; with small frame, in metal or wooden pocket screwed to wall adjacent to frame

21.7. These forms are arranged for use in buildings in which the method of cabling and numbering of distributing boxes is generally similar to that shown in the typical cabling diagram shown in Fig. 12. They should be used for the purposes mentioned above, and should invariably be placed into the clip or pocket provided.

21.8. Typical entries on the forms when used for the purposes intended are shown in Appendix " D." Entries made on the forms should be on the lines indicated, and should be as complete as possible. Particular attention is drawn to the method of indicating, on Forms S.E. 517 (book) and S.E. 518 (card), the locations of distributing boxes.

Each record card—S.E.515 or S.E.516—provided for a box in which multipled pairs are connected, should be endorsed in the space provided, with the particulars indicating which pairs are multipled. The record of multipled pairs should appear in both boxes. If, in an old installation, pairs appear in a number of boxes greater than two, and the standard record cards are used, the particulars of multipling entered on the card should be complete, i.e., each multipled box, and the pairs connected therein, should be recorded.

21.9. The cards are printed on both sides, so that records which tend to become illegible, due to erasures on one side, may be transferred to the other. The records which are cancelled in this manner should be crossed out by two parallel lines drawn diagonally right across the face of the card. The cards should not contain active records on both sides.

22. USE OF RECORD FORMS ON EXISTING INSTALLATIONS.

22.1. The standard forms will be found satisfactory for use in a building in which the cabling and numbering scheme differs from that outlined in this Circular, and should be used in place of any existing card or book. Existing forms for record purposes are thus superseded. Slight modifications may be necessary in methods of recording in some instances. In any case of doubt as to the method of recording, the advice of the officer-in-control should be sought.

22.2. Where the numbering of terminal strips in an existing installation is from top to bottom, the numbering of record cards and books should be rearranged to read downwards before the insertion of records.

23. RECORDS TO BE KEPT ACCURATELY.

23.1. It should be understood that, when any alteration is made to a connexion on a box or frame, as the result of a new service, removal, transfer, or cancellation, it must be recorded by an entry or erasure, as the case requires.

23.2. When an alteration is made to the nature, number, &c., of a service, and connexions in distributing boxes or frames are not affected, the associated record on box and frame should be suitably amended.

23.3. Extreme care should be taken by all concerned, to ensure the safety of the record cards and books. A missing record card in a box of 10-pair or smaller capacity must be replaced by the mechanic who first observes the condition. Reference to the M.D.F. record and a few simple tests should facilitate insertion of the record of actual connexions in the box. A report should be furnished to the officer-in-control regarding missing records in boxes of capacity larger than 10-pair and distributing frames, in order that steps may be taken to place the records in a satisfactory condition. Similar action should be taken if for any reason a mechanic is unable to find time to replace a record card in a small distributing box.

23.4. It will be appreciated that incorrect records in large buildings are a fruitful source of waste effort on the part of mechanics on maintenance and subsequent installation operations. The co-operation of all mechanics is sought in ensuring that records are adequate and accurate.

24. RECORDS OF FAULTY CABLE PAIRS.

24.1. The records concerning a cable pair found to be faulty, during initial or subsequent installation work, should be made at the distributing frame and the relative distributing box. The entry should include particulars indicating the fault, e.g., " Faulty, open B side." This is of extreme importance where a pair in multiple, due to low insulation or " earth " fault, has been disconnected at the multipling point.

SECTION 5.—TESTING OF COMPLETED INSTALLATIONS.

1. GENERAL.

1.1. Each installation shall be tested in accordance with the relevant portion of this section, to ensure satisfactory operation before it is made available for traffic. Some tests required during the progress of an installation can be performed most expeditiously with the aid of the exchange testing equipment. If testing equipment in an exchange is staffed the tests should be made by the exchange testing officer.

2. PRELIMINARY INSPECTION AND ADJUSTMENT.

2.1. Before calling for a test on a completed installation, the component parts of the equipment should be inspected for satisfactory mechanical assembly and operation, and any necessary adjustment should be made.

2.11. Where centralized repair of transmitters is established, the carbon chamber of a "solid-back" transmitter should not be opened if the transmitter is defective, except to give temporary service pending replacement by another complete transmitter.

2.12. Similarly, where dials are adjusted and repaired at an established centre, adjustments for speed may be made, but no other adjustments should be effected, except to give temporary service pending replacement.

2.2. The following should be watched for and any defects remedied during the inspection of equipment at the time of installation :—

2.21. General.

2.211. Inspect closely for, and remedy, dry joints or other loose connexions.

2.212. Ensure that wiring forms are not in rubbing contact with a moving member in the equipment.

2.213. Components should be fixed securely in position.

2.214. The movement of the swivel bracket holding a solid-back transmitter should be stiff, to an extent sufficient to hold the transmitter at any angle in which it is placed.

2.215. Check switch-hook for free movement and adequate break and follow of contact springs. The pivot screw should be screwed up tightly, and in this position should not cause the hook to "bind." If "binding" is caused, the hook carriage should be removed from the assembly. The end of the fixed bush should then be filed slightly to ensure that the length of the loose bush is slightly greater than that of the fixed bush. The pivot screw *should not be left loose* as a means of correcting stiff operation.

2.216. By careful manual operation of all relays with the forefinger, check that armature stroke, break of contacts, and follow of springs is reasonable.

2.217. Observe that movement of generator and associated contact springs is free and adequate, and that the axle or barrel of the handle does not rub against the woodwork or escutcheon.

2.218. Ensure that finger plate of dial restores **freely** to normal, and that the operation of slipping cam and both spring assemblies appears positive and satisfactory. (See paragraph 2.12.)

2.22. Protectors :

2.221. By pressure sideways on the springs make sure that they are secured tightly by the plates holding them to the porcelain base.

2.222. Check that adequate spring tension is exerted on heat coils, fuses and carbons. Inspect the soldered junction between the large collar and the wire from the outer end of the heat coil winding. If unsatisfactory, replace the heat coil. Inspect faces of carbons and micas if protector is of the type in which they are fitted.

2.23. Single Extension Services.—Test ringing in each direction between main and extension. If a speaking battery is provided, test speech also. Observe that supervisory signal—if provided—in extension switch operates when extension "loops" the exchange line and restores cleanly when loop is removed.

2.24. Portable Telephones.—Test **each** portable speaking instrument from **each** jack.

2.25. Extension Bells.—Test magneto bell for ringing. If switch is provided, test that it does not interfere with operation of bell on telephone.

A trembling bell should be tested for efficient operation. Test that the switch disconnects the bell from the battery. Should adjustment be required, the following should be observed :—

2.251. When at rest the contact spring of a bell or buzzer should exert adequate pressure on the contacts. With a 2½-in. bell of standard type (i.e., with terminals permitting series or parallel connexion of two 50-ohm windings), this condition is satisfied by such an adjustment of spring tension, that the contacts do not quite separate, when the bell is placed on its side with the armature horizontal and above the magnet cores. With larger bells this method of ascertaining spring tension should be used as a basis, subject to minor adjustment to ensure satisfactory ringing.

3. SWITCHBOARDS—INSPECTION AND TEST.

3.1. Except when reconditioned or altered in the Workshops, switchboards to be installed will be issued direct from stock, without previous test. Switchboards from Workshops will be tested completely before issue, and the tests on these switchboards by installation mechanics should be confined to that of ensuring satisfactory operation of circuits connected, and of apparatus which will be brought into use. These tests are included in paragraphs 6 and 8. C.B. switchboards (22 V. and 46 V.) direct from stock, without prior test, will require a more comprehensive test prior to the connexion of cabling unless local instructions to the contrary are received. An outline of the most satisfactory methods of test of standard switchboards is given below. (See also paragraph 2.21 (General).)

3.2. Insulation Tests.—The maximum possible amount of wiring and equipment should be tested. It should be borne in mind that condensers for general telephone purposes are built to withstand 400 volts—not 500. The methods of preparing a standard or similar switchboard for insulation tests will be as follows. For switchboards of other types the methods will need to differ in detail, but should be on the lines indicated.

3.21. C.B. Cordless Switchboards.—Disconnect earth common from supervisory relays, or alternatively separate carefully the contacts of each relay with an insulating material. A toothpick or similar insulating medium will suffice. Do not place the insulator between the actual contacts as a particle may remain and cause trouble. Operate each extension switching key in the top row with the lever down, i.e., the top springset operated. Check that the top springsets are those to which the indicator wiring is taken. If not, select the switching common position from which the indicator wiring comes and throw keys to operate springsets on that " common."

Connect the exchange test desk to the power lead terminals and test. The overall insulation resistance should be not less than 1 megohm for a switchboard having unenamelled wiring and 5 megohms if the wiring is enamelled. Unless simple isolation tests reveal ready means of rectifying a definite trouble, the switchboard should not be installed.

3.22. C.B. Cord Type Switchboards (Standard or Similar).

3.221. Operate the plug seat switches by lifting all answering plugs and hanging the plugs over the front of the keyboard clear of each other.

3.222. Remove common earth from contacts of supervisory and also AX relays (if AX relays fitted).

3.223. Connect a 500-volt insulation tester to direct current power lead terminals **after disconnexion of 10 M.F. condenser.** The overall insulation when tested in this manner should be not less than 1 megohm for a switchboard having unenamelled wiring and 5 megohms if the wiring is enamelled. If a lower reading is obtained, sections of the switchboard should be isolated methodically, commencing with the removal of fuses in turn, during the initial stages of the search. Any definite trouble found should be rectified before the installation is handed over as complete. Should the low insulation condition be spread over the switchboard, the officer in control should be advised without delay.

The exchange line wiring should not be tested with a potential of 500 volts in view of the presence of the condenser, but should be tested by the test desk after connexion to the exchange.

3.23. Magneto Switchboards.—No insulation test of magneto type switchboards need be performed unless under instructions.

4. SWITCHBOARD OPERATING TESTS.

4.1. Components of Switchboards.—After connexion of power to a switchboard, the following operating tests should be applied to the components :—

Type of Equipment.	Operating and Release Tests.		Method of Test.
	To operate positively and fully with current in m.a.	To release cleanly on disconnexion after operation with current in m.a.	
Eyeball Indicators—			
Exten. 500 ohms ..	15 to 20	50 to 60	Connect test leads to extension line terminal assembly
Super. 1,000 ohms ..	10 to 15	30 to 40	Lift answering plug of cord circuit to be tested. Separate contacts of super. relays, with insulating material. Earth each indicator in turn at relay contact through testing meter and resistance box
Relays—			
Super. 30 ohms (cord type board)	20 to 25	75 to 100	Connect test leads to an extension line termination. Insert each plug into extension jack in turn. Ensure that answering plug of cord circuit under test is off the plug seat
B.C.O. 1,000 ohms ..	12 to 15	35 to 40	Where no AX relays are fitted, earth each B.C.O. in turn at "sleeve" cord tag, through testing meter and resistance box. If AX relays are fitted, with each answering plug off plug seat switch in turn, earth each B.C.O. relay winding in turn on side opposite to battery common, e.g., at AX2 contact spring, through testing meter and resistance box
AX 1,000 ohms ..	12 to 15	35 to 40	With each answering plug off plug seat switch in turn and earth removed from CS/1 contact, earth each AX relay in turn on side opposite to battery common, through testing meter and resistance box

4.11. Owing to the fluctuation of terminal voltage at the switchboard, approximate values only of testing currents are given, but as considerable margin is provided between test current and practical operating current values, compliance with test conditions should ensure reliable operation.

4.2. Relays in Cordless Switchboards :

4.21. Marginal operating tests will not be necessary on relays in cordless switchboards, unless local instructions are received regarding a particular type or delivery of switchboards.

4.22. Close observation of the operation of supervisory relays and indicators under practical operating conditions shall be made, however. The operation and release shall be positive.

4.23. Relays in the standard C.B. cordless switchboard are of the "slow to release" type, and each of these should comply with the following test under dialling conditions.

4.231. With line current adjusted, by the insertion of resistance, to a value between 30 and 32 milliamperes, the relays shall remain operated during the dialling of 000 from the operator's telephone and should release positively, after the "release lag" period, upon the breaking of the telephone loop.

4.24. This test should be conducted with care. The relays are provided with a "slow-release" feature to prevent the "chatter" operation of the exchange and extension indicators during dialling, and unsatisfactory functioning of the relays will result in undesirable operation of indicators.

4.25. Earlier types of C.B. cordless switchboard are equipped with relays not having a "slow to release" characteristic. Where these switchboards are installed in automatic exchange areas, dialling will cause irregular operation of indicators. This is unavoidable, but the relays should be inspected for operation as indicated in paragraph 4.22.

5. ADJUSTMENTS TO APPARATUS IN P.B.X. SWITCHBOARDS.

5.1. Relays.

5.11. Should failure of relays to comply with tests indicate the need for adjustments, these should be performed in accordance with specified data.

5.12. Switchboards are now purchased with adjustment data given on the circuit diagram. Details of adjustments of typical P.B.X. relays of Ericsson manufacture are shown in Fig. 43, and these may be used as a basis for adjustment of relays of a similar general type. For relays of types not similar, for which the methods outlined cannot be applied, the mechanic, at the commencement of work on the installation, should secure from the officer-in-control, adjustment data for the relays of the type fitted.

5.13. In general it may be stated that the aim should be to obtain sensitivity of relays without reduction of pressure between any two contacts below 10 grammes. Excessive bending of contact springs should be avoided. Where ample operating energy is available, the contact pressure should be as high as practicable, consistent with reliable operation.

5.14. Relays, however, should not be adjusted by "trial and error" methods unless, under conditions of emergency, adjustment data cannot be procured.

5.2. Eyeball Indicators.

5.21. An eyeball indicator which exhibits a tendency to stick should be inspected for the following :—

Defect.	*Remedy.*
Stiffness of pivots in bearings	Clear any "burr" in metal if present. **Do not lubricate,** as this results in later sticky operation.
Side members of moving portion rubbing on framework	Clear by slight bending.
Rubbing of armature on pole piece	Clear by slight bending.
Absence of brass residual stop in armature ..	Replace indicator.
Excessive residual flux	Sticking due to this cause can be cleared usually by a slight increase in tension of the night alarm contact springs. The tension should not be increased to an extent sufficient to prevent full operation.

5.22. If a switchboard is fitted with glass protection over indicators, the frame should be replaced, with all securing screws.

5.3. Drop Indicators.

5.31. These should be tested under working conditions with ringing current. Tendency to stick should be closely watched for. The armature and latch must restore clearly after operation and must retain the shutter positively.

5.32. The following indicates the common causes of, and remedies for, defective operation :—

Defect.	*Remedy.*
Armature stroke insufficient to release shutter ..	Increase stroke by slight upward bend of latch, close to armature, or if residual screw adjustment is excessive, reduce. The latch should not be bent excessively, and should be free from kinks after adjustment.
Pivot screws and lock nuts tight or loose ..	Adjust to permit of very slight slack between armature and pivots, then tighten lock nuts.
Armature sticking in operated position due to residual magnetism	Increase residual adjustment.

5.4. Shunted Indicators on C.B. Switchboards.

5.41. The exchange indicators on a standard C.B. switchboard are provided with a shunt of 2,000 ohms, to minimize unwanted operation due to inductive surges transmitted over the circuit from automatic exchange switching equipment. Should the shunted indicator lack sensitivity, the condition should be rectified by adjustment and *not by disconnexion of the shunt.*

5.5. Switching Keys.

5.51. Generally, keys of the standard type will not require adjustment. Where any evidence of stiff or " sticky " operation is present, the stiff steel spring screwed to the brass frame should be removed, to permit the withdrawal and lubrication of the steel ball and associated brass plunger with key lubricant. This must be done on all keys which exhibit any trace of sticky operation, or where the appearance of that portion of the edge of the nickelled steel cam over which the steel " detent " ball rides, suggests that lubrication is required.

6. OPERATING TESTS (GENERAL).

6.1. Prior to final test, each circuit should be tested for actual operation. On switchboards this includes the test of supervisory equipment. Every switching circuit on cordless and cord switchboards should be used during the test, use being made of the cord test jack where provided on cord type switchboards.

6.2. Each C.B. or automatic exchange line on a P.B.X. installation should be tested for correct polarity, i.e., negative battery on the " B " side.

6.3. Where no exchange test facilities are provided, or staff for testing is not available at the exchange concerned, e.g., at a country station, the instrument should be thoroughly tested before departure for the substation, and where practicable, the line also should be tested. Tests after installation will then be confined to ringing in both directions, and speech with the local telephonist, unless, of course, special local instructions exist regarding method of test.

7. TEST OF CABLING IN A LARGE BUILDING.

7.1. Each cable pair terminated shall be tested for :—

7.11. Continuity.

7.12. Correct sequence.

7.13. Reversals at terminals, i.e., A or B wires in correct position at each termination.

7.14. Transpositions between wires of pairs.

7.2. Where the total number of internal cable pairs terminated at the M.D.F. or box does not exceed 100, a test of insulation by means of the exchange test desk equipment at the time of test of lines connected, will suffice, unless a 500-volt insulation tester is available in the building in connexion with the test of a P.B.X. switchboard.

7.3. If a tester is available, test one pair in each branch cable if enamelled cable is used, and 25 per cent. of pairs in each branch if unenamelled.

7.4. In a larger installation, i.e., over 100 internal pairs, test one pair in each branch of enamelled cable and 25 per cent. of pairs in branches of unenamelled cable, using a 500-volt insulation tester.

7.5. Insulation tests on every pair should not be imposed unless—

7.51. With enamelled cable the insulation resistance of any pair is lower than 10 megohms.

7.52. With unenamelled cable the insulation resistance is lower than 5 megohms.

7.53. Due to damage or for other reasons, the condition of the cable is suspect.

7.6. With enamelled cable, an insulation resistance value below 5 megohms, and with unenamelled cable, 2 megohms, should be rectified or the cable replaced, unless the remaining pairs in good condition are sufficient in number to meet development. Of course, if the insulation resistance value of the faulty pair or pairs is so low as to suggest the occurrence of mechanical damage likely to result in the development of L.I.R. trouble throughout the affected cable, the cable should be thoroughly inspected with a view to replacement.

8. TESTS BY TEST DESK.

8.1. In an exchange area served by staffed testing equipment, each exchange, extension, "tie," or private line equipped with a Departmental telephone, shall be spoken over and tested by the exchange testing officer in conjunction with the installing mechanic. For the purpose of recording information on the master card, the installing mechanic will be asked by the testing officer for the following :—

8.11. Type of equipment.

8.12. Whether dial, or protector, is fitted.

8.13. For P.B.X. exchange lines ; indicator number on which line is terminated.

8.14. General hours of anticipated attendance of subscriber.

8.2. The following tests will be made of each station, the results also being recorded where provided for on the master card or extension card :—

8.21. Line resistance, i.e., with line terminals short-circuited at instrument. (This will not be necessary with magneto equipment.)

8.22. Loop resistance—includes instrument, or on cord switchboards "holding-coil" loop.

8.23. Deflection due to condenser discharge (if condenser fitted).

8.24. Insulation tests, A line to earth.
B line to earth.
A line to B line.
(The overall insulation of circuits should be at least 1 megohm, except in country districts, where long open routes of doubtful construction are involved.)

8.25. Transmission test through 40 db.

8.26. Test of dial for speed, ratio of impulses and counting of impulses.

8.27. Efficiency of protector earth (if provided).
(The resistance of a protector earth measured as accurately as possible from the test desk, generally should not exceed 25 ohms. If, by means normally available, this maximum is exceeded, the Engineer should be advised.)

8.3. **Definition of Loop (Switchboards).**—On a C.B. cordless type switchboard the exchange line loop resistance will include the telephonist's telephone and also the resistance of relays in series with the line. The loop on a magneto switchboard will include the line indicator only. On a C.B. cord type switchboard the holding coil loop is recorded for the exchange lines.

8.4. **Test of Extensions.**—The test of extensions on a C.B. switchboard will be conducted via the first exchange line as follows :—

8.41. **Cordless Type.**—Connect each extension to the exchange line in turn via *different switching commons*. When requested by the testing officer, short-circuit the line terminals of the instrument and co-operate in other tests covered by paragraph 8.2.

8.42. Cord Type.—Any C.B. cord type switchboard purchased subsequent to the date of issue of this instruction, or any switchboard reconditioned in the Workshop and having suitable circuit arrangements, is provided with a key to disconnect the holding coil on the first exchange circuit. This is to permit the exchange testing officer to test the extension lines, using the normal cord circuits. Some earlier types have such circuit arrangements that an extra test key cannot be fitted. Switchboards of earlier types which are in service are generally not provided with this key.

8.43. It will be appreciated that the use of the normal cord circuits for testing will involve the inclusion of the resistance of the relays in the loop readings observed by the testing officer.

8.44. Where no key is provided to open the holding coil, the test of individual extensions added from time to time should be arranged by one of the following alternatives :—

8.441. Remove carefully one wire from the holding coil tag by unsoldering. Conduct test, re-connect, and re-solder.

8.442. Cross-connect an exchange line and the extension at the frame. After test, place wiring straight.

9. PUBLIC TELEPHONES AND COIN ATTACHMENTS.

9.1. Particulars of the adjustments and tests on public telephone equipment of the standard type are included in the following Maintenance Circulars :—

M.C. 17. Automatic Public Telephones—Post-payment type—Adjustment Data.

M.C. 22. Manual Public Telephone Coin Attachments.

9.2. When automatic P.T. equipment is installed on a subscriber's direct exchange or an extension line, it is important that thorough tests be made to ensure that the **normal** battery potential, i.e., negative on the " B " side, is not reversed under any condition, except that of a completed outgoing call. On a P.B.X. service **each** of the exchange lines *and connecting circuits* should be tested for correct polarity.

10. TEST SEQUENCE NUMBER.

10.1. Except where local instructions provide for other procedure, a mechanic on completion of an order for any class of work shall obtain a sequence number by telephone from the test desk, where staffed, whether or not an actual test is necessary.

10.2. In the case of a cancellation the line is usually disconnected at the exchange prior to the recovery of the instrument, therefore a sequence number shall be obtained by other suitable means. The sequence number shall be recorded in the position provided on the order.

11. INFORMATION FOR TRAFFIC STAFF.

11.1. Immediate advice must be furnished in every instance by the installing mechanic to the traffic staff, for " Information " purposes, of the connexion of a new line, a removal, a change of call number, and also a cancellation. This information will be additional to that given to the test desk, and a separate " traffic " sequence number should be obtained and recorded on the order. The point to which this notification is to be made will be arranged locally.

11.2. Where, in the case of a cancellation, the service has already been temporarily disconnected, the mechanic should advise the traffic staff from another telephone at the earliest opportunity.

11.3. Before disconnecting a working service for any reason, the test desk, in the case of an automatic exchange, and the local officer-in-charge (traffic) in the case of a manual exchange, should be advised by telephone, the estimated period of disconnexion being given.

12. OPERATION OF EQUIPMENT—ADVICE TO SUBSCRIBERS.

12.1. Except for cord type switchboards, the mechanic will furnish detailed advice to the subscriber regarding the operation of the equipment, irrespective of any subsequent advice which might be given by officers of the Telephone Branch.

12.2. With a cord type switchboard, however, the operating details will be furnished by the Telephone Branch staff, except where special arrangements are made for this to be done by the installing mechanic. From time to time an officer of the Telephone Branch will be in touch with the installing officer where a cord type board is involved, so that the probable date of completion will be known in sufficient time to enable adequate training to be given in the operation of the switchboard. The installing staff should co-operate with the Telephone Traffic staff in such a way that the arrangements will operate satisfactorily.

12.3. When conveying the information to the subscriber, the mechanic will no doubt do so in a courteous and concise manner, special emphasis being given to the following :—

12.31. The correct manipulation of the dial. Where dialling tone is provided, a suitable explanation should be made in regard to its occurrence.

12.32. The correct method of replacing the receiver or handset.

12.33. In the case of a magneto service, the necessity for " ringing off " at the end of the conversation.

12.34. Identification of busy signals and other tones which are provided.

12.35. The correct manipulation of holding facilities on a C.B. extension switch or cordless switchboard.

12.36. The correct use of night alarm and " power cut-off " facilities. This is of particular importance where extensions on a C.B. cordless switchboard are "night-switched."

12.37. The importance of speaking clearly, in a properly regulated tone, with lips close to but not touching the mouthpiece.

12.38. The correct manner of holding the receiver, i.e., that it should not be pressed **too tightly** against the ear.

12.39. The need for answering calls promptly and in a courteous tone, and also declaring the name of the firm or the exchange number instead of using " Hullo."

12.4. The subscriber should be requested to perform personally the operations necessary to ensure that he is conversant therewith. In addition, his attention should be drawn to the printed instructions regarding the operation of telephones, included in the early pages of the Telephone Directory.

SECTION 6.—DISMANTLING OF SUBSCRIBERS' EQUIPMENT.

1. GENERAL.

1.1. Equipment shall be dismantled carefully, and shall be handled so as to avoid damage during return to store. Much damage to cabinet work may be avoided by careful handling after dismantling. Should it be necessary to leave dismantled equipment at the premises of a subscriber, to await transport or for other reasons, every precaution necessary to ensure safety shall be taken.

1.2. All equipment associated with a service to be cancelled or removed should be dismantled. For example, particular care should be taken to recover the equipment at the main station (i.e., extension switch, generator and battery box, and also protector if installed) when a single extension is cancelled.

1.3. Regarding switchboards ; if upon the cancellation of an extension or extensions, the switchboard, n the opinion of the mechanic, should be replaced by one smaller, or by, say, an extension switch, he should furnish written advice of the matter to the officer-in-control. If the orders held cover such work or, alternatively, additional extensions are likely to be required at an early date, obviously, no such action need be taken.

2. RETURN TO STORE.

2.1. Recovered apparatus shall be correctly accounted for by entries on the telephone order and also on the Form S. 7 covering return to Store. Each separate piece of equipment to be returned shall be provided with a label (Form S.E. 212), upon which the following particulars shall be inserted :—

2.11. Name of station.

2.12. Number of S. 7.

2.13. Number of Telephone Order.

2.14. Plant Account to be credited.

2.2. Terminal screws in all dismantled equipment should be tightened upon recovery, sufficiently to prevent loss of the screws *en route* to the Store. A bell receiver, or other portion of equipment attached only by cord, should be tied securely by the cord or other means to the major portion of the equipment. The mouthpiece and generator handle should be protected against damage.

3. DISMANTLING OF CABLING AND WIRING.

3.1. Generally the cost of recovery of 1-pair and 2-pair cable exceeds the recovered value. In view of this, and also of the possibility of re-use, wiring which is in a tidy condition may be left in position upon dismantling of the equipment, except where the subscriber requests that it be dismantled.

3.2. Cable of larger sizes should be recovered, except where re-use is expected. In such circumstances, upon receipt of instructions, it may be left in position.

4. ABANDONMENT OF FLOOR OUTLETS.

4.1. When a standard or similar floor outlet is to be abandoned the cable should be withdrawn from the duct. A suitable plug should then be inserted in the outlet to take the place of the outlet fitting.

5. RECOVERY OF CONTROL AND COIN ATTACHMENT KEYS.

5.1. Upon dismantling a telephone equipped with a control lock or coin attachment, the keys thereof must be recovered from the subscriber and tied securely to the equipment. If, through loss or other cause, the keys cannot be recovered, the telephone order should be endorsed. In any case, the number of keys which have been recovered should be indicated on the order.

6. DISCONNEXIONS ON DISTRIBUTING FRAMES AND BOXES.

6.1. Upon cancellation or removal of a service connected via an internal distribution scheme, all jumpers on frames and also on distributing boxes—if provided thereon—shall be removed and tags left in a clean condition. Wiring connected to tags or terminals in distributing boxes, which are not in multiple, may remain connected, with a view to possible re-use, unless it is known to be faulty. This, however, must not be applied to jumpers.

6.2. Wiring connected to tags or terminals which are multipled in another distributing box must be disconnected, turned neatly back, and secured clear of the box. (See also paragraph 7.2.)

7. AMENDMENT OF RECORDS.

7.1. Records affected by services disconnected from associated distributing boxes and frames must be amended by neat erasure of the particulars of the service.

7.2. Where a long run of wiring, the route of which is not obvious, is thrown out of use, the mechanic should, where practicable, affix to the wiring at the end adjacent to the box, a small linen or card label indicating the room number or other brief note sufficient to identify at the box the position of the remote end of wiring. The label should be concealed as far as possible from common view.

8. EQUIPMENT RECOVERED IN A DAMAGED CONDITION.

8.1. Should equipment to be recovered show damage or excessive depreciation which cannot be ascribed to normal usage, the attention of the subscriber should be drawn to the condition, after which the mechanic should take the following steps :—

8.11. Ascertain if the equipment is insured, and if so, whether the insurance assessors have made an inspection.

8.12. If equipment is uninsured, or inspection for the value of the insurance has been made, the mechanic should request the subscriber to complete an application for repair to damage, on Form " Tel. 40." The number of the relevant Form S. 7 should be shown on the Form " Tel. 40," which should be forwarded direct to the Telephone Branch.

8.13. Upon recovery, the equipment should be labelled clearly, " Cost recoverable from subscriber," and returned to store. The accompanying Form S. 7 and the telephone order should be endorsed " Urgent—Cost recoverable from subscriber."

8.14. If the subscriber is not available, or refuses to sign the Form " Tel. 40," the mechanic should proceed, as outlined in paragraph 8.13, and in addition, briefly endorse the telephone order to indicate why Form " Tel. 40 " has not been signed.

9. ENTRY TO CLOSED PREMISES.

9.1. Where it is known that premises, in which dismantling is required, have been vacated, steps should be taken by any means which appear reasonable to arrange in advance for the supply of keys and thus avoid waste of travelling time.

9.2. In no circumstances shall a forced entry be made to premises.

10. REFUSAL TO PERMIT RECOVERY OF EQUIPMENT.

10.1. On an occasion when the occupant of premises refuses definitely to permit recovery of equipment, which is covered by orders held, the circumstances should be reported briefly in writing to the officer in control.

10.2. Should an occupant suggest that permitting the equipment to remain would be expedient in view of a recent application for a new service in the location, or payment of an overdue periodical account, the statements should, if possible, be confirmed by telephone enquiries before return to the centre. If confirmed, the equipment should be left in position, and the order suitably endorsed.

11. REPAIR OF WALL SURFACES.

11.1. When equipment is dismantled, installation mechanics generally should not make "good" disfigurement to wall surfaces, providing that the extent of damage is not greater than that which was reasonable to securely fix the equipment when installed. If requested by the subscriber to make good in these circumstances, the mechanic should explain courteously that the damage was essential in the provision of a service.

11.2. Where the extent of damage is considerable, i.e., not reasonable having regard to the type of installation concerned, and also the type of building construction, and the subscriber requests repairs, the mechanic may offer to permit the backboard to remain in position. If this is not satisfactory to the subscriber, the mechanic should make good if practicable. If not, he should briefly report the circumstances, and advise the subscriber of his intentions.

12. RECOVERY OF EQUIPMENT IN COUNTRY DISTRICTS.

12.1. A country district mechanic should avoid expense in special travelling merely to effect recovery of cancelled equipment.

12.2. As a general rule, equipment on wholly Departmental services should be recovered by the mechanic or lineman when in the locality on other work. In order to obviate undue delay in recovering apparatus in isolated districts, or townships which are not visited frequently, the mechanic should communicate by telephone with the subscriber, on or about the date the service is to be disconnected, and endeavour to induce the subscriber to dismantle the equipment and return it to the Post Office on his next visit to the township, in order to avoid considerable expenditure of time and travelling expenses, &c. At the same time the subscriber should be advised that the wires at the protector or leading-in point, including the earth wire, should be twisted together securely. This is desirable, in order that the leading-in wires be earthed.

12.3. If the subscriber will not co-operate, or if any unusual circumstances appear to call for a special visit by the mechanic, the matter should be brought under the notice of the District Engineer.

12.4. A subscriber on a P.P.E. service invariably should return cancelled equipment. A refusal to do so should be brought under the notice of the District Engineer.

13. CANCELLATION OF SERVICES ON DIRECT LEADS.

13.1. Wiring connected to a direct lead from underground should be carefully insulated, upon cancellation of a service, to remove a possible cause of fault on the cable pair.

13.2. If a terminal block No. 1 is fitted at the point of entry, the internal wiring should be disconnected from the block, and turned back securely, clear of the connexion plates.

13.3. Where wiring, taken direct from underground to a telephone, is readily accessible near the point of entry, the "lead-in" should be terminated on a terminal block No. 1 and the internal wiring left disconnected, clear of the connexion plates. If not accessible at the point of entry, the wiring should be terminated on a terminal block No. 1, fitted at a convenient point at the end of the wiring run.

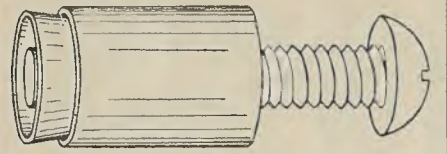
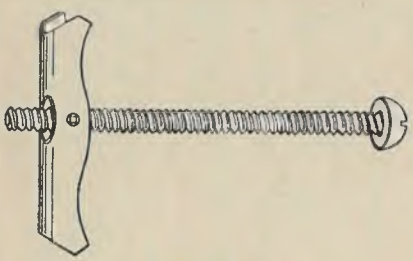
J. M. CRAWFORD,
Chief Engineer.

30th November, 1934.

APPENDIX "A."

TABLE OF STANDARD ANCHORS, AND TYPICAL USE.

Type of Anchor. (A)	Sizes. (B)	Diameter of Hole. (C)	Depth of Hole. (D)	Used to Secure. (E)	Method of Use. (F)
 Drive Anchor.	$\frac{3}{16}$" x $\frac{7}{8}$"	$\frac{3}{16}$"	1"	Cable or wire on unplastered wall	Complete anchor is passed through hole in clip, then into hole, the nail is then driven to expand the anchor
	$\frac{3}{16}$" x $1\frac{1}{4}$"	$\frac{3}{16}$"	$1\frac{3}{8}$"	Cable or wire on plastered wall	
 Screw Anchor.	8 x $\frac{3}{4}$"	$\frac{1}{4}$"	1"	Protector, telephone, extension switch and similar equipment on unplastered wall	Anchor is placed in position with outer end flush with surface of wall. Screw is then passed through mounting hole in equipment and tightened. Should anchor rotate due to soft wall material, enlarge hole and drive in a wooden plug
	8 x $1\frac{1}{2}$"	$\frac{1}{4}$"	$1\frac{3}{4}$"	Protector, telephone, extension switch and similar equipment on plastered wall	
	12 x 1"	$\frac{5}{16}$"	$1\frac{1}{4}$"	Large distributing box and wall frame and pyramid type switchboard on unplastered wall	
	12 x $1\frac{1}{2}$"	$\frac{5}{16}$"	$1\frac{3}{4}$"	Large distributing box and wall frame and pyramid type switchboard on plastered wall	

 Expansion Bolt Anchor.	$\frac{1}{4}$"	$\frac{1}{2}$"	$1\frac{1}{2}$" or to suit screw length	Cordless and cord type switchboard when fitted on wall. Cord type switchboard to concrete floor	Anchor is pushed down to bottom of drilled hole and "tamped" with tool provided, to cause initial expansion. Screw or bolt is passed via mounting holes in equipment, and when tightened up, the further expansion of anchor causes the anchor to become tightly wedged in wall or floor fabric. Screw or bolt (*not* provided with anchor) must be of suitable length, i.e., must not reach bottom of hole
 Toggle Bolt.	$\frac{3}{16}$" x 4" or 6"	$\frac{1}{2}$"	Into hollow portion of wall	Equipment on wall of hollow section, e.g., terracotta, coke breeze, plaster blocks	Check that length of screw is not too great. If so, reduce. Remove screw from toggle, pass through mounting hole, replace toggle, and so lay it along the screw that it will pass through drilled hole. When inside hollow of the wall the out of balance of the toggle will cause it to take a position at right angles to screw

APPENDIX "B."

ANCHORING METHODS.

General Notes.

1. Do not use a backboard except where specified in the table below, unless :—

1.1. Wall is damp or with irregular surface.

1.2. Search for anchor positions agreeing with mounting centres of apparatus is unsuccessful or difficult.

1.3. Pricking for location of brick courses has damaged wall over an area which is larger than equipment.

1.4. Plaster of a poor type is inclined to " run."

2. If possible, avoid placing equipment, &c., on a wall of single brick. Do not attempt to drill into a brick in a wall of this type, but use wood plugs in the seams.

3. Except in walls of single brick or of similar construction, do not use wood plugs unless standard anchors are unsuitable or standard drilling tools are not included in the tool kit.

4. To locate position for plugs in seams under plaster, use a small pricker or awl. If equipment has a top mounting hole at such a distance above the bottom mounting hole that they do not line up with horizontal seams, proceed as follows :—

4.1. Locate a *vertical* seam by making successive pricker holes in a *horizontal* line at a height from the floor approximating that of a lower mounting hole in the equipment. The search with the pricker should be confined to a maximum distance of 5 inches on each side of the pricker hole first made.

4.2. Mark the position of the vertical seam. Then locate the *horizontal* seam next above the marked position, by pricking the vertical seam in an upward direction at intervals of approximately $\frac{1}{2}$ inch. A horizontal seam suitable in association with the marked vertical seam for the mounting holes can then be found readily by measurement, the distance between centres of seams with " standard " bricks being approximately $3\frac{3}{8}$ inches.

5. After selection of the seams, the positions for the anchors should be chosen with due regard to covering the pricker holes.

6. For wood plugs, clear the mortar from seams to a depth at least $\frac{1}{2}$ inch greater than length of plug.

7. For metal anchors drill a hole *at least* $\frac{1}{4}$ inch deeper than length of anchor.

8. The timber used for wood plugs should be soft, close grained, and should not split readily. The plug should be at least $2\frac{1}{2}$ inches long and if for a " seam " $1\frac{1}{4}$ inches wide, cut with a *very slight* taper.

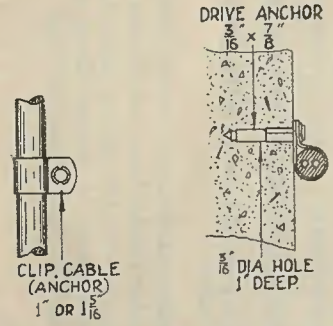
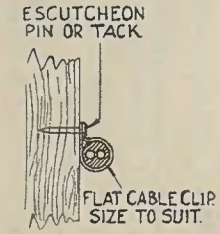
9. The screws to be used with wood plugs should be as shown in Column C below.

10. If equipment is provided with exposed mounting holes, always use R.H. black or japanned wood screws in lieu of C.S. screws where shown below.

11. The screws used to secure a backboard should be located, as far as possible, so that the equipment will cover them from view. If a screw anchor rotates in a wall of coke-breeze or cinder-concrete when an attempt is made to drive the screw home, abandon the anchor and attempt to secure the instrument in a position with mounting holes clear of the anchors, by screws direct into the wall material. Provide a small starting hole and use a screw $2\frac{1}{2}$ inches No. 8 on a plastered wall.

APPENDIX "B"—*continued.*

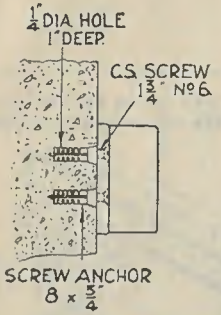
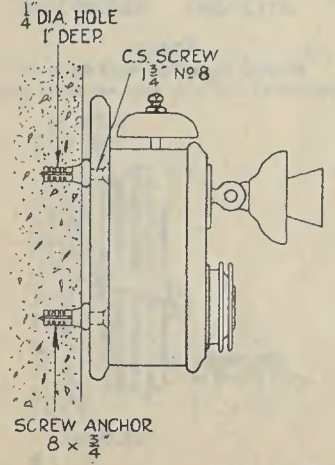
The following indicates typical anchoring methods and types of anchor, &c.:—

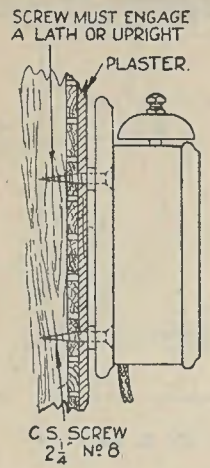
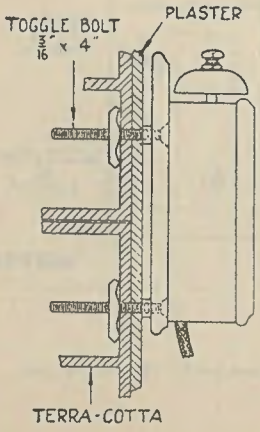
Sketches showing typical anchoring. (A)	No. of anchoring points. (B)	Type of anchor on double brick or on concrete; also coke-breeze or cinder-concrete (see note above). Plastered. (C)	Not plastered. (D)	Type of anchor on terra-cotta or similar hollow partition wall, plastered or unplastered. (E)	Number and sizes of screws, &c., to be used on— Timber wall or backboard. (F)	Lath and plaster wall. (G)	Fibrous plaster or fibro-cement on uprights. (H)	Remarks. (J)
CABLE.								
 Small cable secured to plain concrete, brick, or terracotta wall.	1 per clip	Drive anchor, $\frac{3}{16}$" x $1\frac{1}{4}$" Drill $\frac{3}{16}$" hole, $1\frac{3}{8}$" deep	Drive anchor, $\frac{3}{16}$" x $\frac{7}{8}$" Drill $\frac{3}{16}$" hole, 1" deep	Drive anchor, as for double brick or concrete wall	Staples on 1-pair and 2 pair-cable, clips and clouts for large cables Where visible on skirtings, &c., use flat cable clip and tack ($\frac{1}{2}$" to $\frac{5}{8}$")	Flat cable clips and screws R.H. 1" No. 3	Flat cable clips and screws R.H. 1" No. 3 on upright or batten	Drive anchor includes the securing nail. Use flat cable clip; clip, cable (Anchor): or conduit clip of size to suit cable. Do not crush sheath of cable Over single brick or lath and plaster surface in a residence use flat steel section for short runs secured as shown in Figs. 5 and 6 Clip cable at 1′ 6″ centres on exposed horizontal runs, and 3′ centres on vertical runs or runs in picture rails, &c.
 Small cable secured to timber.								

Small cable secured to brick, concrete, or terracotta wall with plaster covering

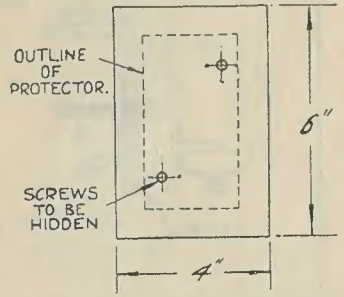
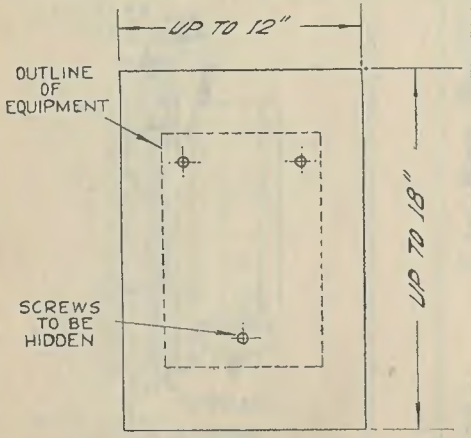
Large cable secured to plain concrete, brick, or coke breeze wall.

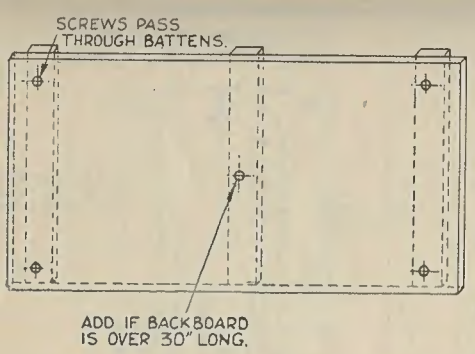
APPENDIX "B"—*continued.*

Sketches showing typical anchoring. (A)	No. of anchoring points. (B)	Type of anchor on double brick or on concrete; also coke-breeze or cinder-concrete (see note above). Plastered. (C)	Not plastered. (D)	Type of anchor on terra-cotta or similar hollow partition wall, plastered or unplastered. (E)	Number and sizes of screws, &c., to be used on— Timber wall or backboard. (F)	Lath and plaster wall. (G)	Fibrous plaster or fibro-cement on uprights. (H)	Remarks. (J)
SMALL EQUIPMENT.  Protector secured to plain brick, concrete, or terracotta without backboard.	2	Screw anchor, 8 x 1½" Drill ¼" hole, 1¾" deep Screw, C.S. 2¼" No. 6	Screw anchor, 8 x ¾" Drill ¼" hole, 1" deep Screw C.S. 1¾" No. 6	Use backboard always	Two C.S. 1" No. 6	Two C.S. 1¾" No. 6	Use backboard unless protector can be secured to upright or batten by two screws, then use two C.S. 1¾" No. 6	
 Telephone secured to wall of plain brick or concrete, &c., without backboard.	..	Wall set Use backboard (see Remarks)	See page 57	Wall set Use backboard (see Remarks)	See page 57	Wall set Use backboard (see Remarks)	Use backboard always	On any plastered surface, except where anchor can be fixed tightly and *flush* with surface, use a backboard for a wall set, extension switch, generator, and all equipment which is likely to be subject to disturbance when used.

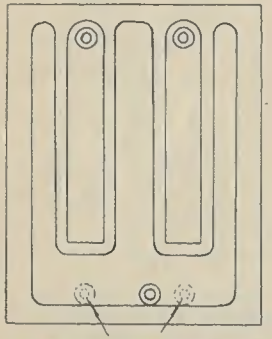
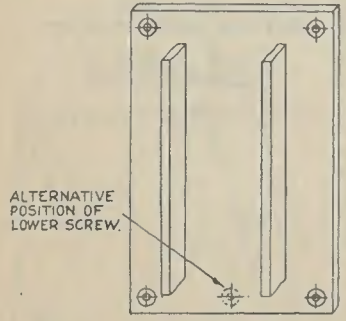
 Bell set secured to wall of lath and plaster, without backboard.	3 or 4	Bell set or other equipment, not subject to force during use Screw anchor, 8 x 1½" Drill ¼" hole, 1¾" deep Screw C.S. 2¼" No. 8	.. Screw anchor, 8 x ¾" Drill ¼" hole, 1" deep Screw C.S. 1¾" No. 8 If seams in brick are used enlarge mounting holes and use wooden plugs (see preamble above)	Bell set or other equipment, not subject to force during use Toggle bolt 3/16" x 4" or 6"	..	Bell set or other equipment, not subject to force during use Four C.S. 1½" No. 8	Use backboard always Four C.S. 2¼" No. 8
 Bell set, with backboard, secured to plastered terracotta wall.							

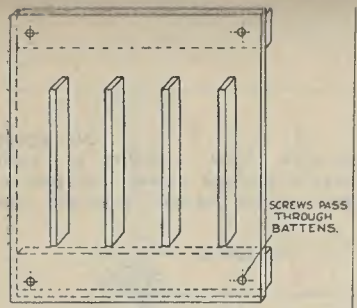
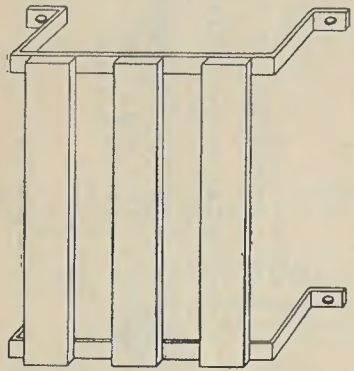
APPENDIX "B"—*continued.*

Sketches showing typical anchoring. (A)	No. of anchoring points. (B)	Type of anchor on double brick or on concrete: also coke-breeze or cinder-concrete (see note above). Plastered. (C)	Not plastered. (D)	Type of anchor on terra-cotta or similar hollow partition wall, plastered or unplastered. (E)	Number and sizes of screws, &c., to be used on— Timber wall or backboard. (F)	Lath and plaster wall. (G)	Fibrous plaster or fibro-cement on uprights. (H)	Remarks. (J)
BACKBOARDS.  Backboard for protector, showing approx. positions for screws.	2	Screw anchor, 8 x 1½" Drill ¼" hole, 1¾" deep Screw C.S. 2¼" No. 6	Screw anchor, 8 x ¾" Drill ¼" hole, 1" deep Screw C.S. 1¼" No. 6	Avoid if possible Toggle bolt $\frac{3}{16}$" x 4" or 6"	Two C.S. 1" No. 6	Two C.S. 1¾" No. 6	Two C.S. 1¾" No. 6 into upright or batten	
 Backboard for wall set, bell set, &c., showing approx. positions of screws.	3 or 4	Screw anchor, 8 x 1½" Drill ¼" hole, 1¾" deep Screw C.S. 2¼" No. 8	Screw anchor, 8 x ¾" Drill ¼" hole, 1" deep Screw C.S. 1¾" No. 8	Toggle bolt, $\frac{3}{16}$" x 4" or 6"	Four C.S. 1½" No. 8	Four C.S. 2¼" No. 8	Two or three C.S. 2¼" No. 8 along centre line in upright and if possible in batten	

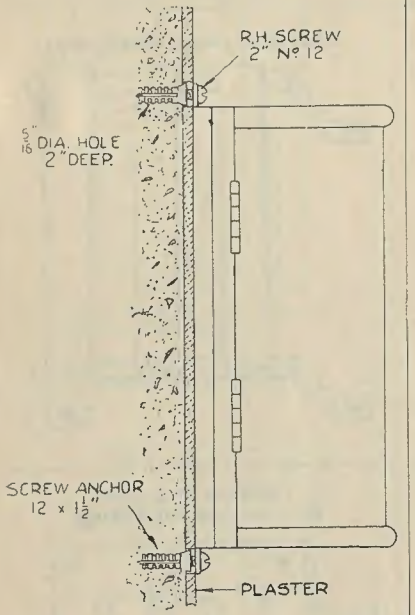
 Large backboard with reinforcing battens. Used for switchboards, &c.	4 or 5	See Remarks Screw anchor, 12 x 1½" Drill 5/16" hole, 1¾" deep Screw C.S. 3" No. 12	See Remarks Screw anchor, 12 x 1" Drill 5/16" hole, 1¼" deep Screw C.S. 2½" No. 12	Toggle bolt, 3/16" x 4" or 6"	Four or five C.S. 2½" No. 12	Four or five C.S. 3" No. 12 (Counter-bore backboard to admit head of screw ½" below face)	Four or five C.S. 3" No. 12 in uprights or battens	When a large backboard is to be used on a masonry wall, for a C.B. cordless or a wall type cord switchboard use expansion bolt anchors in lieu of screw anchors See pages 63, 64 & 65 *re* switchboard fitting

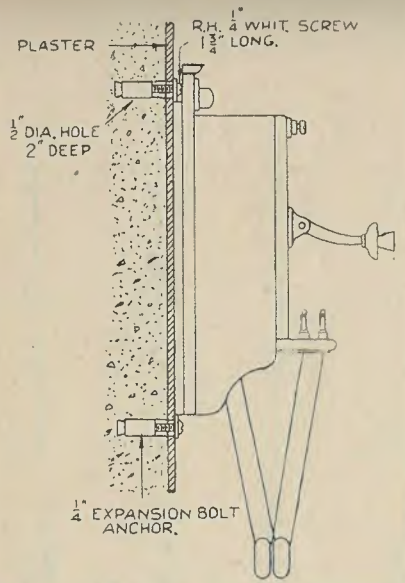
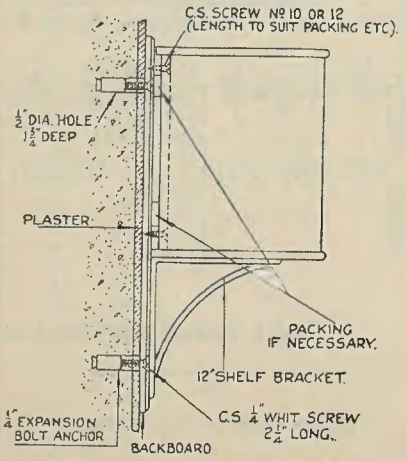
APPENDIX "B"—*continued.*

Sketches showing typical anchoring. (A)	No. of anchoring points. (B)	Type of anchor on double brick or on concrete; also coke-breeze or cinder-concrete (see note above). Plastered. (C)	Type of anchor on double brick or on concrete; also coke-breeze or cinder-concrete (see note above). Not plastered. (D)	Type of anchor on terra-cotta or similar hollow partition wall, plastered or unplastered. (E)	Number and sizes of screws, &c., to be used on— Timber wall or backboard. (F)	Number and sizes of screws, &c., to be used on— Lath and plaster wall. (G)	Number and sizes of screws, &c., to be used on— Fibrous plaster or fibro-cement on uprights. (H)	Remarks. (J)
DISTRIBUTING BOXES AND FRAMES.								
 Distributing box—10 pairs. (Terminal block No. 6.)	3	Screw anchor, 8 x 1½″ Drill ¼″ hole, 1¾″ deep Screw C.S. 2¼″ No. 6	Screw anchor, 8 x ¾″ Drill ¼″ hole, 1″ deep Screw C.S. 1¼″ No. 6	Toggle bolt, 3/16″ x 4″ 6″ Enlarge holes in box	Four C.S. 1″ No. 6	Four C.S. 1¾″ No. 6	Two C.S. 1¾″ No. 6 in upright, and if possible one additional in a batten	
 Distributing box—wooden (with two verticals).	3 or 4	Screw anchor, 8 x 1½″ Drill ¼″ hole, 1¾″ deep Screw C.S. 2¼″ No. 8	Screw anchor, 8 x ¾″ Drill ¼″ hole, 1″ deep Screw C.S. 1¾″ No. 8	Toggle bolt, 3/16″ x 4″ or 6″	Four C.S. 1½″ No. 8	Four C.S. 2¼″ No. 8	Two or three C.S. 2¼″ No. 8 along centre line in upright, and if possible one additional in a batten	

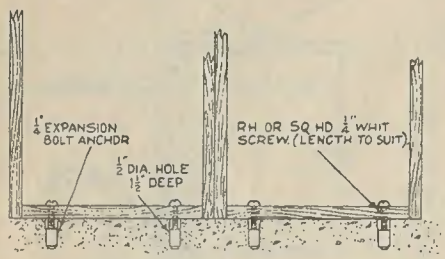
 Distributing box—wooden (with four verticals).	4	Screw anchor, 12 x 1½″ Drill $\frac{5}{16}$″ hole, 1¾″ deep Screw C.S. 3″ No. 12	Screw anchor, 12 x 1″ Drill $\frac{5}{16}$″ hole, 1¼″ deep Screw C.S. 2½″ No. 12	Toggle bolt, $\frac{3}{16}$″ x 4″ or 6″	Four C.S. 2½″ No. 12	Rarely necessary, if so secure to uprights	Rarely necessary, if so secure to uprights	
 Distributing frame—wall type.	4	Screw anchor, 12 x 1½″ Drill $\frac{5}{16}$″ hole, 1¾″ deep Screw C.S. 2″ No. 12	Screw anchor, 12 x 1″ Drill $\frac{5}{16}$″ hole, 1¼″ deep Screw C.S. 1½″ No. 12	Toggle bolt, $\frac{3}{16}$″ x 4″ or 6″	Four C.S. 1½″ No. 12	Rarely necessary, if so use horizontal battens secured to uprights	Rarely necessary, if so use horizontal battens secured to uprights	

APPENDIX "B"—*continued.*

Sketches showing typical anchoring. (A)	No. of anchoring points. (B)	Type of anchor on double brick or on concrete; also coke-breeze or cinder-concrete (see note above). Plastered. (C)	Type of anchor on double brick or on concrete; also coke-breeze or cinder-concrete (see note above). Not plastered. (D)	Type of anchor on terra-cotta or similar hollow partition wall, plastered or unplastered. (E)	Number and sizes of screws, &c., to be used on— Timber wall backboard. (F)	Number and sizes of screws, &c., to be used on— Lath and plaster wall. (G)	Number and sizes of screws, &c., to be used on— Fibrous plaster or fibro-cement on uprights. (H)	Remarks. (J)
SWITCHBOARDS (WALL TYPE).								
 Magneto pyramid pattern switchboard secured to plaster covered double brick or concrete wall, without backboard.	4	Screw anchor, 12 x 1½" Drill 5/16" hole, 2" deep Screw R.H. 2" No. 12	Screw anchor, 12 x 1" Drill 5/16" hole, 1½" deep Screw R.H. 1½" No. 12	Toggle bolt, 3/16" x 4" or 6"	Four R.H. 1½" No. 12	Rarely necessary; if so use horizontal battens secured to uprights	Rarely necessary; if so use horizontal battens secured to uprights	

 Magneto wall pattern cord type switchboard secured to plaster covered double brick or concrete wall, without backboard.	4	Expansion bolt anchor, 1/4" Drill 1/2" hole, 2" deep Screw 1 3/4" x 1/4" Whit. R.H. Do not install on coke breeze, &c.	Expansion bolt anchor, 1/4" Drill 1/2" hole, 1 1/4" deep Screw 1 1/4" x 1/4" Whit. R.H. Do not install on coke breeze, &c.	Avoid if possible; if not use Toggle bolt, 3/16" x 4" or 6"	Four R.H. 1 1/2" No. 12	Rarely necessary; if so use horizontal battens secured to uprights	Rarely necessary; if so use horizontal battens secured to uprights	If a backboard is necessary, use a C.S. screw in lieu of R.H. shown
 C.B. cordless type switchboard secured to plaster covered double brick or concrete wall, with backboard.	4	Expansion bolt anchor, 1/4" Drill 1/2" hole, 1 3/4" deep Screw 2 1/4" x 1/4" Whit. C.S. Do not install on coke breeze, &c.	Expansion bolt anchor, 1/4" Drill 1/2" hole, 1 1/4" deep Screw 1 3/4" x 1/4" Whit. C.S. Do not install on coke breeze, &c.	Do not install	Ten to fourteen R.H. 1" No. 12	Rarely necessary; if so secure backboard to uprights	Rarely necessary; if so secure backboard to uprights	Use a backboard always, except on a solid wooden wall. Secure switchboard to brackets and backboard with screws, as shown in Column A. Pack switchboard out from backboard. The back edge of removable top should not be in contact with backboard

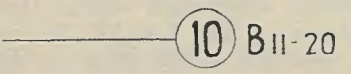
APPENDIX "B"—*continued.*

Sketches showing typical anchoring. (A)	No. of anchoring points. (B)	Type of anchor on concrete floor. (C)	Method of securing to wooden floor. (D)	Remarks. (E)
SWITCHBOARDS (FLOOR TYPE).				
 Floor pattern switchboard secured to concrete floor (two position installation).	4 per position	Expansion bolt anchor, ¼" .. Drill ½" hole, 1½" full, into concrete Screw R.H. or Sq. H. Whitworth ¼" diameter, with length to suit	Coach screws 1½" x ¼" with square head, or C.S. wood screws 1½" No. 16 if they can be driven For unstandard boards without metal securing bars, use screws of greater length to suit	On wood parquet floors which are usually laid on bitumen over concrete, the anchor should be placed through the wood blocks into the concrete floor If two or more positions are installed, they must line-up accurately If floor is not level, make switchboard "plumb" by packing neatly with timber

APPENDIX "C."

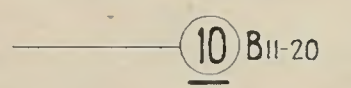
STANDARD SYMBOLS FOR USE IN CABLING DIAGRAMS.

ENTIRELY NEW INSTALLATIONS.



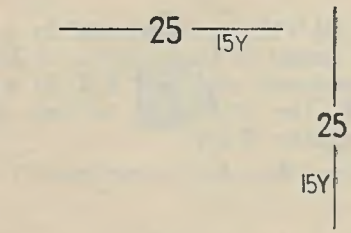
Final distributing box with **single** sets of tags or terminals. Number inside circle indicates size in pairs. Letters and numerals—B.11–20—indicate that pairs in box are connected to bay "B" of M.D.F., pairs 11–20 thereon.

Final distributing box with **double** sets of tags, requiring jumpers. Markings as above.

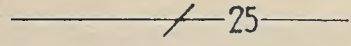


Final distributing box with **single** sets of tags, concealed in riser shaft.

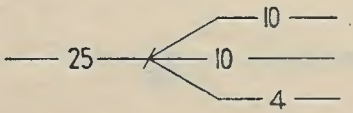
Final distributing box with **double** sets of tags, concealed in riser shaft.



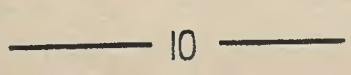
Cable, lead sheathed.—Numerals indicate capacity in pairs. (Line is light.) Distance between boxes, joints, &c., shown in yards. If cable with paper-covered conductors is used, the letter "P" in addition to the figures should appear thus :—25—P.



Joint in straight run of cable.

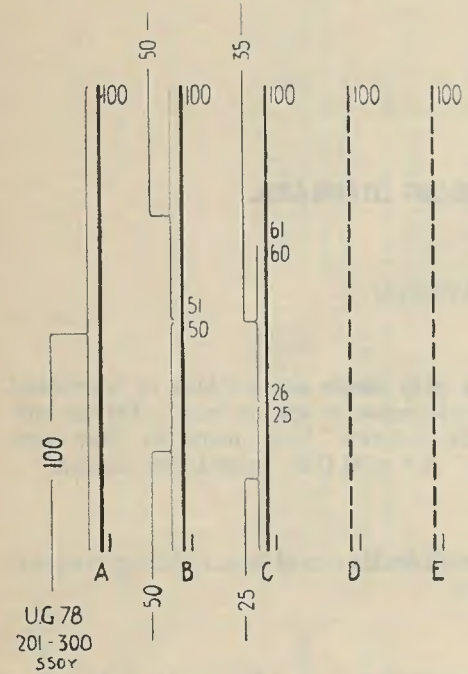


"Y" joint, or joint at which cables are "split."



Conduit.—Numerals indicate approximate capacity in pairs. (Heavy line.)

APPENDIX "C"—*continued.*



Main distributing frame.—Letters A, B, C, &c., indicate designation of verticals, commencing at vertical on left, as far as practicable. Figures at each vertical indicate terminal numbering and range of terminals covered by cable connected thereto.

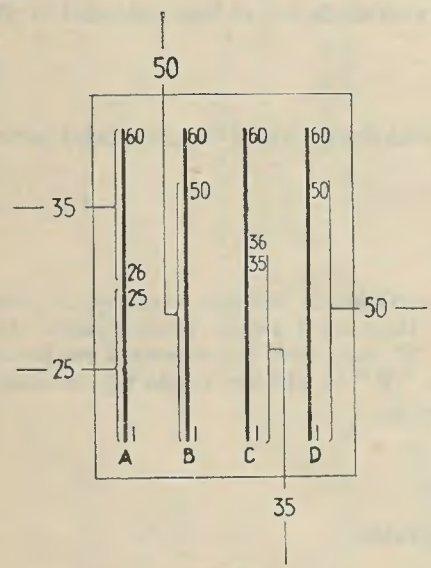
Vertical line "dotted" indicates accommodation for additional vertical of terminal strips on ironwork, but not equipped.

Information *re* U.G. shows capacity, cable number, pair numbers, and distance from exchange in yards.

Where a large P.B.X. service in a building has a distribution scheme cabled to a frame other than that used for the main building distribution scheme the lettering of the verticals should be XA, XB, XC, &c., to prevent confusion which otherwise would occur at distributing boxes.

Similarly the lettering of a frame associated with a second or third large P.B.X. would be YA, YB, &c., or ZA, ZB, &c., respectively.

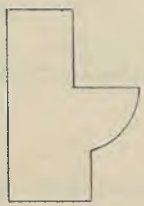
(See typical cabling scheme, Fig. 12.)



Distributing box used in lieu of small distributing frame in smaller buildings, or as distribution terminal for P.B.X. switchboard.

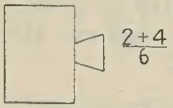
Symbol as for M.D.F., but surrounded by a "light" line. Particulars similar to those relative to M.D.F. are shown. When associated with a P.B.X. in a building having an M.D.F., the lettering of verticals should be prefixed as for a separate M.D.F.

(See notes under "Main distributing frame.")



Switchboard P.B.X. floor type, size stated as shown.

APPENDIX "C"—*continued.*

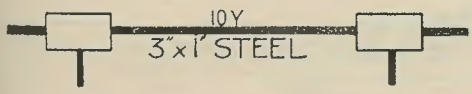


Switchboard, wall or table type, size stated as shown.

The following additional symbols will be used on floor plans, where it is necessary to indicate the layout of conduits or special concealed runs in floors :—

Riser shaft.

Draw box.



Metal or fibre ducts under floor "fill." Line is very heavy. Type and size of duct to be stated clearly on drawing. Distances between draw boxes to be shown where necessary.

Telephone outlet or terminal block in wall or pillar, &c.

Telephone outlet in floor.

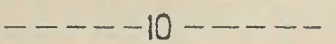
Telephone.—Use following code letters :—

W = Wall set.
T = Table set.
H = Handset instrument.

APPENDIX "C"—*continued.*

ALTERATIONS, ADDITIONS, ETC.

On plans illustrating proposed alterations, additions, &c., to plant in position, the following symbols will be used. Those already referred to will be used to indicate the existing plant. *Alternatively*, additions may be shown by means of *continuous* lines, in **red.**



Proposed additional or replacement cable. (Light dotted line with numerals indicating capacity in pairs).

Additional final distributing box with single set of tags or terminals.

Additional final distributing box with double set of tags.

Cable to be recovered.

Distributing box being removed or recovered.

APPENDIX "D."

TYPICAL ENTRIES ON STANDARD RECORD FORMS FOR SUBSCRIBERS' BUILDING CABLING SCHEMES.

1. STANDARD ABBREVIATIONS.

1.1. To conserve accommodation on the record cards, the following standard abbreviations should be used :—

X. .. Extension
T.L. .. Tie Line
P. .. Party Line
F.A. .. Fire Alarm
B.A. .. Burglar Alarm
K. .. Private Line
P.T. .. Public Telephone
P.L. .. D.C. Power Lead
R.L. .. Ringing Lead
F.S. .. Fire Sprinkler Alarm
B. .. Broadcast Line
P.M. .. Phonogram Line
D.L. .. Subscriber's Line to Trunk Room

2. POWER LEAD RECORDS.

2.1. At a large distributing box or M.D.F. via which power leads are distributed to several P.B.X. switchboards, one or more terminal strips will be replaced by the power lead distributing panel 0/10 fitted to the lower end of the vertical. As only 10 circuits per strip can be accommodated on the power distribution panel as distinct from the 20 circuits per strip on the terminal strips, the vertical numbering will be affected. When recording particulars in this vertical, the numbering of the terminals intact should be normal, e.g., if one 20-pair terminal strip is replaced by one power distribution panel for 10 leads, the terminal strip numbering immediately above will commence at 20; if two are replaced, at 40. The numbering of the power distribution panel will be from 1 to 10 where one panel is fitted, and from 1 to 20 where two panels are fitted.

DISTRIBUTING BOX RECORD (10 PAIR). S.E. 515.

Box No. ***B. 26/35.*** Pairs.....to.....appear also in Box.....

Pair No. in Box.	M.D.F. Pair No. in Vert. *B.*	Exch. No. or Other Description.	Pair No. in Box.	M.D.F. Pair No. in Vert. *B.*	Exch. No. or Other Description.
5	*30*	*T.L.-F. 6322*	0	*35*	
4	*29*	*P.L.-F. 6322*	9	*34*	
3	*28*	*X.-F. 6322 to High St.*	8	*33*	
2	*27*	*F. 6322*	7	*32*	
1	*26*	*F. 2345*	6	*31*	*F. 7122*

NOTE.—1. Write lightly with black pencil. 2. Fill in all relative particulars.

3. FORM S.E. 515.

3.1. Typical entries on Form S.E. 515 used at a final distributing point are shown above. No pairs are in multiple. (See S.E. 516 for entry regarding pairs in multiple.)

S.E. 516

DISTRIBUTING BOX RECORD.

(For a box used as a main distributing point at a P.B.X., use card S.E. 518.)

Box No. ***C.51/70.*** Pairs ***64*** to ***70*** appear also in Box ***C. 64/70.***

No. of pair in left Vert.	No. of pair in M.D.F. Vert. *C* / or No. of pair in U.G. Cable. No. ..... *	No. of Exch. line.	Particulars of lines other than direct Exchange lines.	Jumpered to pair No. :— (Right Vert.)
	*			
20	***70***			
9	***69***			
8	***68***			
7	***67***			
6	***66***			
5	***65***			
4	***64***			
3	***63***			
2	***62***			
11	***61***			
0	***60***			
9	***59***	*F. 6366*		***10***
8	***58***		*B—Room **76** to **2** M.R. Studio.*	***8***
7	***57***	*F. 6377*		***6***
6	***56***		*T.L.—F. **6365** to Robinson Bros.*	***4***
5	***55***		*R.L.—F. **6365***	***3***
4	***54***	*F. 2711*		***7***
3	***53***		*P.L.—F. **6365***	***5***
2	***52***	*F. 6365*		***2***
1	***51***	*F. 2700*		***1***

* Strike out that which does not apply. When used at a small U.G. terminal place U.G. pair Nos. in this column.

NOTE.—1. Write lightly with **black** pencil.
2. Fill in all relative particulars.

4. FORM S.E. 516.

4.1. Typical entries on Form S.E. 516, when used at a final distributing point with 7 pairs in multiple, are shown above.

(*Note.*—Records of pairs connected in Box C. *64/70* do not appear in Box C. *51/70.*)

APPENDIX "D"—*continued.*

No. of Pair in Vertical *A*	No. of Pair in U.G. Cable No. *327* or Location of ~~Dist.~~ Box.	No. of Exch. or Extn. Line.	Name, or Other Particulars of Service.	Jumpered to— Vertical.	Jumpered to— Pair.	If jumpered via protector, state No. of protector in this column.
5 0	*315*					
9	*4*		*T.L.—F. 6365 to F. 3101*	*A*	*56*	
8	*3*					
7	*2*					
6	*1*					
5	*310*					
4	*9*					
3	*8*					
2	*7*					
4 1	*6*	*F. 6366*	*Johnston*	*C*	*59*	
0	*5*					
9	*4*					
8	*3*					
7	*2*					
6	*1*					
5	*300*					
4	*9*					
3	*8*					
2	*7*					
3 1	*6*					
0	*5*					
9	*4*					
8	*3*					
7	*2*					
6	*1*					
5	*290*					
4	*9*					
3	*8*					
2	*7*	*F. 3841*	*Rapid Repair Service*	*F*	*7*	
2 1	*6*		*F.A.—General Insurance to King St.*	*F*	*10*	
0	*5*					
9	*4*					
8	*3*					
7	*2*					
6	*1*					
5	*280*					
4	*9*	*F. 2711*	*Mitchell*	*C*	*54*	
3	*8*		*R.L.—F. 6365*	*C*	*55*	
2	*7*	*M. 3476*	*P.T.—Royal Cafe*	*C*	*81*	
1 1	*6*		*B.—Room 76 to 2 M.R.* Studio	*C*	*58*	
0	*5*	*F. 6377*	*Cleaning Service*	*C*	*57*	
9	*4*					
8	*3*					
7	*2*					
6	*1*		*P.L.—F. 6365*	*C*	*53*	
5	*270*	*F. 6365*	*Johnston*	*C*	*52*	
4	*9*	*F. 2700*	*James*	*C*	*51*	
3	*8*		*X—F. 7421 to factory, Carlton*	*D*	*87*	
2	*7*	*F. 7422*	*MacPherson*	*D*	*83*	
1	*266*	*F 7421*	*MacPherson*	*D*	*82*	

5. FORM S.E. 517.

5.1. Form S.E. 517—Typical entries are shown above on page used for recording particulars of connexions on an M.D.F. or large distributing box vertical *associated with underground cable.*

APPENDIX "D"—*continued.*

No. of Pair in Vertical C	No. of pair in U.G. Cable. No. ~~.....~~ or Location of Dist. Box.	No. of Exch. or Extn. Line.	Name, or Other Particulars of Service.	Jumpered to— Vertical.	Jumpered to— Pair.	If jumpered via protector, state No. of protector in this column.
10 0	*7th Floor near Room 107*					
9						
8						
7						
6						
5						
4						
3						
2						
9 1						
0	*7th Floor near back lift*					
9						
8						
7						
6						
5		*X 3*	*F. 1088 to Factory*	*A*	**92**	
4			*B.A.—Assayers Ltd. to Central Police*	*B*	**24**	
3		*F. 1088*	*Process Engravers Pty. Ltd.*	*B*	**12**	
2			*F.S.—Royal Cafe to King St.*	*A*	**52**	
8 1		*M. 3476*	*P.T.—Royal Cafe*	*A*	**12**	
0	*6th Floor S. end*					
9						
8						
7						
6						
5						
4						
3						
2						
7 1						
0	*6th Floor centre*	*F. 1166*	*Taxpayers' League*	*A*	**91**	
9			*K.—Associated Press to Sports Ground*	*A*	**89**	
8						
7						
6						
5						
4						
3						
2						
6 1	*6th Floor N.W. corner*					
0						
9		*F. 6366*	*Johnston*	*A*	**41**	
8			*B.—Room 76 to 2 M.R. Studio*	*A*	**11**	
7		*F. 6377*	*Cleaning Service*	*A*	**10**	
6			*T.L.—F. 6365 to F. 3101 (Robinson Bros.)*	*A*	**49**	
5			*R.L.—F. 6365*	*A*	**13**	
4		*F. 2711*	*Mitchell*	*A*	**14**	
3			*P.L.—F. 6365*	*A*	**6**	*Via power panel 3*
2		*F. 6365*	*Johnston*	*A*	**5**	
5 1		*F. 2700*	*James*	*A*	**4**	

6. FORM S.E. 517.

6.1. Form S.E. 517—Typical entries are shown above on page used for recording particulars of connexions on an M.D.F. or large distributing box vertical on *which internal pairs are terminated.*

(Note method of indicating box locations, and *range* of pairs connected in each box.)

S.E. 518.

DISTRIBUTING BOX RECORD.

P.B.X. SERVICES.

Box No. *D 26-45.*

No. of pair in box in Vert. *A.*	No. of pair in M.D.F.Vert. *D.* / or No. of pair in U.G. No..... / or Location of Dist. Box. *	No. of Exch. or Extn. line.	Particulars of lines other than direct Exchange or Extension lines.	Jumpered to :— Vert.	Jumpered to :— Pair No.	If jumpered via protector state No. of protector in this Column.
2 0	*45*		*R.L.—B. 2101*	*C*	*79*	*14*
9	*44*					
8	*43*					
7	*42*					
6	*41*					
5	*40*		*K.—Sales to Store, Rockbank*	*B*	*33*	*17*
4	*39*		*F.S. to Central Fire*	*A*	*80*	*13*
3	*38*		*T.L.—B. 2101 to B. 4200*	*C*	*15*	*15*
2	*37*	*X. 41*	*Basement*	*D*	*26*	
1	*36*	*X. 27*	*Retail Depot, High St.*	*D*	*12*	*16*
1 0	*35*		*P.L.—B. 2101*	*D*	*80*	*20*
9	*34*		*P.L.—B. 2101*	*D*	*80*	*19*
8	*33*					
7	*32*	*X. 25*	*Store, James St.*	*D*	*10*	*18*
6	*31*					
5	*30*	*B. 2105*		*C*	*5*	*5*
4	*29*	*B. 2104*		*C*	*4*	*4*
3	*28*	*B. 2103*		*C*	*3*	*3*
2	*27*	*B. 2102*		*C*	*2*	*2*
1	*26*	*B. 2101*		*C*	*1*	*1*

* Strike out that which does not apply. Use column as necessary in particular circumstances.

NOTE.—1. Write lightly with **black** pencil.
2. Fill in all relative particulars for each vertical in box.

7. FORM S.E. 518.

7.1. Form S.E. 518—Typical entries are shown above for a card at a distributing box used as a main distributing point at a P.B.X. Particulars show method of recording connexions on a vertical or portion of a vertical on which *cable from building M.D.F.* terminates.

(If U.G. cable terminates directly in box, column 2 should show U.G. cable No. and pair Nos.)

S.E. 518.

DISTRIBUTING BOX RECORD.

P.B.X. SERVICES.

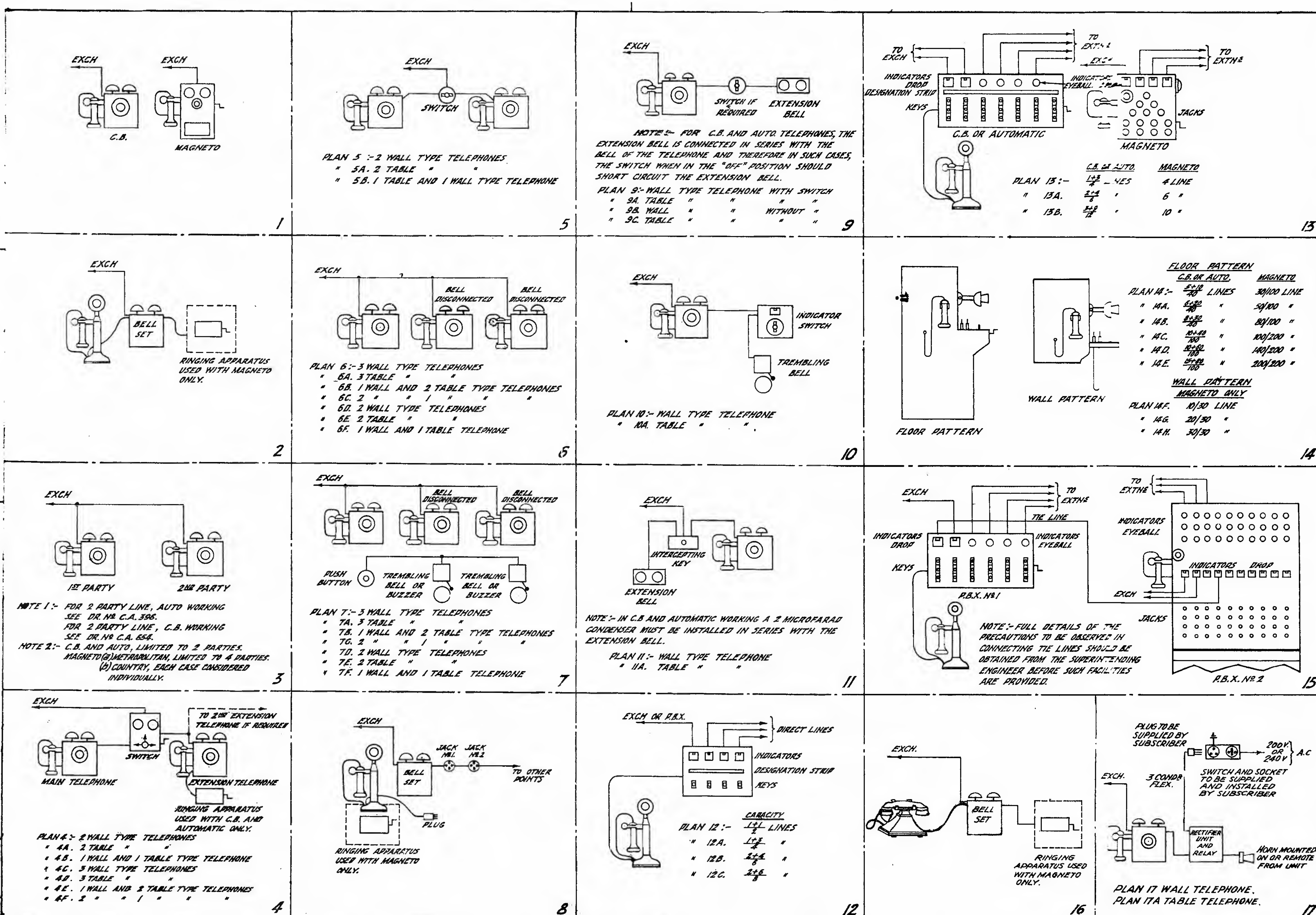
Box No. *D. 26-45.*

No. of pair in box in Vert. *B.*	No. of pair in M.D.F. Vert.... / or No. of pair in U.G. No..... / or Location of Dist. Box.	No. of Exch. or Extn. line.	Particulars of lines other than direct Exchange or Extension lines.	Jumpered to :— Vert.	Jumpered to :— Pair No.	If jumpered via protector state No. of protector in this Column.
	*					
4 0	*S.E. Corner Sales Section*					
9						
8						
7						
6		*X 25*		*B*	*65*	
5		*X 21*		*B*	*61*	
4		*X 28*		*B*	*68*	
3			*K.—Sales to Store, Rockbank*	*A*	*15*	*17*
2		*X 31*		*B*	*71*	
1		*X 26*		*B*	*66*	
3 0	*Rear Wall, General Office.*					
9						
8						
7		*X 10*		*B*	*50*	
6		*X 13*		*B*	*53*	
5		*X 18*		*B*	*58*	
4		*X 14*		*B*	*54*	
3		*X 11*		*B*	*51*	
2		*X 19*		*B*	*59*	
2 1		*X 16*		*B*	*56*	

* Strike out that which does not apply. Use column as necessary in particular circumstances.
NOTE.—1. Write lightly with black pencil.
2. Fill in all relative particulars for each vertical in box.

8. FORM S.E. 518.

8.1. Form S.E. 518—Typical entries are shown above for a card at a distributing box used as a main distributing point at a P.B.X. Particulars show method of recording connexions on a vertical or portion of a vertical on which *extension cabling* terminates.



EXCH
EXCH
C.B.
MAGNETO
1
EXCH
SWITCH
PLAN 5 :- 2 WALL TYPE TELEPHONES
" 5A. 2 TABLE " "
" 5B. 1 TABLE AND 1 WALL TYPE TELEPHONE
5
EXCH
SWITCH IF REQUIRED
EXTENSION BELL
NOTE :- FOR C.B. AND AUTO. TELEPHONES, THE EXTENSION BELL IS CONNECTED IN SERIES WITH THE BELL OF THE TELEPHONE AND THEREFORE IN SUCH CASES, THE SWITCH WHEN IN THE "OFF" POSITION SHOULD SHORT CIRCUIT THE EXTENSION BELL.
PLAN 9:- WALL TYPE TELEPHONE WITH SWITCH
" 9A. TABLE " " " "
" 9B. WALL " " WITHOUT "
" 9C. TABLE " " " "
9
TO EXCH
TO EXTNS
TO EXTNS
INDICATORS DROP
DESIGNATION STRIP
KEYS
C.B. OR AUTOMATIC
JACKS
MAGNETO
PLAN 13 :-
13A.
13B.
C.B. or AUTO.
MAGNETO
4 LINE
6 "
10 "
13
EXCH
BELL SET
RINGING APPARATUS USED WITH MAGNETO ONLY.
2
EXCH
BELL DISCONNECTED
BELL DISCONNECTED
PLAN 6 :- 3 WALL TYPE TELEPHONES
" 6A. 3 TABLE " "
" 6B. 1 WALL AND 2 TABLE TYPE TELEPHONES
" 6C. 2 " " 1 " " "
" 6D. 2 WALL TYPE TELEPHONES
" 6E. 2 TABLE " "
" 6F. 1 WALL AND 1 TABLE TELEPHONE
6
EXCH
INDICATOR SWITCH
TREMBLING BELL
PLAN 10:- WALL TYPE TELEPHONE
" 10A. TABLE " "
10
FLOOR PATTERN
C.B. OR AUTO.
MAGNETO
PLAN 14 :- LINES
14A.
14B.
14C.
14D.
14E.
30/100 LINE
50/100 "
80/100 "
100/200 "
140/200 "
200/200 "
WALL PATTERN
MAGNETO ONLY
PLAN 14F. 10/30 LINE
" 14G. 20/30 "
" 14H. 30/30 "
WALL PATTERN
FLOOR PATTERN
14
EXCH
1ST PARTY
2ND PARTY
NOTE 1 :- FOR 2 PARTY LINE, AUTO WORKING SEE DR. NO C.A. 396.
FOR 2 PARTY LINE, C.B. WORKING SEE DR. NO C.A. 654.
NOTE 2 :- C.B. AND AUTO, LIMITED TO 2 PARTIES.
MAGNETO (a) METROPOLITAN, LIMITED TO 4 PARTIES.
(b) COUNTRY, EACH CASE CONSIDERED INDIVIDUALLY.
3
EXCH
BELL DISCONNECTED
BELL DISCONNECTED
PUSH BUTTON
TREMBLING BELL OR BUZZER
TREMBLING BELL OR BUZZER
PLAN 7:- 3 WALL TYPE TELEPHONES
" 7A. 3 TABLE " "
" 7B. 1 WALL AND 2 TABLE TYPE TELEPHONES
" 7C. 2 " " 1 " " "
" 7D. 2 WALL TYPE TELEPHONES
" 7E. 2 TABLE " "
" 7F. 1 WALL AND 1 TABLE TELEPHONE
7
EXCH
INTERCEPTING KEY
EXTENSION BELL
NOTE :- IN C.B AND AUTOMATIC WORKING A 2 MICROFARAD CONDENSER MUST BE INSTALLED IN SERIES WITH THE EXTENSION BELL.
PLAN 11 :- WALL TYPE TELEPHONE
" 11A. TABLE " "
11
EXCH
TO EXTNS
TIE LINE
INDICATORS DROP
INDICATORS EYEBALL
KEYS
P.B.X. No 1
TO EXTNS
INDICATORS EYEBALL
INDICATORS DROP
EXCH
JACKS
NOTE :- FULL DETAILS OF THE PRECAUTIONS TO BE OBSERVED IN CONNECTING TIE LINES SHOULD BE OBTAINED FROM THE SUPERINTENDING ENGINEER BEFORE SUCH FACILITIES ARE PROVIDED.
P.B.X. No 2
15
EXCH
TO 2ND EXTENSION TELEPHONE IF REQUIRED
SWITCH
MAIN TELEPHONE
EXTENSION TELEPHONE
RINGING APPARATUS USED WITH C.B. AND AUTOMATIC ONLY.
PLAN 4 :- 2 WALL TYPE TELEPHONES
" 4A. 2 TABLE " "
" 4B. 1 WALL AND 1 TABLE TYPE TELEPHONE
" 4C. 3 WALL TYPE TELEPHONES
" 4D. 3 TABLE " "
" 4E. 1 WALL AND 2 TABLE TYPE TELEPHONES
" 4F. 2 " " 1 " "
4
EXCH
JACK No 1
JACK No 2
BELL SET
TO OTHER POINTS
PLUG
RINGING APPARATUS USED WITH MAGNETO ONLY.
8
EXCH OR P.B.X.
DIRECT LINES
INDICATORS
DESIGNATION STRIP
KEYS
CAPACITY
PLAN 12 :- LINES
" 12A.
" 12B.
" 12C.
12
EXCH.
BELL SET
RINGING APPARATUS USED WITH MAGNETO ONLY.
16
PLUG TO BE SUPPLIED BY SUBSCRIBER
200V. OR 240V A.C
SWITCH AND SOCKET TO BE SUPPLIED AND INSTALLED BY SUBSCRIBER
EXCH.
3 COND. FLEX.
RECTIFIER UNIT AND RELAY
HORN MOUNTED ON OR REMOTE FROM UNIT
PLAN 17 WALL TELEPHONE.
PLAN 17A TABLE TELEPHONE.
17

COMMONWEALTH OF AUSTRALIA
P.M.G's. DEPARTMENT

STANDARDISED SUBSCRIBERS SERVICES

DRAWING No C609

Drawn 9-4-29
Examined 13-4-29
Approved
Supt. Engineer

ISSUE No	DATE	APPD
1.	13-4-29	
2.	21-4-35 Fig. 16 added	
3	26-6-36 Fig. 17 added	

DRAWING C609.

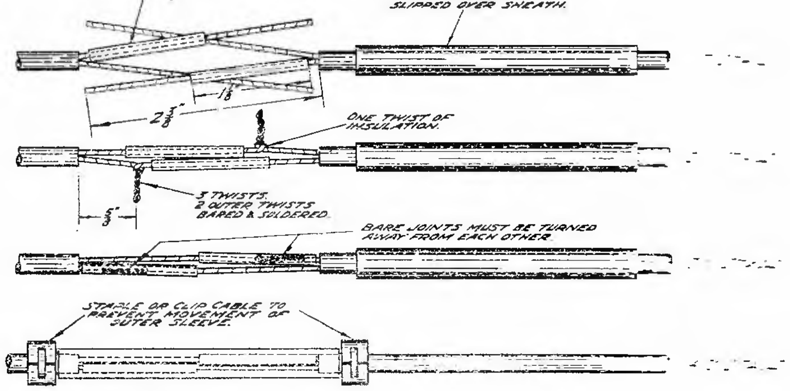


FIG 1A
JOINT USING WAXED PAPER SLEEVES.
USE ONLY IN DRY SITUATIONS AND WHERE CONTINUITY OF CABLE SHEATH IS NOT NECESSARY.

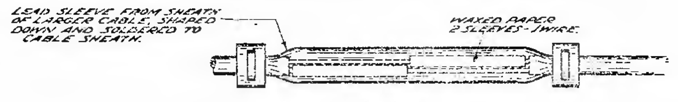
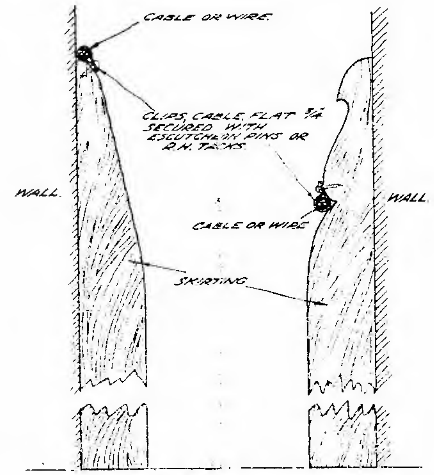
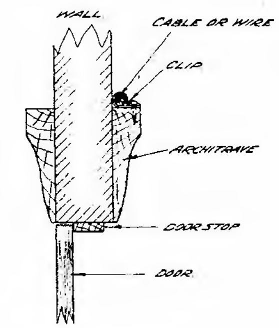


FIG 1B
ALTERNATIVE JOINT USING LEAD OUTER SLEEVE FOR USE IN DAMP SITUATIONS, OR WHERE CONTINUITY OF CABLE SHEATH IS NECESSARY.
STAGES OF JOINTING ARE SIMILAR TO THOSE IN FIG. 1A.

FIG 1
JOINTING SMALL CABLES.
(1 PAIR & 2 PAIR).



SKIRTING. SECTIONAL VIEW.



DOOR ARCHITRAVE
PART SECTIONAL PLAN.

FIG 2
TYPICAL METHODS OF SECURING WIRING TO SKIRTING BOARDS OR ARCHITRAVES.

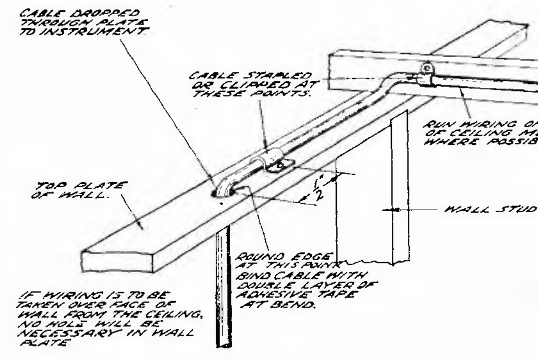
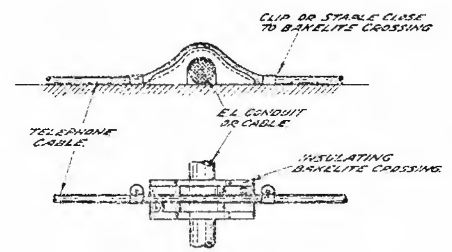
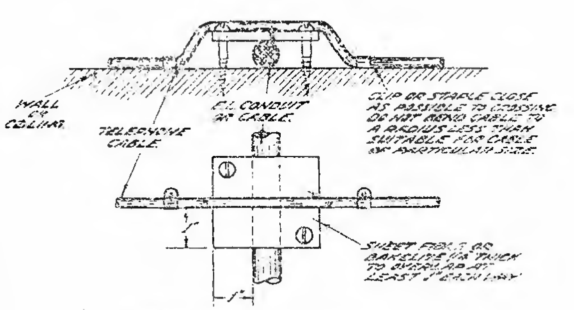


FIG 3
METHOD OF ANCHORING WIRING DROPPED THROUGH WALL PLATE OF TIMBER DWELLING.



OVER E.L. CONDUIT OR CABLE
NOT EXCEEDING 3/4" DIA.



OVER LARGER CONDUITS OR CABLES.

FIG 4
CROSSINGS OVER E.L. CONDUITS OR CABLES.

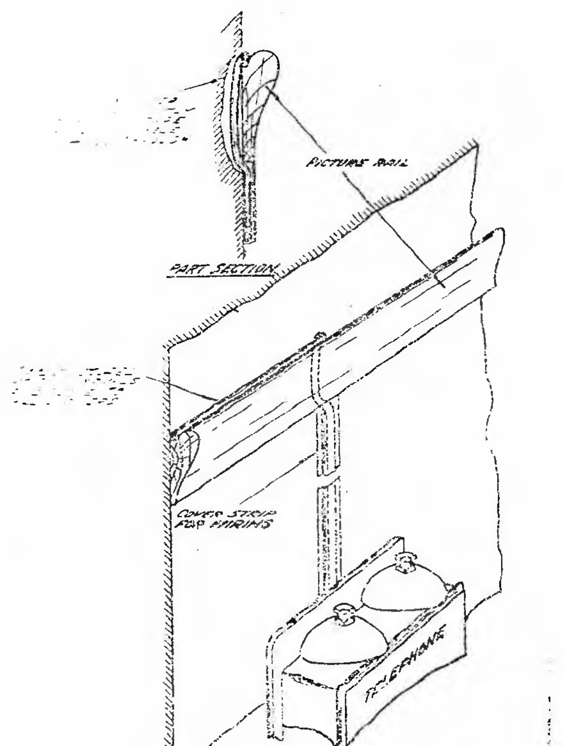
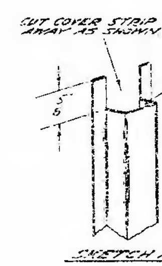


FIG 5
TYPICAL EXIT FROM PICTURE RAIL IN RESIDENCE.



SKETCH "A"

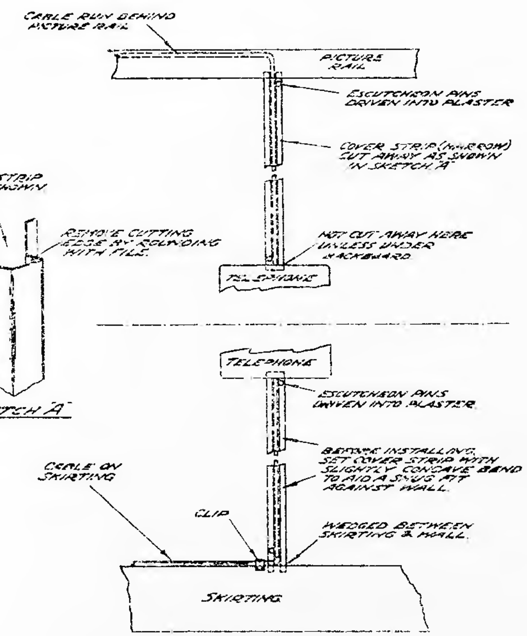


FIG 6
PROTECTION OF WIRING OVER PLASTER.

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	[illegible]	[illegible]		DRAWING No C 995 SHEET 1
				Drawn T.B.G. 1.10.34 Examined Approved Chief Engineer Date [illegible]

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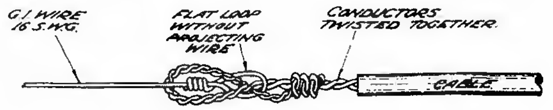


FIG 8A
CABLE, 1 OR 2 PAIR.

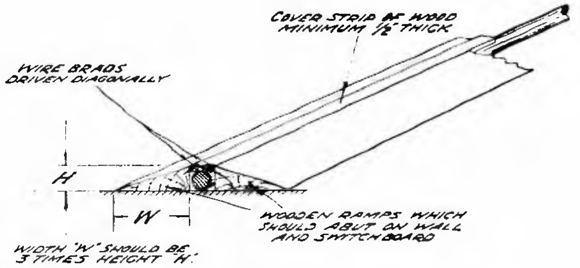


FIG 7
PROTECTION OF CABLE OVER SURFACE OF FLOOR BETWEEN WALL & P.B.X.

NOTE: CABLE SHOULD NOT BE RUN OVER FLOOR SURFACE IF SPACE USED FOR TRAFFIC.

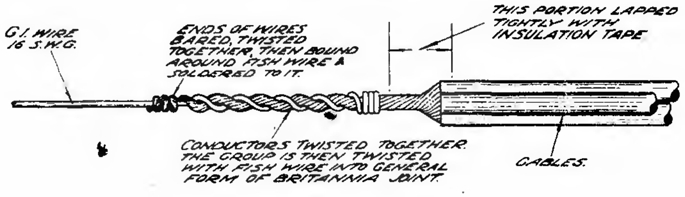


FIG. 8B.
SEVERAL CABLES 1 OR 2 PAIR.

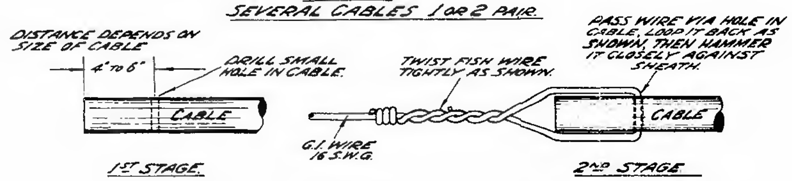


FIG. 8C.
CABLE. 4 PAIR OR LARGER.

FIG. 8
METHOD OF SECURING CABLE TO FISH WIRE FOR PURPOSE OF DRAWING CABLE INTO CONDUITS OR DUCTS.

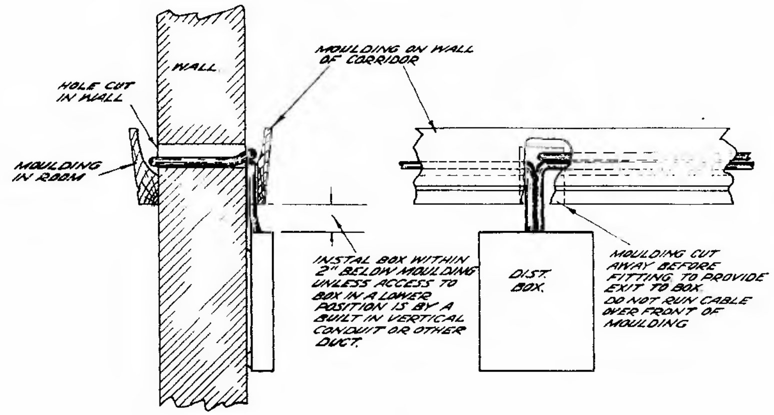


FIG. 9
ENTRY INTO TYPICAL MOULDING RUN IN LARGE CITY BUILDING

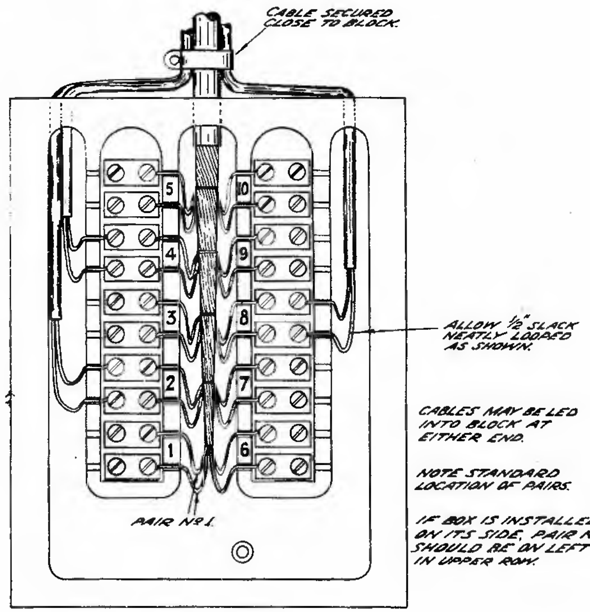


FIG 10
BLOCK, TERMINAL, No 6.
USED AS 10 PAIR DISTRIBUTING BOX.
METHOD OF LEADING IN AND TERMINATING.

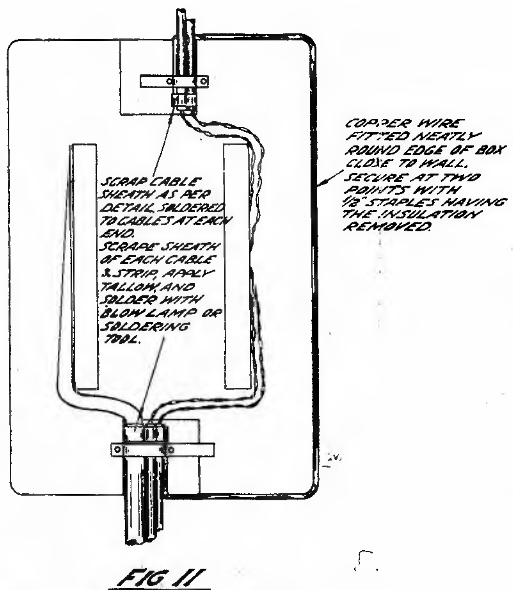
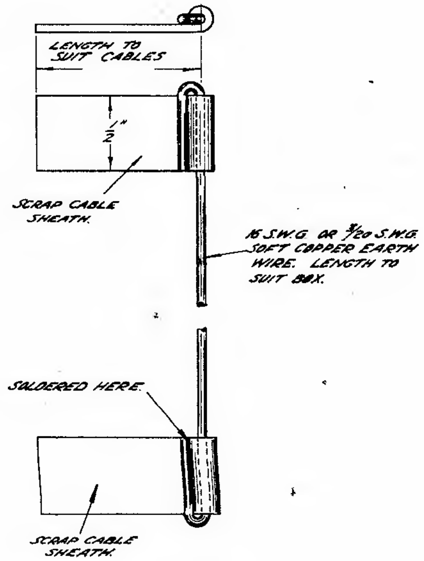


FIG 11
METHOD OF BONDING CABLE SHEATHS.

NOTES: WHEN CABLES ARE TO BE BONDED AT ONE END ONLY, USE A PIECE OF SCRAP CABLE SHEATH WITHOUT BRIDGING WIRE.
DO NOT BOND SMALL CABLES UNLESS NECESSARY TO PROVIDE EARTH FOR P.B.X. SERVICE.



DETAILS OF BOND.

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	16/11/34	E.P.		DRAWING No C.993	Drawn T.B.G. 2-10-34 Examined W.D. Approved E.P. Chief Engineer Date 16.10.34
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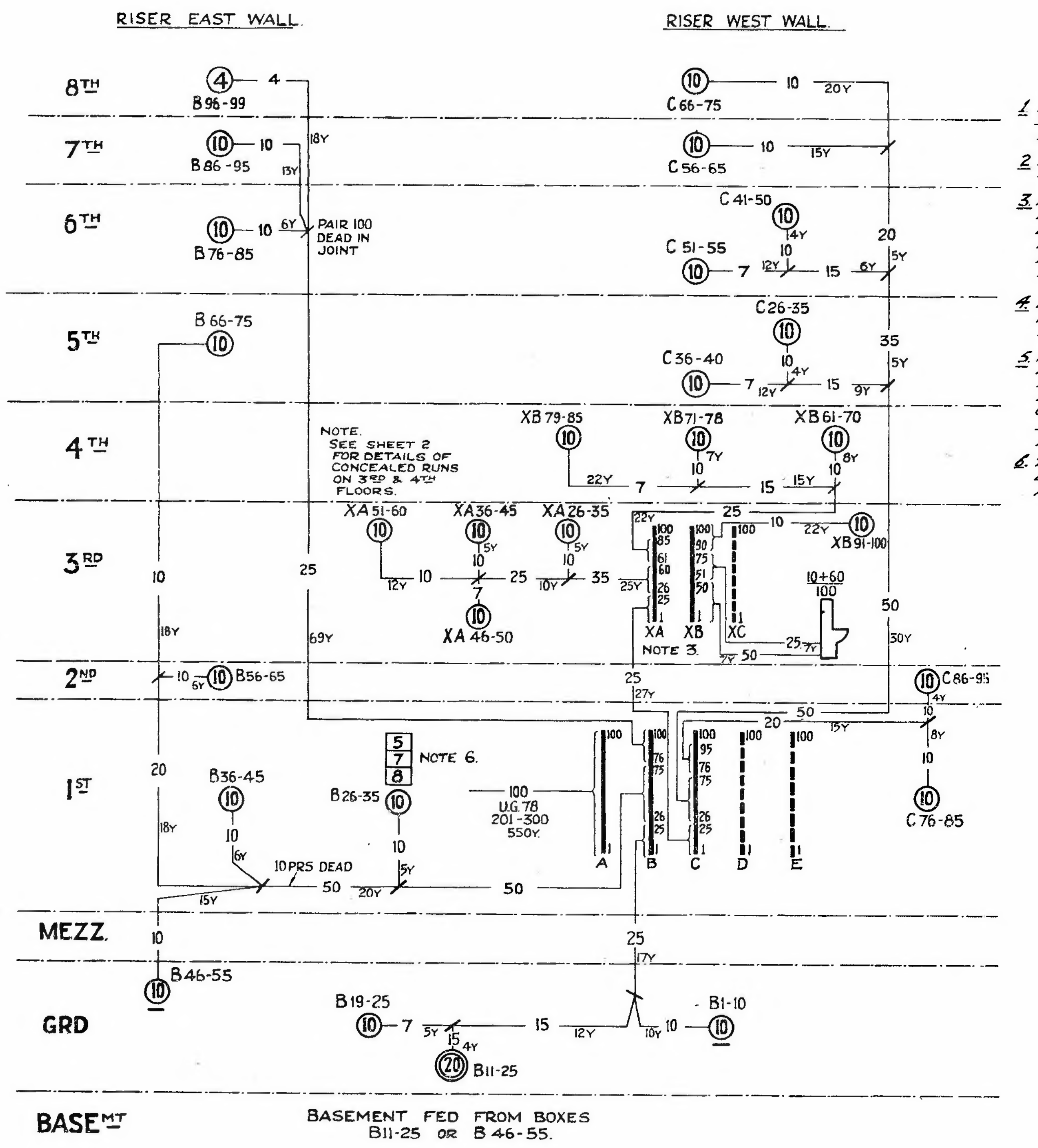

FIG. 12.
TYPICAL CABLING SCHEME FOR CITY BUILDING

NOTES.
1. FOR COMPLETE DETAILS OF STANDARD SYMBOLS SEE I.C. 4. APPENDIX "C".
2. FOR METHODS OF MULTIPLING SEE FIGS. 13, 14, 15.
3. FOR NUMBERING OF M.D.F. VERTICALS & DISTRIBUTING BOXES WHERE A SUBSIDIARY M.D.F. IS INSTALLED, FOLLOW THE METHOD OF LETTERING SHOWN.
4. MULTIPLE IS NOT USED UNLESS A DEFINITE ADVANTAGE IS FORESEEN.
5. WHERE TELEPHONE DENSITY IS HIGH, OR WHERE NECESSARY TO SHOW ROUTES OF CABLES, DUCTS, OR CONDUITS, THE CABLING DIAGRAM SHOULD BE SUPPLEMENTED BY FLOOR PLANS.
6. TYPICAL ENTRY REGARDING DEVELOPMENT, WHICH DOES NOT APPEAR ON FINAL PLANS.

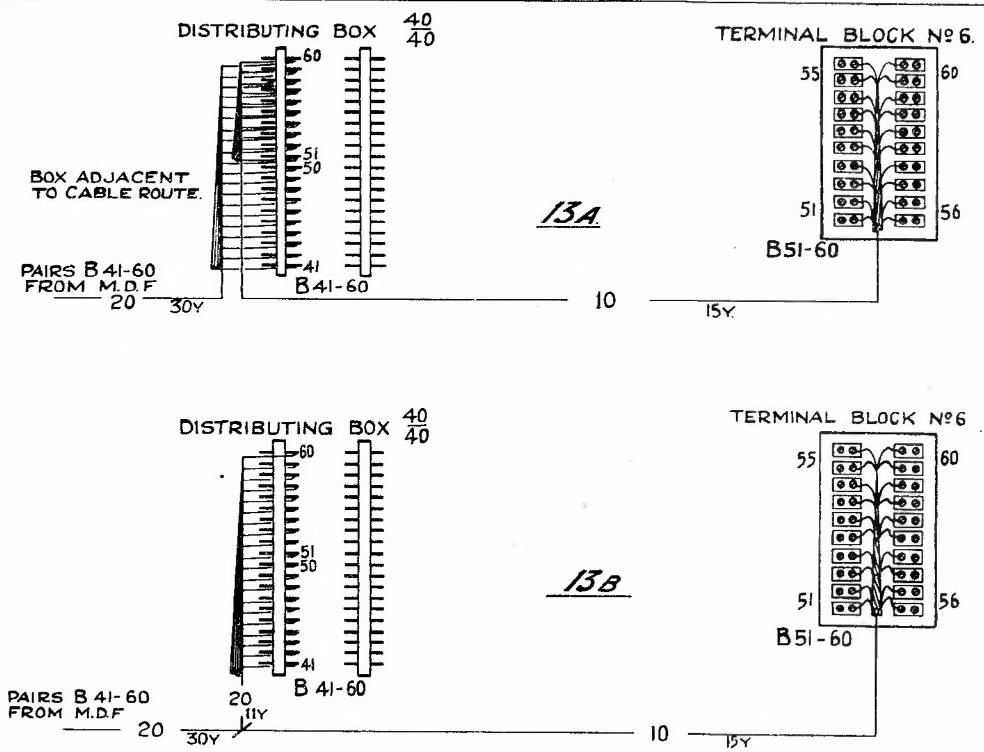

FIG. 13.
ALTERNATIVE METHODS OF CONNECTING TWO BOXES WITH 10 PRS IN MULTIPLE WHERE THE BOX FURTHER FROM M.D.F. IS THE SMALLER.

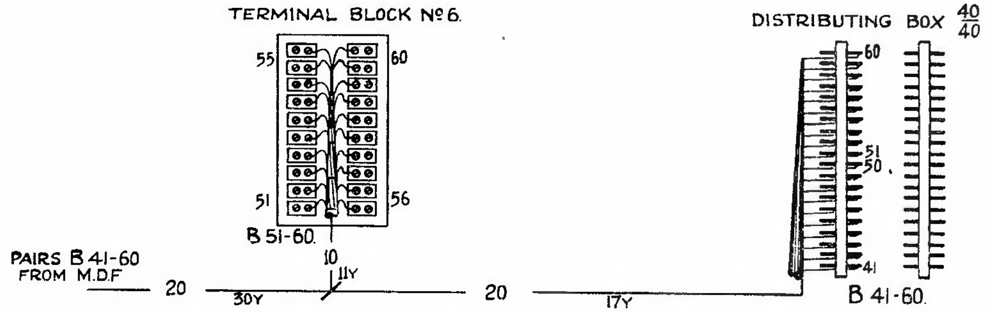

FIG. 14. METHOD OF MULTIPLING WHERE BOX NEARER M.D.F. IS SMALLER.

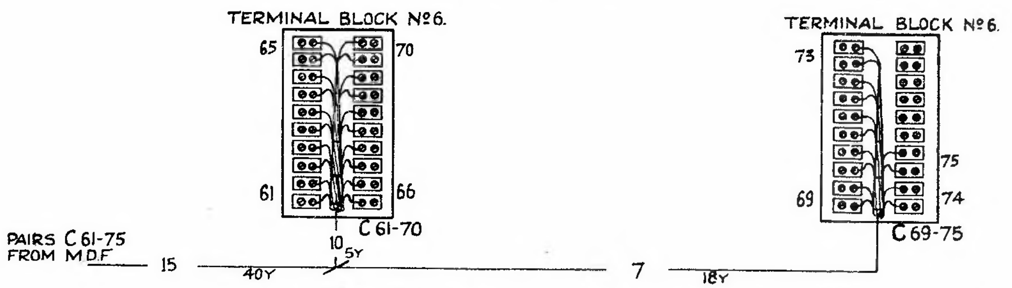

FIG. 15. TYPICAL METHOD OF MULTIPLING WITH OVERLAP OF MINIMUM NUMBER OF PAIRS. THIS METHOD IS OF USE WHERE FOR EXAMPLE:- TO MEET DEVELOPMENT A LENGTH OF 20 PR CABLE IN LIEU OF 15 PAIR CABLE OTHERWISE WOULD BE NECESSARY.

NOTES.
1. FOR EXPLANATORY PURPOSES THE POSITIONS OF NUMBERED PAIRS ARE INDICATED. ON CABLING DIAGRAMS THE STANDARD SYMBOLS SHOULD BE USED.
2. FULL MULTIPLE OF CABLE SHOULD NOT BE USED.
3. TO REDUCE COST MULTIPLING SHOULD BE CARRIED OUT AT THE TERMINALS OF THE DISTRIBUTING BOX INSTEAD OF BY MEANS OF A JOINT UNLESS THIS IS UNECONOMICAL AS IN FIG. 14. OR WHERE THE LARGER BOX IS REMOTE FROM THE ROUTE OF THE CABLE CONCERNED. IN THESE INSTANCES MULTIPLE IN A JOINT.
4. EXCEPT IN INSTANCES SIMILAR TO THAT IN FIG. 15 THE PAIRS NOT MULTIPLED SHOULD APPEAR AT THE LOWER END OF THE STRIP IN ALL CASES. PAIRS WHICH ARE MULTIPLED SHALL BE USED LAST.
5. PARTICULARS OF PAIRS MULTIPLED MUST BE ENTERED ON RECORD CARDS.

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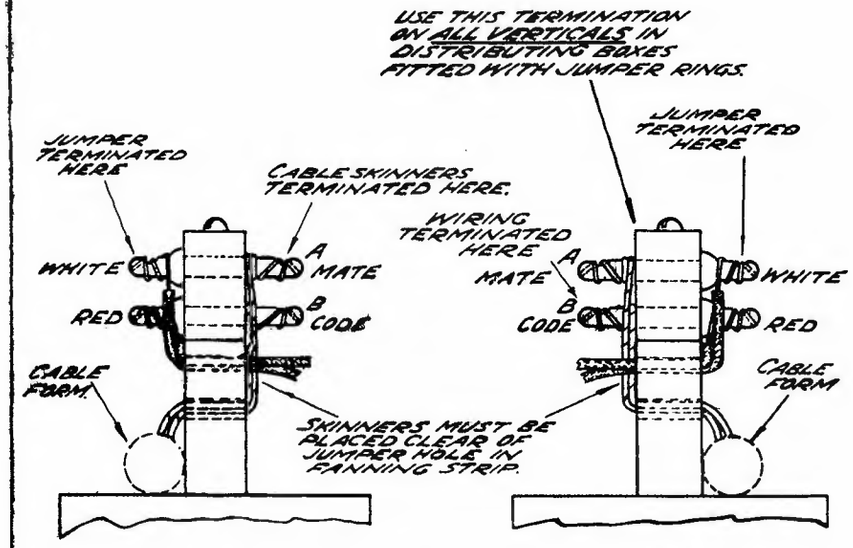
Approved
Chief Engineer
Date



16A
LEFT HAND VERTICAL IN $\frac{40}{40}$ BOX.

16B
ALL OTHER VERTICALS.

VIEW FROM LOWER END OF STRIP.

FIG. 16.

DISTRIBUTING BOXES.
TERMINATIONS ON VERTICALS.

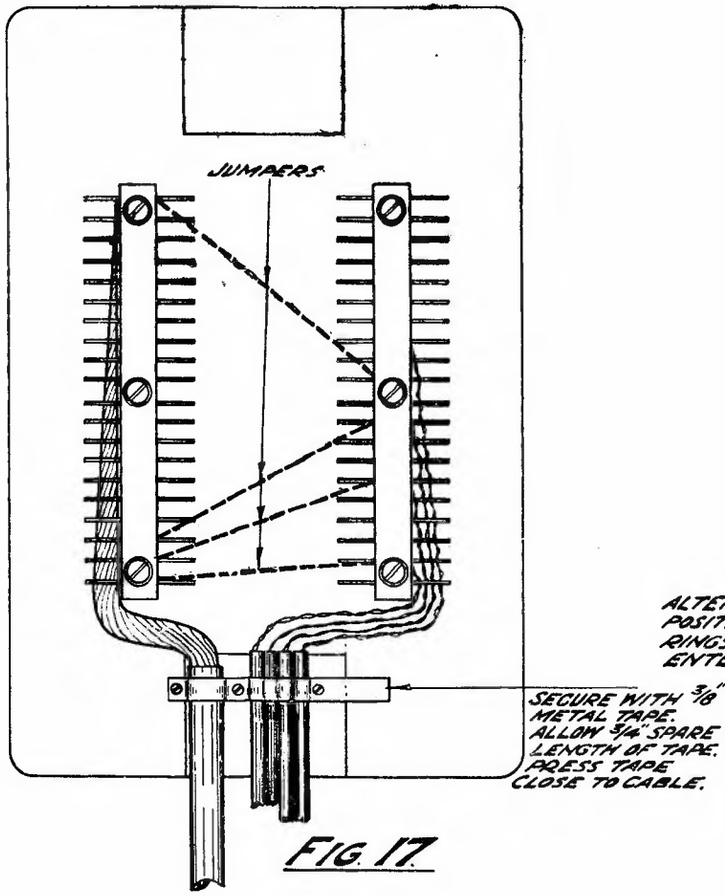


FIG. 17.

DISTRIBUTING BOX $\frac{40}{40}$ (VIEW WITH COVER OFF)
METHOD OF LEADING IN, TERMINATING, AND JUMPERING.

CABLE MAY BE LED IN AT EITHER TOP OR BOTTOM OF BOX.

THIS BOX HAS NO JUMPER RINGS. JUMPERS SHOULD TERMINATE AT OUTER ENDS OF TAGS IN BOTH STRIPS. SEE FIG. 16 FOR TERMINATION.

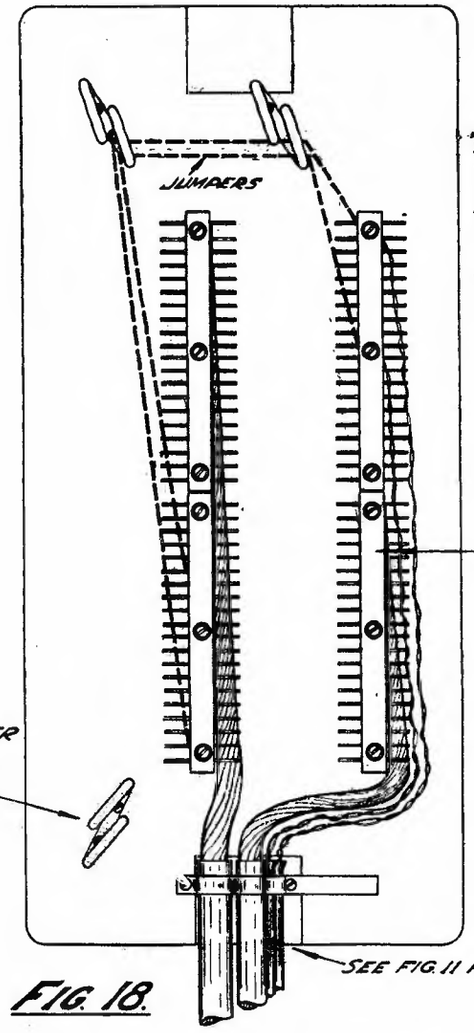


FIG. 18.

IF NECESSARY TO LEAD THE CABLE INTO TOP OF BOX, REMOVE TOP PLATE AND FIT IT TO BOTTOM OF BOX, AND FIT JUMPER RINGS AT LOWER END AS SHOWN DOTTED. (ONLY ONE RING SHOWN).

SKINNERS AND JUMPERS ARE TERMINATED IN STANDARD MANNER I.E. SKINNERS AT LEFT HAND END OF TAGS. JUMPERS AT RIGHT HAND END OF TAGS. SEE FIG 16 B.

VERTICALS NOT LETTERED OR NUMBERED.

DISTRIBUTING BOX $\frac{80}{80}$ (VIEW WITH COVER OFF).
METHOD OF LEADING IN, TERMINATING, AND JUMPERING.
TYPICAL OF ALL STANDARD DISTRIBUTING BOXES FITTED WITH JUMPER RINGS.

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Examined W.S.
Approved E.G.
Chief Engineer
Date 16.11.34.

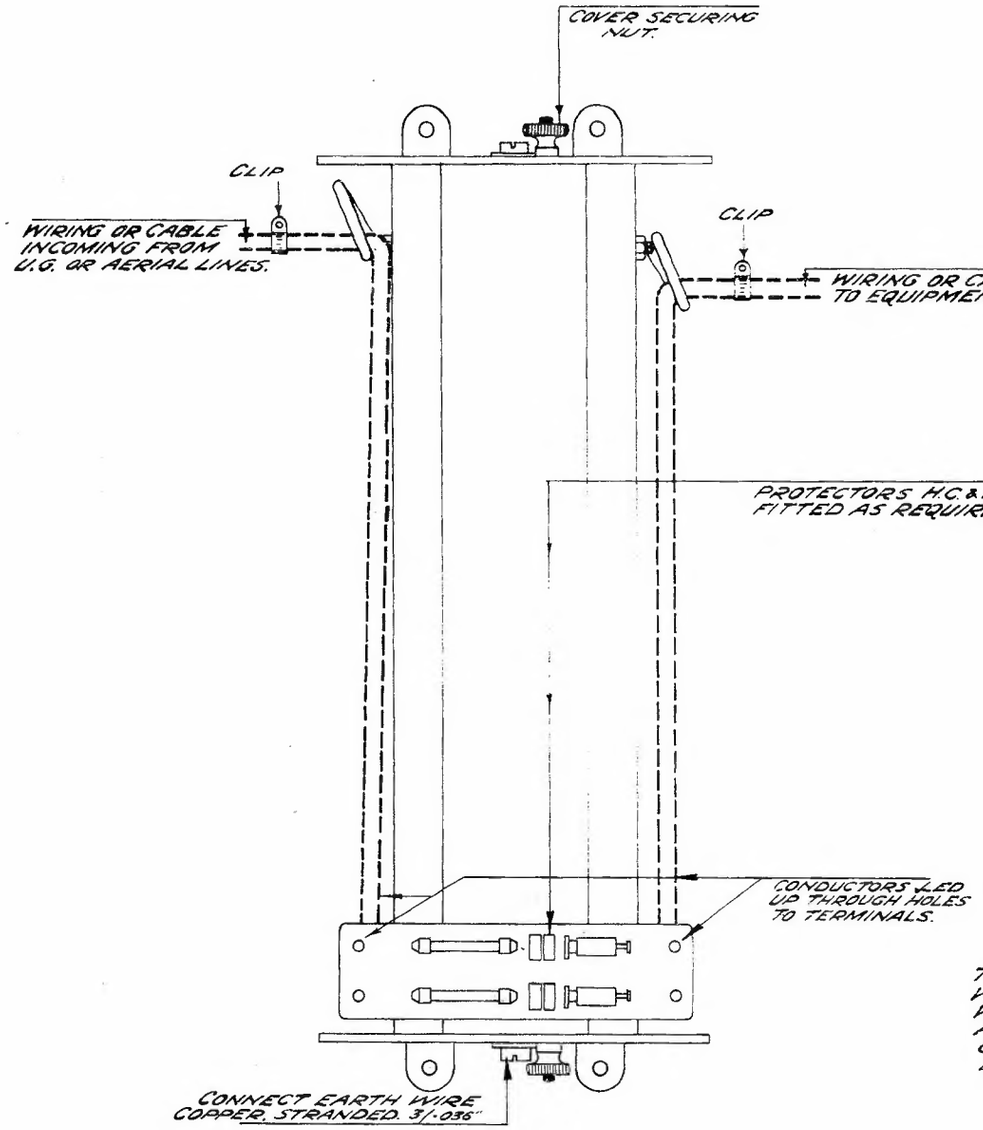
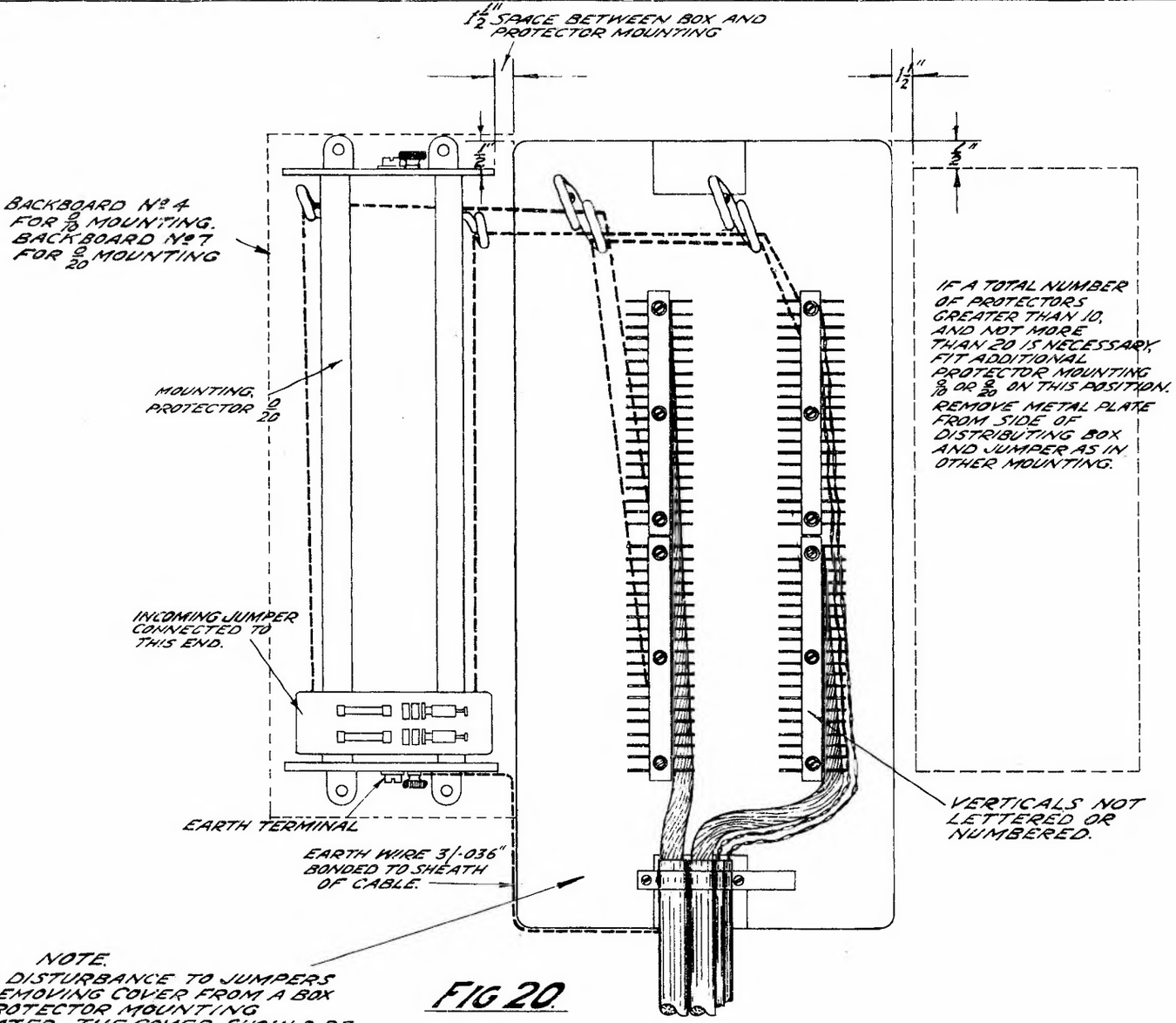


FIG 19.

METHOD OF TERMINATING IN A PROTECTOR MOUNTING $\frac{0}{10}$ OR $\frac{0}{20}$ WHEN USED TO PROTECT A SMALL GROUP OF CIRCUITS WHERE NO DISTRIBUTING BOX IS NECESSARY.



NOTE.
TO AVOID DISTURBANCE TO JUMPERS WHEN REMOVING COVER FROM A BOX WITH PROTECTOR MOUNTING ASSOCIATED, THE COVER SHOULD BE OPENED ONLY SLIGHTLY, AND THEN LIFTED OFF THE HINGE PINS.

FIG 20.

DISTRIBUTING BOX $\frac{80}{80}$ AND PROTECTOR MOUNTING $\frac{0}{20}$

METHOD OF INSTALLATION AND JUMPERING. TYPICAL OF ALL STANDARD DISTRIBUTING BOXES FITTED WITH JUMPER RINGS.

ISSUES				COMMONWEALTH OF AUSTRALIA P.M.G'S DEPARTMENT.
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	1-11-34	[illegible]		DRAWING No C.993 — Drawn T.B.G 2-10-34; Examined [illegible]; Approved [illegible] Chief Engineer; Date 1-11-34
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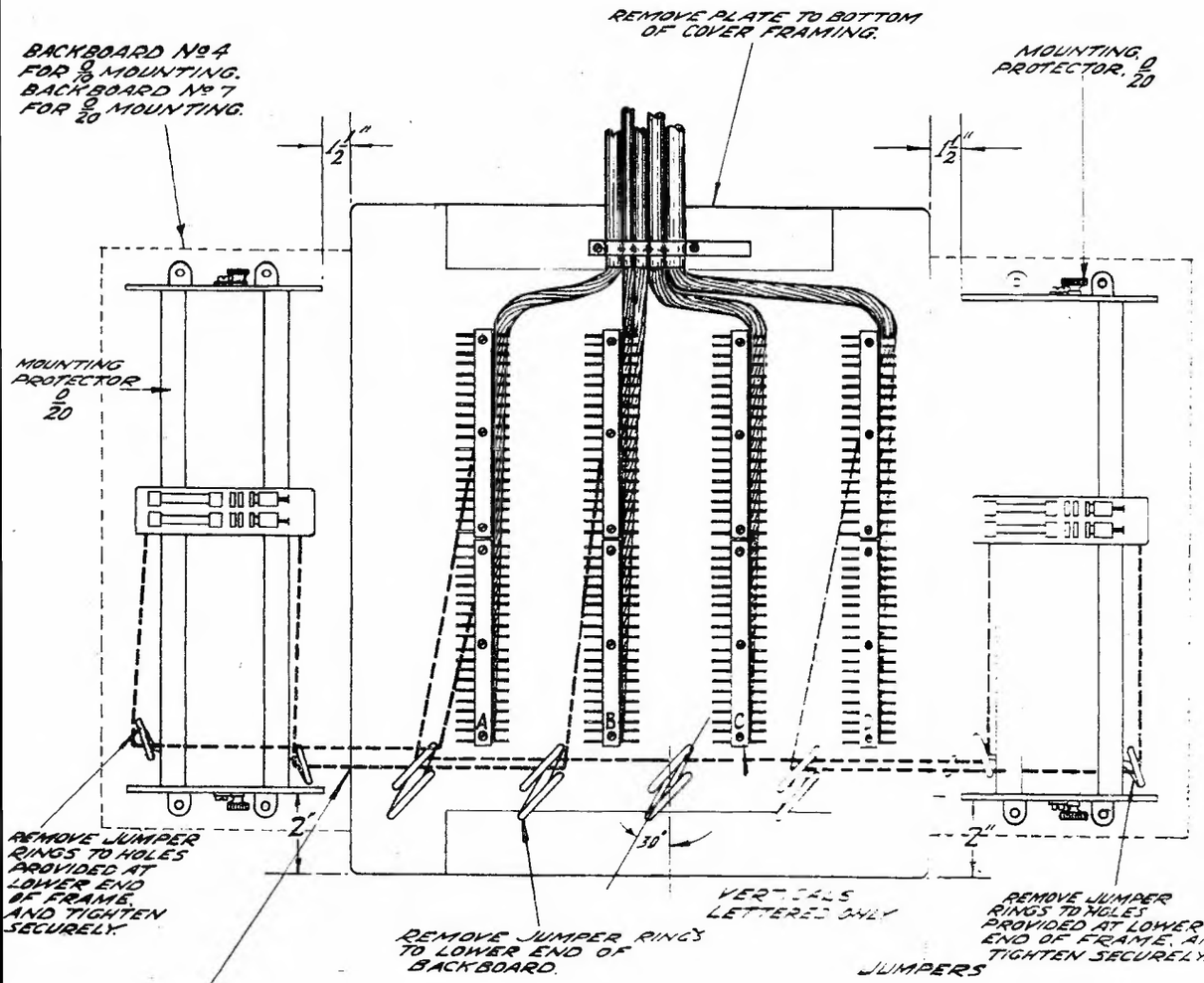

FIG 21

DISTRIBUTING BOX 150/100

WITH TWO PROTECTOR MOUNTINGS 0/20 ARRANGED FOR THE ENTRY OF CABLES INTO THE DISTRIBUTING BOX AT THE TOP END.

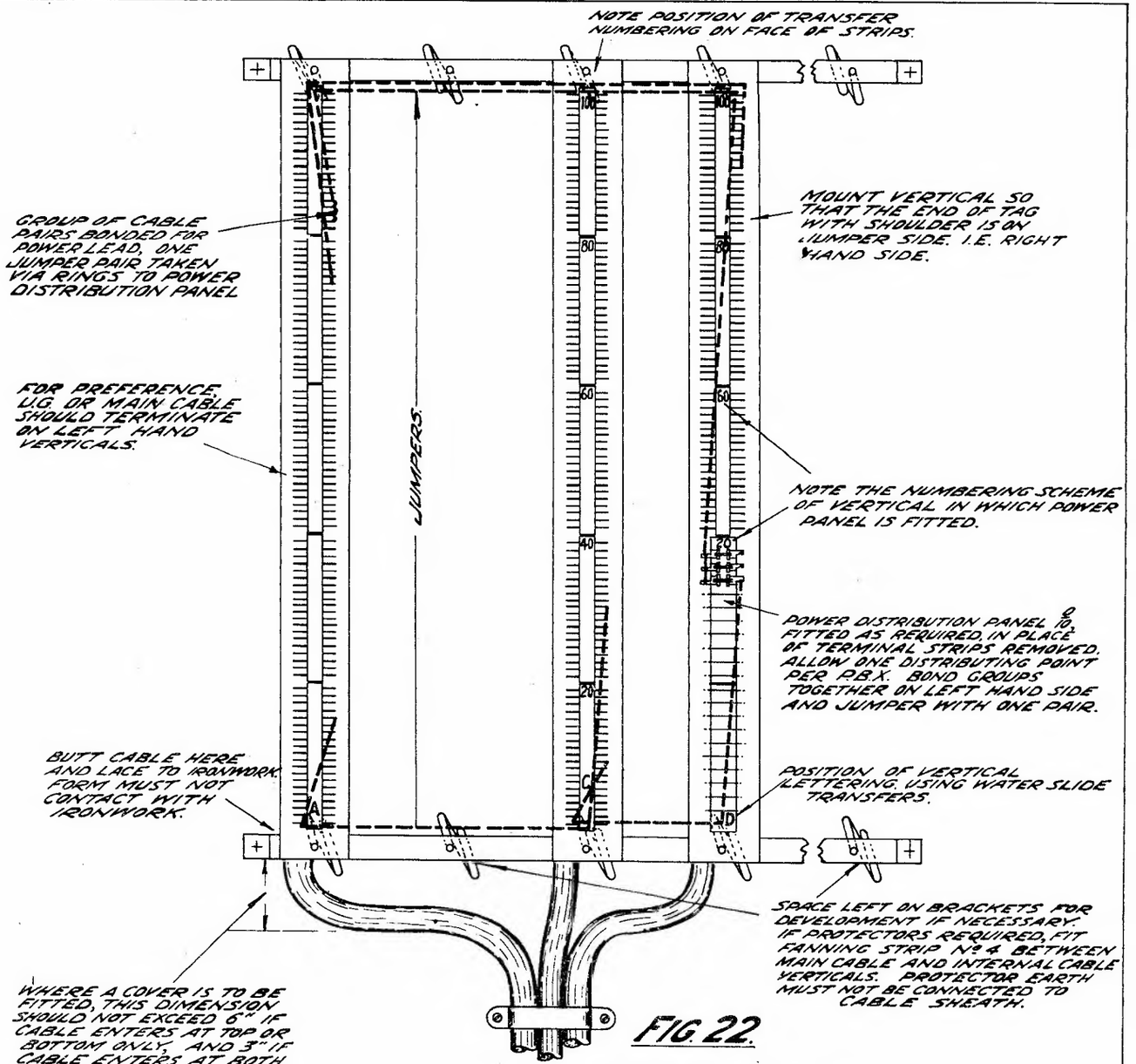

FIG 22.

WALL TYPE M.D.F.

ARRANGEMENT OF CABLING, JUMPERING ETC. WHED USED FOR DISTRIBUTION OF CABLING IN A CITY BUILDING.

MAXIMUM SIZE OF SINGLE M.D.F. IS 700 PAIRS. IF M.D.F. OF CAPACITY NOT EXCEEDING 1400 PAIRS IS REQUIRED, ERECT TWO 700 PR. FRAMES ONE ABOVE THE OTHER.

ISSUES				COMMONWEALTH OF AUSTRALIA P.M.G'S DEPARTMENT.
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				SHEET 6

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Examined [illegible]
Approved [illegible]
Chief Engineer
Date 16/11/34

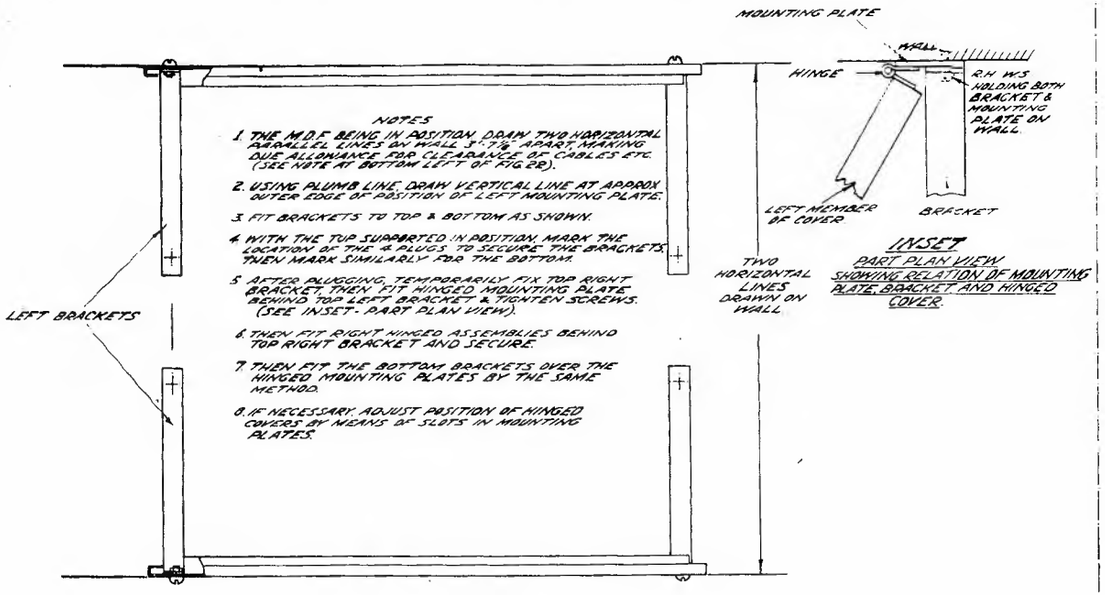


FIG 23
METHOD OF ERECTION OF COVER OVER WALL TYPE M.D.F.

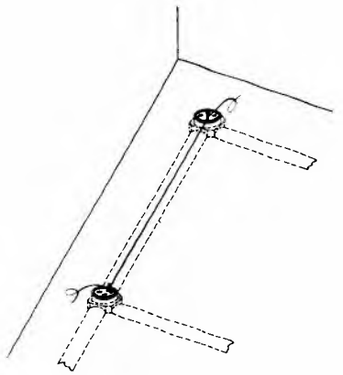


FIG 24A
LOCATE THE DUCT BY DRAWING A STRAIGHT LINE FROM POINT TO POINT BETWEEN DRAW-BOXES, OUTLETS ETC.

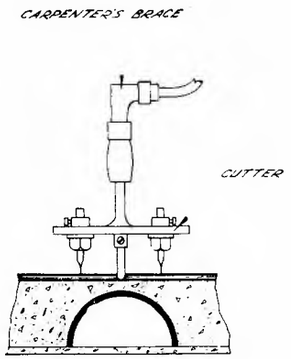


FIG 24B
AFTER ADJUSTING THE CUTTER TO THE OUTSIDE DIAMETER OF THE FLOOR FLANGE. CUT A HOLE IN THE FLOOR COVERING.

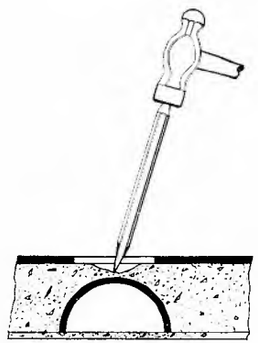


FIG 24C.
CHIP OUT THE CONCRETE WITH A CHISEL UNTIL THE TOP OF THE DUCT IS UNCOVERED. MAKE HOLE LARGE ENOUGH TO ALLOW THE DUCT CUTTER TO REACH THE DUCT.

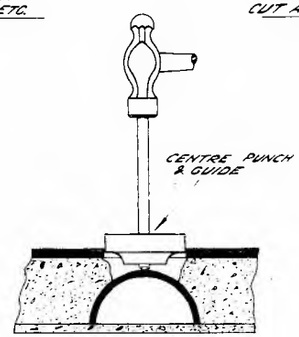


FIG 24D
USE THE CENTRE PUNCH TO MARK A DRILLING CENTRE. DRILL A 1/4" DIA. HOLE IN FIBRE DUCT.

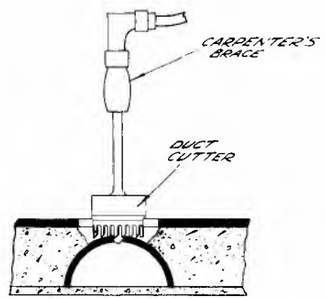


FIG 24E
DRILL A HOLE IN THE DUCT WITH THE DUCT CUTTER. USE GREASE ON THE BLADE, AND APPLY ONLY LIGHT PRESSURE ON THE BRACE. BY MEANS OF A TAP (PLUG OR BOTTOMING) START A THREAD IN THE HALE MADE WITH CUTTER

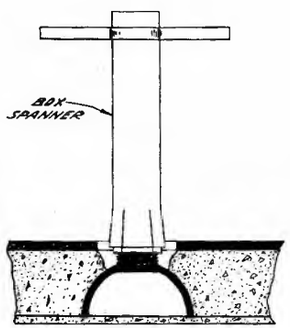


FIG 24F.
USING A BOX SPANNER SCREW A 3/8" x 1" HEXAGON REDUCING BUSH INTO THE THREADED DUCT.
USE A LARGER BUSH IF NECESSARY FOR A CABLE OVER 4 PAIRS.
THE BUSH SHOULD BE SCREWED INTO DUCT TO AN EXTENT ONLY SUFFICIENT TO FULLY ENGAGE THREAD.

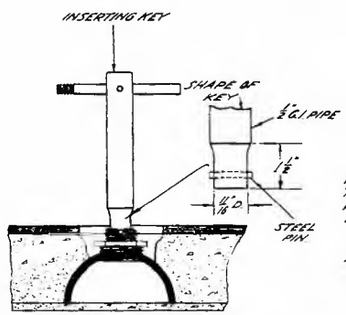
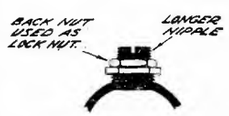


FIG 24G.
WITH A SPECIAL INSERTING KEY SCREW A 3/8" x 1/4" PLAIN NIPPLE (WITH SLOT AS SHOWN) INTO BUSH.
USE TWO BLADES IN A HACK-SAW FRAME TO CUT SLOT IN NIPPLE. DO THIS AT INSTALLATION CENTRE OR WORKSHOPS AS CONVENIENT.
NIPPLE SHOULD NOT PASS THROUGH BUSH, AND SHOULD PROJECT APPROX 3/8" TO TAKE FLANGE. THE OPERATION OF SCREWING THE NIPPLE SHOULD NOT CAUSE THE BUSH TO SCREW FURTHER INTO DUCT. STEPS SHOULD BE TAKEN TO PREVENT THIS IF NIPPLE IS TIGHT IN BUSH.
WHERE DEPTH OF FLOOR FILL IS SUCH THAT FLOOR FLANGE WILL NOT SCREW OVER THE NIPPLE DOWN AGAINST THE BUSH, USE A LONGER NIPPLE, AND SECURE WITH A BACK NUT AS SHOWN IN INSET.



INSET.

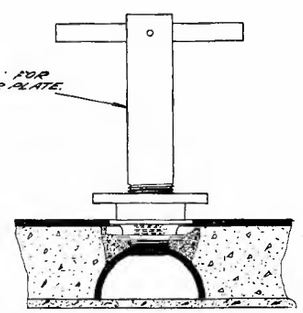


FIG 24H
WHEN HEIGHT OF THE TOP OF NIPPLE IS ADJUSTED TO WITHIN 1/2" OF FLOOR SURFACE, GROUT THE OUTLET WITH CEMENT & SAND (1-3 RATIO) LEAVING THREAD ON NIPPLE CLEAR, AND SPACE TO SCREW DOWN FLOOR PLATE.
THEN SCREW DOWN FLOOR PLATE FLUSH WITH FLOOR, USING THE SPECIAL "T" WRENCH SHOWN. IF NIPPLE IS LOOSE IN BUSH AND TENDS TO SCREW INTO BUSH INSTEAD OF FLOOR PLATE, BURR THREAD OF NIPPLE ABOVE BUSH.

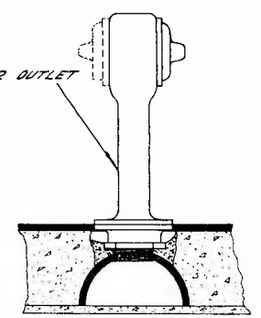


FIG 24 I.
THEN SCREW THE OUTLET FITTING INTO FLOOR PLATE.
IF ONE PAIR IS TO BE TERMINATED, CONNECT CONDUCTORS TO TERMINALS IN ROSE, AND EXTEND TO TABLE ETC WITH CORD, TPH, INSTRUMENT 22098. IF SUITABLE, OR CORDAGE, TPH, INSTRUMENT 2000.
IF TWO PAIRS, AN ADDITIONAL ROSE MAY BE FITTED ON BACK OF OUTLET FITTING BY DRILLING HOLES AND TAPPING WHERE NECESSARY.
IF MORE THAN TWO, DRILL OUT CENTRE OF ROSE, AND EXTEND CABLE TO TABLE VIA THE HOLE.
WHEN OUTLET IS NOT FURTHER REQUIRED, REMOVE OUTLET FITTING, AND REPLACE WITH BRASS FLOOR PLUG

FIG 24
FIBRE DUCT
METHOD OF OBTAINING ENTRY

IF FLOOR IS OF TIMBER, MARK INITIAL CIRCLE WITH CUTTER AS FOR LINO. WITH SHARP CHISEL CUT WOOD AWAY TO ABOUT 3/32 DEEP. THEN DRILL OR CUT THROUGH REMAINDER OF WOOD. A HOLE APPROX. 1/4" LESS THAN THAT AT SURFACE OF FLOOR.
THEN PROCEED AS ABOVE.

ISSUES			AMENDMENTS	COMMONWEALTH OF AUSTRALIA
NO	DATE	APP		POSTMASTER GENERAL'S DEPARTMENT
	14/7/54	[illegible]		

SUBSCRIBERS' INSTALLATION METHODS

DRAWING No	Drawn T.B.G. 2-10-54
C.993	Examined [illegible]
SHEET 7.	Approved [illegible] Chief Engineer
	Date [illegible]

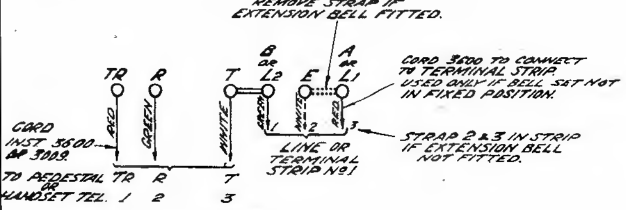


FIG 25.
CONNECTIONS BETWEEN C.B. OR AUTOMATIC BELL SET & PEDESTAL, OR HANDSET TELEPHONE.

WHEN HANDSET TELEPHONE IS FITTED TO BELL SET USE CORD 3009 TO CONNECT BELL SET, AND CONNECT L2, E, & L1 TO TERMINALS 1, 2 & 3 IN TERMINAL STRIP.

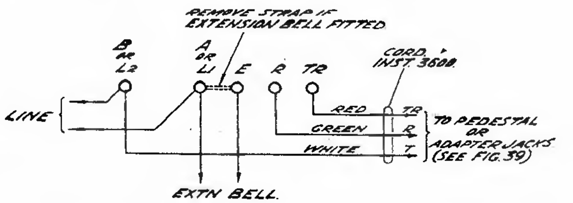


FIG 26.
CONNECTIONS ON WALL SET, WITH PEDESTAL OR PORTABLE TELEPHONE JACKS IN PARALLEL.

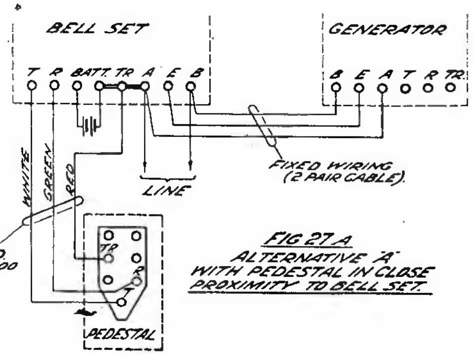


FIG 27 A.
ALTERNATIVE "A" WITH PEDESTAL IN CLOSE PROXIMITY TO BELL SET.

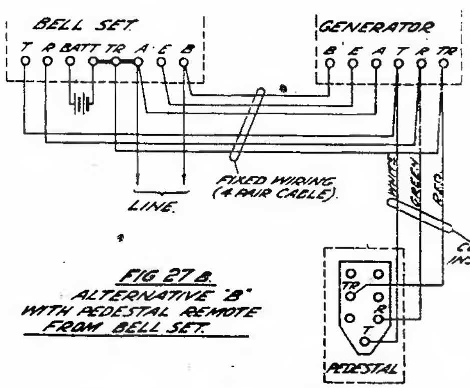


FIG 27 B.
ALTERNATIVE "B" WITH PEDESTAL REMOTE FROM BELL SET.

FIG 27.
CONNECTIONS ON MAGNETO TABLE TELEPHONE.

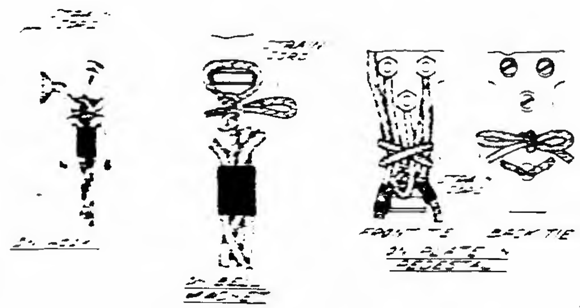


FIG 28
[illegible]

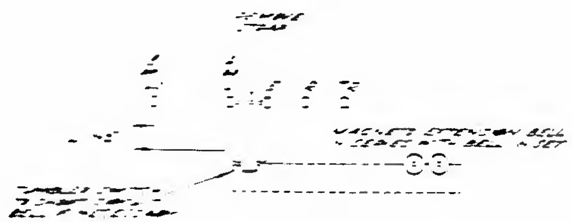


FIG 29
[illegible]

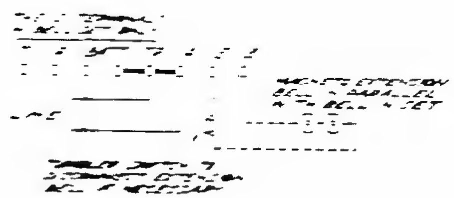
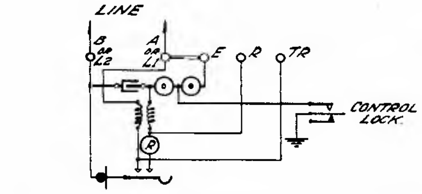
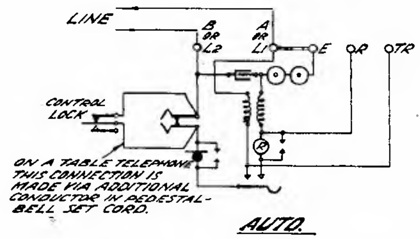


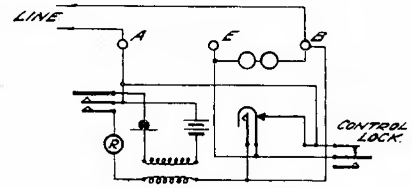
FIG 30
[illegible]



C.B. MANUAL.

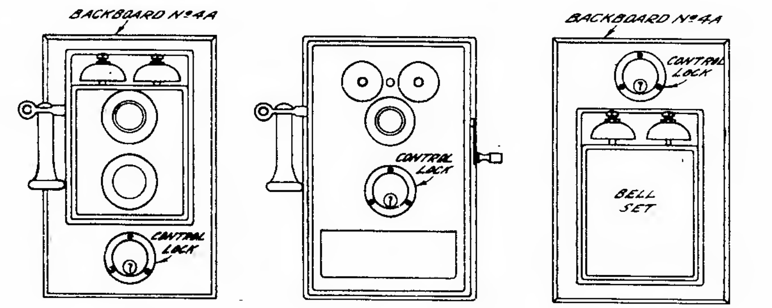


AUTO.



MAGNETO.

FIG 31
CONTROL LOCKS.
METHOD OF CONNECTION.

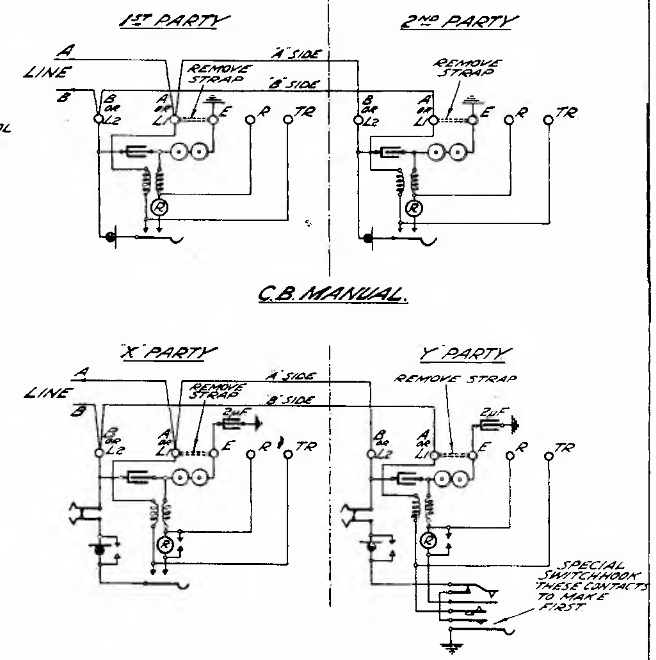


C.B. & AUTO. WALL TELEPHONE.

MAGNETO WALL TELEPHONE.

C.B., AUTO, & MAGNETO TABLE TELEPHONE.
(IF DESIRABLE FOR MAGNETO, LOCK MAY BE FITTED ON CASE OF GENERATOR.)

FIG 32.
CONTROL LOCKS
METHOD OF FITTING.



AUTO.
(ADDITIONAL CONDENSER CLIPPED BELOW SET.)

FIG 33.
CONNECTIONS FOR PARTY-LINE WORKING
(PLAN 3).

ISSUES				COMMONWEALTH OF AUSTRALIA P.M.G.'S DEPARTMENT
No	DATE	APPD	AMENDMENTS	SUBSCRIBERS' INSTALLATION METHODS
	14/4/34			DRAWING No C.993. SHEET 8
				Drawn T.R.G. 2-10-33; Examined; Approved; Chief Engineer; Date 16/4/34

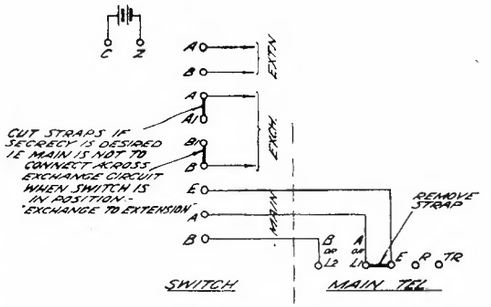


FIG 34
C.B OR AUTO EXTENSION SWITCH
METHOD OF CONNECTION
PLAN No 4.

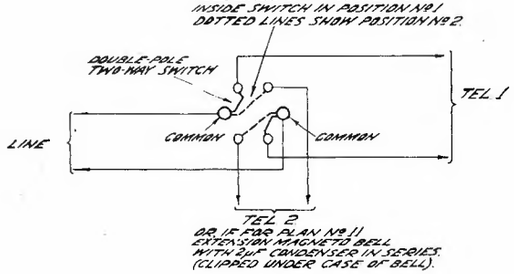


FIG 35
ALTERNATIVE TELEPHONES OR ALTERNATIVE TELEPHONE & BELL WITH CHANGE-OVER SWITCH. (PLANS Nos 5 & 11).

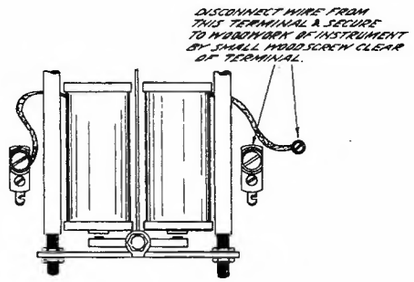


FIG 36
DISCONNECTION OF BELL ON PARALLEL SERVICE.

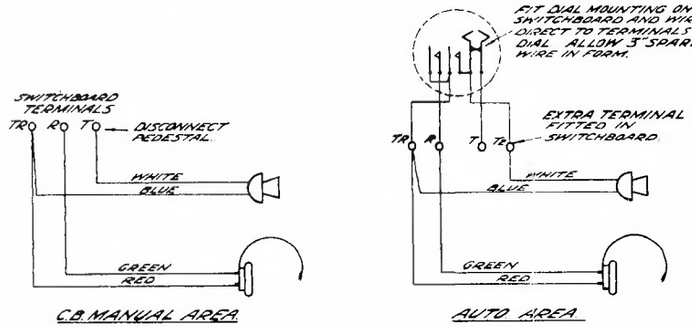


FIG 37
FITTING TELEPHONIST'S TELEPHONE TO CORDLESS SWITCHBOARD IN PLACE OF PEDESTAL.

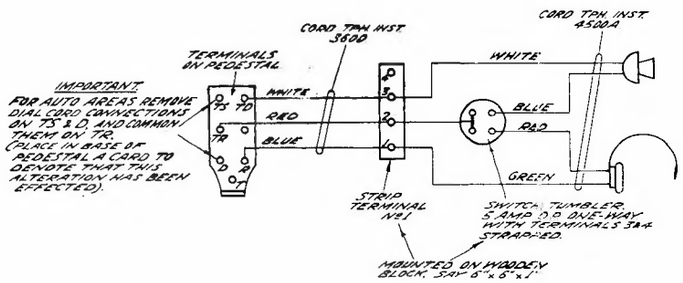


FIG 38A
FITTING TELEPHONIST'S TELEPHONE IN PARALLEL WITH PEDESTAL. C.B. MANUAL OR AUTO.

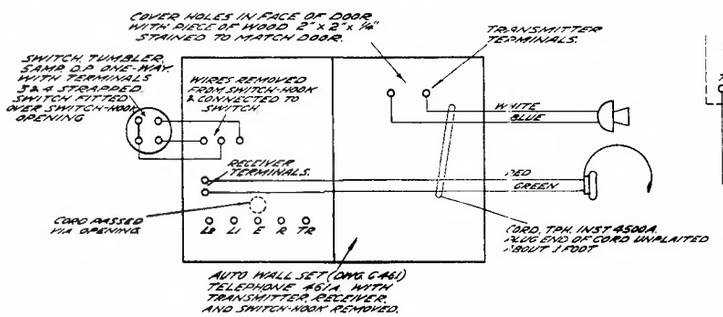


FIG 38B.
FITTING TELEPHONIST'S TELEPHONE ON WALL SET FOR USE AS A TABLE SET.
C.B. MANUAL OR AUTO.

NOTE - SET MAY BE INSTALLED AS FOLLOWS -
1. IN A FIXED POSITION IF CONVENIENT.
2. ON A BRACKET (SEE INSET) ON SURFACE OF A TABLE, WITH A & B LINES CONNECTED BY 2-CONDUCTOR CORD.

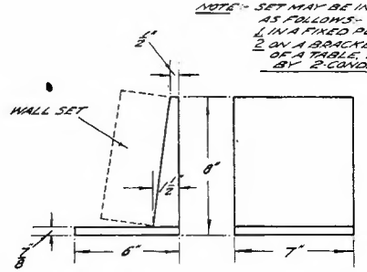


FIG 38
TELEPHONIST'S TELEPHONES
SPECIAL CONNECTIONS.

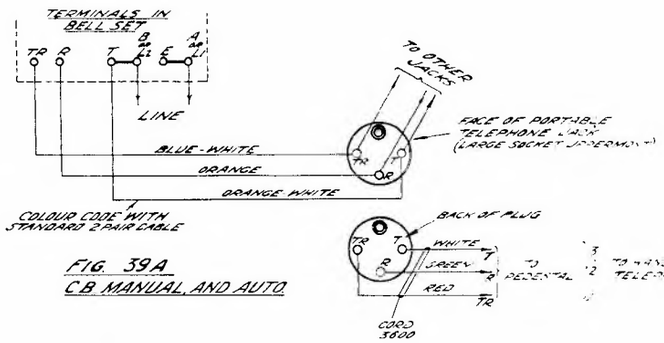


FIG. 39A
C.B. MANUAL AND AUTO

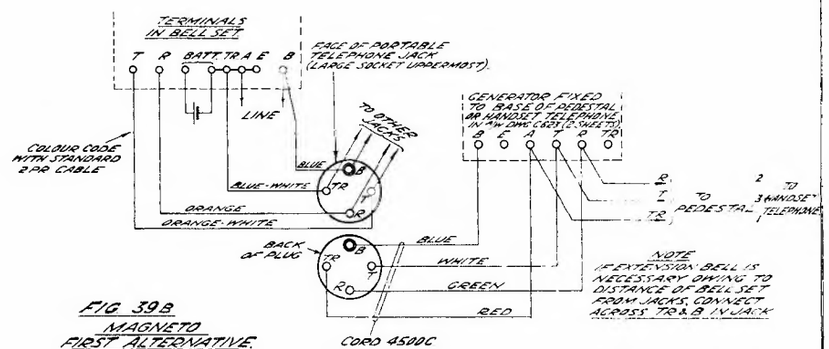


FIG 39B
MAGNETO
FIRST ALTERNATIVE.

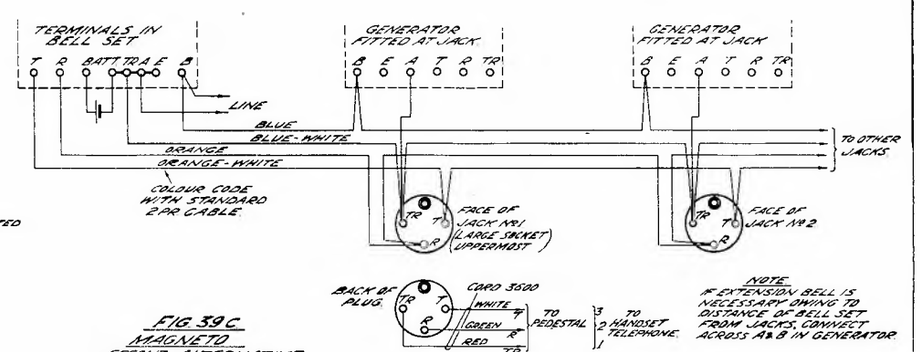


FIG 39C
MAGNETO
SECOND ALTERNATIVE.

FIG 39
PORTABLE TELEPHONES
(PLAN No 8).

ISSUES			COMMONWEALTH OF AUSTRALIA
No	DATE	AMENDMENTS	P.M.G'S DEPARTMENT
	1/11/34	C.3	SUBSCRIBERS' INSTALLATION METHODS
			DRAWING No C.993
			SHEET 9

Drawn TAG 5-11-34
Examined
Approved
Chief Engineer
Date

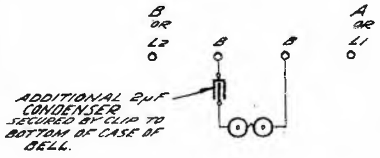
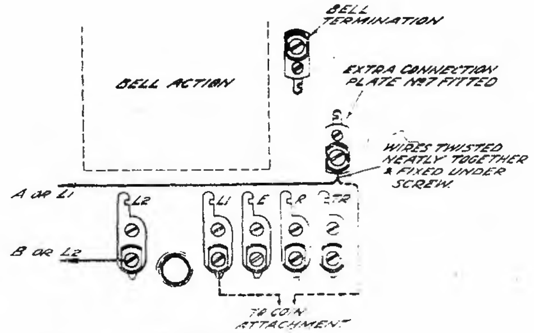


FIG 40

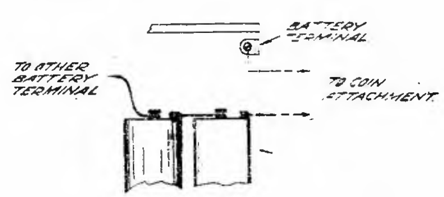
MAGNETO BELL ON AUTO. PUBLIC TELEPHONE.

FITTED ONLY AT POST OFFICES AND SUBSCRIBER'S PREMISES WHEN REQUIRED.



C.B MANUAL

CONNECT ATTACHMENT IN SERIES WITH LINE AS SHOWN.

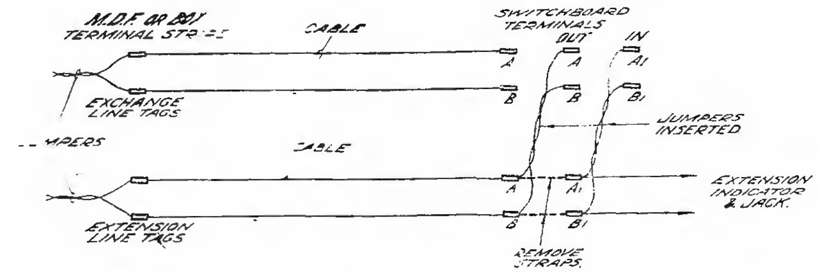


MAGNETO

CONNECT ATTACHMENT IN SERIES WITH LOCAL BATTERY AS SHOWN.

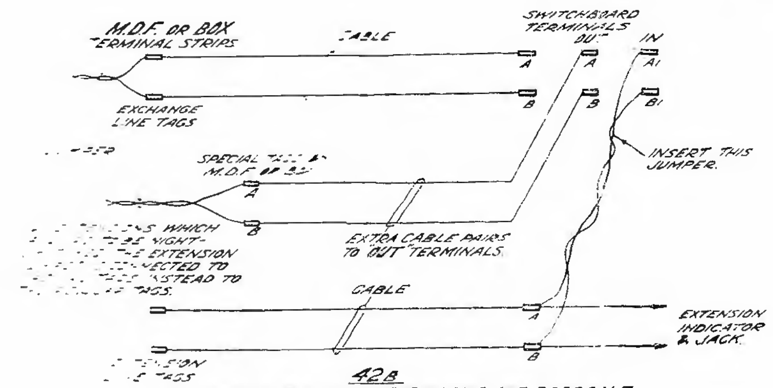
FIG 41

MANUAL PUBLIC TELEPHONES METHODS OF CONNECTION.



42 A

WHERE EXTENSION TAGS IN SWITCHBOARD ARE DUPLICATED AND STRAPPED.



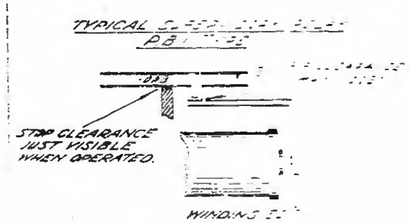
42 B

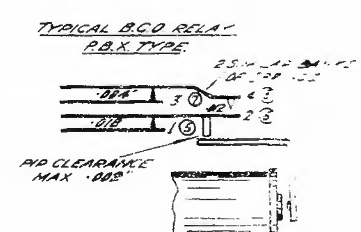
WHERE FUTURE ALTERATIONS ARE PROBABLE PROVIDE EXTRA CABLE PAIRS TO M.D.F. OR BOX.

[illegible] ALTERATIONS ARE UNLIKELY, TERMINATE CABLE PAIR [illegible] SELECTED EXTENSION ON THE "OUT" N.S. TERMINALS OF EXCHANGE LINE, AND JUMPER FROM "IN" N.S. TERMINALS TO EXTENSION TERMINALS.

FIG. 42

CONNECTIONS FOR NIGHT-SWITCHING FACILITIES. STANDARD C.B. P.B.X. SWITCHBOARDS.

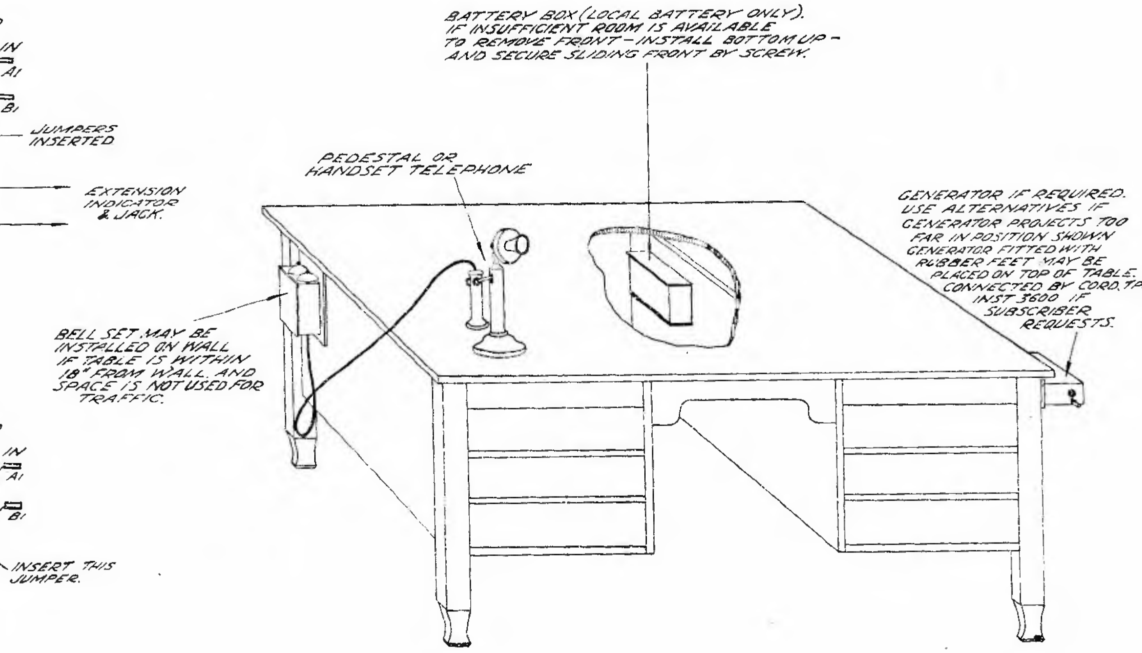


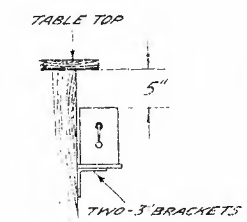


ADJUSTMENTS						ELECTRICAL CHARACTERISTICS	
ARMATURE TRAVEL			SPRING TENSIONS			RELAY OPERATES	RELAY RELEASES
RESIDUAL	TOTAL TRAVEL	SPRING ADJUSTMENTS	SPRINGS Nº	OPERATED GRAMMES	NOT OPERATED GRAMMES	MA	MA
·008" FIXED	·010"	BREAK ·008"	2		12 MINIMUM	20	ZERO OR 2
·010" FIXED	·027"	BREAK ·018" MAKE ·012" BREAK ·004"	[illegible]	20	15 MINIMUM 15 MINIMUM	14	ZERO

FIG 43

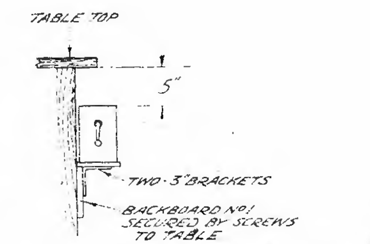
P.B.X. RELAY ADJUSTMENTS TYPICAL DATA





ALTERNATIVE "A"

IF TWO BRACKETS CAN BE SECURED DIRECT TO TABLE AT SAY 4" OR 6" CENTRES.



ALTERNATIVE "B"

IF TWO BRACKETS AT REASONABLE CENTRES CANNOT BE FITTED DIRECT TO TABLE, SECURE BACKBOARD Nº1 AS SHOWN, BY AT LEAST THREE SCREWS.

FIG. 44

TYPICAL TABLE SET INSTALLATION. (SEE SECTION 4, PARA 18).

ISSUES				COMMONWEALTH OF AUSTRALIA P.M.G'S DEPARTMENT
Nº	DATE	APPD	AMENDMENTS	SUBSCRIBERS' INSTALLATION METHODS
	14/1/37	E.A.		DRAWING Nº C.993 — SHEET Nº — Drawn T.B.G. 3-11-34; Examined [illegible]; Approved [illegible] (Chief Engineer); Date [illegible]

F.

Page 3 - Substitute the following:

M.C.32 (Amendment No.3).
Serial No. 91.
C.E. 4054/G.
17/5/35.

STATEMENT "A".

AUTOMATIC EXCHANGES AND P.A.B.X.'s.

FAULTS PER 100 UNITS AND EQUATED VALUES PER UNIT.

Item	Type of Equipment	Units	Faults per 100 units per annum	Equated values per unit.
1	1st Preselectors (Plunger Type)	Switches	3	0.12
2	2nd Preselectors (Plunger Type)	Switches	3	0.12
3	Master Switches	Switches	70	2.8
4	1st Preselectors (Rotary Type)	Switches	4	0.16
5	2nd Preselectors (Rotary Type)	Switches	5	0.2
6	Junction Preselectors	Switches	5	0.2
7	Line Finders (Rotary Type)	Switches	-	-
8	Discriminating Repeaters (Siemens)	Switches	30	1.2
9	Miscellaneous Preselectors N.E.I.	Switches	5	0.2
10	Group Selectors (Covered)	Switches	60	2.4
11	1st and Incoming Group Selectors (Siemens)	Switches	70	2.8
12	Group Selectors, Discriminating (P.A.B.X's)	Switches	60	2.4
13	Group Selectors (Uncovered)	Switches	80	3.2
14	Intermediate Group Selectors (Siemens)	Switches	40	1.6

Page 4 - Substitute the following:

STATEMENT "A" (Continued).

Item	Type of Equipment	Units	Faults per 100 units per annum	Equated values per unit.
15	Final Selectors (Covered)	Switches	65	2.6
16	Final Selectors (Uncovered)	Switches	120	4.8
17	Switching Selector Repeaters	Switches	90	3.6
18	Discriminating Selectors (Siemens)	Switches	60	2.4
19	Selector Repeaters	Switches	75	3.0
20	Line Finders (Bi-motional)	Switches	-	-
21	Miscellaneous Bi-motional Switches N.E.I.	Switches	10	0.4
22	Repeaters	Switches	15	0.6
23	Registers	Registers	1	0.04
24	Manual Desks (P.A.B.X's)	Total Switches	12	0.48
25	Manual Desks (Other Exchanges)	Total Switches	0.5	0.02
26	M.D.F. and I.D.F. Equipment	Protector Pairs	3	0.12
27	Miscellaneous - Alarm, Signal, Fuse, Supervisory, Power and Miscellaneous Equipment, N.E.I.	Total Switches	1	0.04

The Unit "Total Switches" (Items 24, 25 and 27) is defined on Page 4, M.C. No.12.

.....

STATEMENT "B". Form E.M.109.

AUTOMATIC EXCHANGES AND P.A.B.X's.

PLANT PERFORMANCE IN SERVICE.

Exchange: A.

State: . . . . . Period: From / /19 to / /19

Type of Exchange . . . A.E.C.

Item	Type of Equipment	Units	No. of Units in situ	Equated values per unit.	Equated Units
1	1st Preselectors (Plunger Type)	Switches		0.12	
2	2nd Preselectors (Plunger Type)	Switches		0.12	
3	Master Switches	Switches		2.8	
4	1st Preselectors (Rotary Type)	Switches	4,400	0.16	704
5	2nd Preselectors (Rotary Type)	Switches		0.2	
6	Junction Preselectors	Switches	378	0.2	75.6
7	Line Finders (Rotary Type)	Switches		-	
8	Discriminating Repeaters (Siemens)	Switches		1.2	
9	Miscellaneous Preselectors. N.E.I.	Switches		0.2	
10	Group Selectors (Covered)	Switches	967	2.4	2320.8
11	1st and Incoming Group Selectors (Siemens)	Switches		2.8	
12	Group Selectors, Discriminating (P.A.B.X's)	Switches		2.4	
13	Group Selectors (Uncovered)	Switches		3.2	
14	Intermediate Group Selectors (Siemens)	Switches		1.6	
15	Final Selectors (Covered)	Switches	434	2.6	1128.4
16	Final Selectors (Uncovered)	Switches		4.8	
17	Switching Selector Repeaters	Switches		3.6	
18	Discriminating Selectors (Siemens)	Switches		2.4	

19 /

Page 6 - Substitute the following:

M.C.32 (Amendment No.3).
Serial No. 91.
C.E. 4054/G.
17/5/35.

Form E.M.109 (Continued).

STATEMENT "B" (Continued).

Item	Type of Equipment	Units	No. of Units in situ	Equated values per unit	Equated Units
19	Selector Repeaters	Switches		3.0	
20	Line Finders (Bi-motional)	Switches		-	
21	Miscellaneous Bi-motional Switches N.E.I.	Switches		0.4	
22	Repeaters	Switches	237	0.6	142.2
23	Registers	Registers	4,400	0.04	176
24	Manual Desks (P.A.B.X's)	Total Switches		0.48	
25	Manual Desks(Other Exchanges)	Total Switches	6,416	0.02	128.32
26	M.D.F. and I.D.F. Equipment	Protector Pairs	4,606	0.12	552.72
27	Miscellaneous - Alarm, Signal, Fuse, Supervisory, Power & Miscellaneous Equipment, N.E.I.	Total Switches	6,416	0.04	256.64
28	Total Equated Units				5484.68
29	Total Faults (Exchange) - E.M.63, Item 31, Column 7				618
30	Percentage of Faults (Exchange) on Equated Units				11.27
31	Total F.O.K's (Exchange) - E.M.63, Item 32, Column 7				50
32	Percentage of F.O.K's (Exchange) on Equated Units				0.91

Completed by . . . .
Superintending Engineer.

Forwarded to Chief Engineer: Date / /19 Date / /19

.....