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THE NORTH ELECTRIC MFG. CO.
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Installation Procedure for All-Relay Switchboards
CX-10, CX-30, CX-60, CX-100, CX-200 and CX-200A

1. GENERAL

This instruction is intended for the use of installers in the field. It describes the apparatus units comprising a complete switchboard of the CX-10, CX-30, CX-60, CX-100, CX-200 and CX-200A types, and gives information required to install the switchboard. It contains points to be observed with regard to the exchange quarters.

2. POINTS TO BE OBSERVED REGARDING THE EXCHANGE QUARTERS

The installer should inspect the quarters provided for the exchange equipment in order to ascertain that the switchroom is in a suitable condition for the housing of equipment. If anything is found which seems to require attention, he should immediately discuss this with the customer company before proceeding with the installation.

While it is advantageous from the standpoint of cleanliness and freedom from dust to close up the room as much as possible, it should be kept in mind that stagnant, damp air entails some danger of corrosion of the equipment. Proper means of ventilation should therefore be provided if the exchange quarters are not, already, provided with such facilities.

The All-Relay equipment will operate satisfactorily under normal climatic conditions. Heating or cooling of the switchroom is, therefore not necessary, except in extreme cases. Precautions should be taken, however during periods of rapid temperature change to avoid moisture condensation due to these changes.

The equipment should not be installed where the odor of paints or floor wax may be detected, as all electrical contacts are susceptible to damage from certain paint vapors. Paints or floor waxes containing turpentine or other similar volatile solvents should be used with caution in switchrooms or any place where the fumes may reach the telephone equipment. Paints and floor waxes containing non-active solvents and residues should be used, preferably.

3. INFORMATION AND RECORDS

The following information will be furnished with each order:

3.1 A set of information for the installer consisting of:

- a) Installation Procedure
- b) Specification and Layout Sheet (includes Floor Plan and Layout Drawings)
- c) Maintenance Notes - Relay Inspection and Adjusting Instructions
- d) Such supplementary instructions as may be required for the specific installation.
- e) Circuit Drawings (Schematics)
- f) Circuit Descriptions
- g) Wiring Diagrams

3.2 Two sets of information to be delivered to the customer company for permanent record as follows:

- a) Installation Procedure
- b) Specification and Layout Sheet (includes Floor Plan and Layout Drawings)
- c) Maintenance Notes - Relay Inspection and Adjusting Instructions
- d) Such supplementary instructions as may be required for the specific installation.
- e) Circuit drawings (Schematics)
- f) Circuit Descriptions
- g) Wiring Diagrams

Items (a) to (f) will be bound in folders, and item (g) will be contained in manilla envelopes.

The installer should check all information received. If any items are missing, advice should be given.

Drawings illustrating the standard wiring diagram and circuit conventions are attached to the Installation Procedure and the Maintenance Notes. The conventional drawings contain such information as may be required to read the wiring diagrams and circuit schematics.

4. CHECK OF FLOOR PLAN

Immediately after checking the received job information, the installer should examine the exchange quarters to see that they conform to the floor plan supplied and if there should be any material difference, the customer company should be advised. If a rearrangement of the equipment should be necessary, the installer should suggest to the customer company such rearrangement as he considers suitable and a copy of the suggested layout should be sent to the district supervisor for comment.

If additional cable or modification of the equipment is involved to adapt the equipment to the quarters, excepting cable rack changes, or supports for the equipment, the district supervisor should be notified before any work is done.

5. EQUIPMENT UNIT SIZES

All items necessary for these units are housed in one or more cabinets arranged in combinations of various sizes, all cabinets being 81-7/16" high, 12" deep, and will be provided in three widths - 18-7/8", 36", or 72-1/4". The actual number and size of cabinets provided varies with the type and amount of equipment desired.

A power board is provided which is 81-7/16" high, 19-5/16" wide, and 9" deep. Identical power board dimensions are provided on all units.

5.1 CX-10

All of the equipment required for a CX-10, with the exception of the power board, is contained in one 18-7/8" cabinet. The top bar mounts the fuses. The next 20 bars mount the link equipment for 3 links, link busy jacks, the guard and miscellaneous relays and 10 sets of line relay equipments. The next 7 bars are used for the usual common circuit equipments, leaving 2 sections of 3 bars each for trunks, paystations and other line adapters. For capacity of these sections, see Section 5.7.

5.2 CX-30

All of the equipment required for a CX-30, with the exception of the power board, is contained in one 36" cabinet. The top 22 bars mount the 30 line relay equipments and 5 link control relays, together with the necessary link multiple for the 30 lines on the 5 links. Necessary automatic trunk selection relays are also mounted in this section.

Immediately below the links is the miscellaneous and the guard circuit relays, link busy jacks and fuse panels. The fuse panels carry fuses for all circuits in this board, with the exception of those carried on the power board. See Section 5.8.

The next five bars mount one each of all-relay code ringing interrupter, automatic converter transfers, all-relay timer, busy and dial tone equipment, and alarm checking and sending circuit.

The bottom 6 bars are divided into 4 sections of 3 bars each, 15 relays long. These sections are used for mounting trunks, paystations, grounded line adapters, long line repeaters, emergency line adapters, and other special equipment required for the particular switchboard. For the capacity of these frames, see Section 5.7, and for power board, see Section 5.8.

5.3 CX-60

This unit is contained in one 36" frame and one 18-7/8" frame. The 36" frame mounts 60 line relay equipments and 6 link control relay equipments, together with the necessary link multiples for the 60 lines on the 6 links. The automatic trunk selection relays needed for the trunk circuits are also mounted in this 36" unit.

The 18-7/8" unit from the top down is equipped as follows: The first bar - link busy jack; the second and third spaces - fuse panels; fourth space open; four bars with guard and miscellaneous relays; the next 9 bars mount one each all-relay timer, busy and dial tone, all-relay code ringing interrupter, converter transfer and alarm checking and sending circuit. This leaves six 3 bar spaces for mounting trunks, paystations, grounded line adapters, long line repeaters, etc. For capacity of these, see Section 5.7.

The number of links in a CX-60 may be extended beyond 6 by the addition of another 36" unit for 6 links. Where an additional unit of this kind is provided, space for the fuses and busy jack is provided in the 18-7/8" unit.

5.4 CX-100

This unit is contained in one 72-1/4" frame and one 18-7/8" frame. The 72-1/4" frame carries 100 line relay equipments and 10 link control relay equipments, together with necessary link multiples for access to the 100 lines. The automatic trunk selection relays are in this unit.

The 18-7/8" unit is equipped the same as the 18-7/8" cabinet for the CX-60 (Section 5.3), with the exception that the guard relay equipments are extended for a total of 100 lines instead of 60 and necessary busy jacks and fuses are provided for 10 links instead of 6 links.

The number of links in a CX-100 may be extended beyond 10 by the addition of a 36" unit for 6 links, or a 72-1/4" unit for 12 links. Where an additional unit of this kind is provided, an additional fuse panel and additional busy jacks are also provided in the 18-7/8" unit for serving these additional links.

5.5 CX-200

100-10
100 mult

50-6
150 mult

50-3
200 mult

A CX-200 fully equipped consists of three 72-1/4" units and one 18-7/8" unit and as many more 18-7/8" units as are required by trunks or paystations equipped. The first 72-1/4" unit is equipped with 100 line relay equipments and 10 link control relay equipments with necessary link multiples for access to the 100 lines.

The second 72-1/4" unit is equipped with 50 line relay units, 6 link control relays and the necessary link multiple relays for access of these 6 links to 150 lines. The guard circuit relays for all of the second hundred is in this cabinet. In addition, this cabinet has link multiple relays for extending the 10 links in the first switchboard for access to an additional 50 lines.

The third 72-1/4" unit is equipped with 50 lines and 3 link control relay equipments with link multiple access to these three links to 200 lines. In addition, link multiple relays are provided for access of the 16 links in the first and second units to the second additional 50 lines.

Note: The link multiple for the first 10 links is in three separate cabinets; for the next 6 links it is in two cabinets, and the last three links are complete in one cabinet.

The auxiliary 18-7/8" unit is similar to the unit provided for the CX-60 and CX-100, except that an additional fuse panel is provided for fusing the additional lines and links. This unit carries a guard circuit for only the first 100 lines. The guard circuit for the second 100 lines is installed in the second 72-1/4" unit. Automatic trunk selection relays are installed in the various 72-1/4" units as required. The number of large units provided initially depends upon the number of lines and links installed. If 100 lines and 10 links or less are initially installed, only one 72-1/4" cabinet will be provided. If 101 to 150 or 11 to 16 links are required, two 72-1/4" units will be provided. If more than 150 lines or more than 16 links are required, all three units will be furnished.

5.6 CX-200 A

100 - 6
200 mult

100 - 6
200 mult

- 7
200 mult

The CX-200-A unit fully equipped consists of three 72-1/4" units and one 18-7/8" unit and as many more 18-7/8" units as are required by trunks or paystations equipped. The first 72-1/4" unit contains 100 line relay equipments and 6 link control relay equipments, together with link multiples for access to 200 lines. The second 72-1/4" unit almost duplicates the first unit and contains 100 line relay units, 6 link control relays, together with link multiple for access to 200 lines. The third 72-1/4" unit contains 7 link control relays, together with link multiple for access to 200 lines. Automatic trunk selection relays required for these boards are included in each 72-1/4" unit.

Note: All links have complete multiples in each unit.

The 18-7/8" unit is identical with the CX-200 unit, containing fuses and jacks for the full 19 links, guard circuit for 100 lines only, the guard relays for the second 100 lines being contained in the second 72-1/4" unit.

5.7 Auxiliary Unit - 18-7/8" Frame

This auxiliary unit is provided on all CX-60's, 100's, 200's and 200A's and is similar for each switchboard, the difference being in the number of link busy jacks, fuses and guard relays required for the various sized units.

Two terminal strips are provided at the top of this unit, the front terminal strip being used for general miscellaneous and common circuit connections. The rear terminal strip is divided into six sections for use with the six demountable frames to be mentioned later.

At the top of the unit, link busy jacks are provided in accordance with the number of links installed on a particular unit. Immediately below are provided fuse panels, each with space for 27 fuses. CX-60's and 100's with only one 72-1/4" unit are equipped with two such fuse panels. CX-200's, CX-200A's and CX-100's with more than one unit are equipped

with three fuse panels. The space for the third fuse panel is reserved on all boards when not equipped. The fuse panel alarm buses are divided into 3 sections, one of 18, one of 8, and an individual stud, so that major and minor fuse alarms can be signalled.

Below the fuses four spaces are reserved for the guard circuits and miscellaneous relays. The arrangement of the relays in these spaces is identical for all boards. In CX-200's and 200A's, the guard for the first hundred lines only is provided in this unit. The next three bars mount one each all-relay timer and busy and dial tone equipment. The third three bars mount the code ringing interrupter, converter transfer and necessary relays for converter transfer alarms. The fourth group of three bars carries the alarm checking and sending circuit, together with cumulative permanent signal alarm and low cable insulation alarm. The sending circuit, cumulative permanent signal alarm and equipment necessary for these low cable insulation alarms are wired only when not specified in the order. All of the above 13 bars are permanently welded to the frame and are identical on all units.

Below this point space is provided for mounting individual three bar units. Sufficient space is provided for 6 of these units.

Trunk relay equipment, coin box line adapters, long line repeaters, grounded line adapters, emergency line adapters and other miscellaneous line equipment is mounted on these three bar units, with individual cabling to specific terminal positions on the terminal in the rear of the unit.

The capacity of a three bar frame is as follows:

(A) Trunks to Manual Office

1. Composite Type	3 Trunks
2. Loop Dial Type	3 Trunks
3. Composite Dial Back	2 Trunks
4. Loop Dial Back	2 Trunks

(B) Trunks to Other Automatic Offices

1. Composite Dialling	3 Trunks
2. Loop Dialling	2 Trunks

(C) Dual Function and Other Special Trunks

Usually two per three bar frame.

(These are usually special, and in some cases, the quantity of equipment necessary will limit these trunks to one per frame.)

Notes: Frames for mounting trunks will be provided for the number which can be mounted on the frame and no arrangements will be made to mix various types of trunks on the same frame or mix trunks with other items.

(D) Miscellaneous Line Adapters

- | | |
|--|--------------------------|
| 1. Paystation Line Adapters
for 163A Type Coin Collectors | 4 per Frame or 1 per Bar |
| 2. Paystation Tone Only | 9 per Frame or 3 per Bar |
| 3. Grounded Line Adapters,
Maximum Resistance 1100 Ohms | 6 per Frame or 2 per Bar |
| 4. Grounded Line Adapters,
Extended Dialling | 3 per Frame |
| 5. Long Line Repeaters | 6 per Frame or 2 per Bar |

Note: These adapters may be mixed on frames.

On CX-30's, no 18-7/8" auxiliary frame is normally provided. Space is provided at the bottom for four 3 bar units with capacities as described above.

Note: These bars are welded into place on the original unit and are not mounted by bolts as on the 18-7/8" unit.

(E) Tandem Trunks

Tandem trunk is interpreted by the North Company to mean an arrangement whereby trunks from distant offices, or a line from a toll station tandem through the automatic exchange to trunks to manual office and are arranged not to use a link on such a call.

Calls from manual office to tandem office are routed through the link in the intermediate office. When tandem trunks are provided, it is usually necessary to provide a second 18-7/8" auxiliary frame as the amount of equipment required for tandem trunks could not normally be mounted in the six spaces available on the original 18-7/8" frame. The normal arrangement for a tandem trunk frame of this kind would be as follows:

- | | |
|--|--|
| 1. Fuse Panel | |
| 2. Miscellaneous Relays | |
| 1 Bar | |
| 3. Manual Office Trunks, Loop or Composite | |
| 3 per Two 3 Bar Frames | |
| 4. Automatic Office Trunk Loop Dial | |
| 3 per Two 3 Bar Frames | |
| 5. Automatic Office Trunk Composite | |
| 2 per Frame | |
| 6. Toll Stations | |
| 3 per Frame | |

The standard frame will be arranged to provide for 9 trunks to manual office and 8 tandem trunks from either automatic exchanges or toll stations.

5.8 Power Board

The power board frame for all of the switchboard types is identical and is drilled for the mounting of 42 Bell System 19" mounting plates.

The top four spaces are usually provided blank, but can be used by the telephone company for mounting any Western Electric equipment they desire.

The second four spaces are occupied by a metal panel, mounting the Sensitrol relays, time delay relay for the cumulative permanent alarm, and cable insulation alarm signals. This panel also carries two 6 point fuse panels. The left panel is provided for use by the telephone company for fusing composite equipment or other Western Electric items mounted on this frame. The right-hand panel is used for fusing the ringing converters, test circuit, and other miscellaneous alarm circuits provided by the North Company on this frame. When cumulative permanent alarm signals or cable insulation alarm signals are not provided, mounting space for sensitrol relays is blanked.

Positions 9 to 11 are occupied by the meter and fuse panel. This panel mounts a voltmeter used for reading the battery voltage, or for line testing, a charge ammeter and a discharge ammeter, the main switchboard fuse and main ringing fuse or terminal. The scales of the ammeters and capacity of the fuses vary with the size of the switchboard for which the power panel is being provided.

Position 12 carries the alarm lamps and space for mounting four message registers. Originating call and line finder overload message registers are usually provided and space for two trunk meters is available if specified by the telephone company. If more than four meters are required, the second mounting strip will be provided.

Position 13 is occupied by wire chief test keys. At present, these are pushbutton keys similar to the ones provided on the earlier panels.

Duplicate ringing machines are mounted on a swinging gate in the rear of these panels. When only one ringing machine is required, wiring for two is supplied and one machine equipped.

Note: On the CX-10's, only the main fuse and meter panel and alarm lamp panel is provided on this frame.

Self-regulating selenium rectifier battery chargers are mounted in the bottom of this frame, the 1, 2, and 4 amp. chargers occupying seven spaces, the 6, 8 and 10 amp. chargers occupying 13 spaces. This leaves twenty-two 1-3/4" spaces available with a small charger and 16 spaces available with a large charger for mounting Western Electric composite equipment or other Western Electric equipment desired by the telephone company. This is in addition to the four spaces available at the top of the frame.

5.9 Main Distributing Frame

Main Distributing Frames are provided as standard in two types:

1. Floor Mounting
2. Bracket Type for Mounting on Wall or End of Cabinet

"B" Type frames are standard. However, "A" Type frames can be provided on special order.

(A) - "B" Type Frames

Verticals carry five 25 pin terminals blocks per vertical. Four of these blocks will be provided as two or three rows as specified, on which the switchboard line cables will terminate. Normally, cabling for tip and ring only is provided between switchboard and the terminal blocks. However, tip, ring and sleeve will be provided if ordered.

The top terminal block is 6 rows of 25. Cabling from the auxiliary unit for trunks, paystations and other special auxiliary line adapters is terminated on this block for cross-connecting to the desired line.

The protector side of the frame will mount one hundred 1268A's or 1267A protectors as specified. 1177 type protectors will be provided for if desired.

(B) - "A" Type Frames

Only the tip and ring leads can be brought to "A" type frames and a supplementary cable is carried over from the auxiliary unit for terminating trunks, paystations and other line adapters directly to the protector for the line number desired. Two or three row terminal blocks are provided for terminating the outside cable, as specified. The third row terminals can be strapped for grounding spare pairs if desired.

Note: With "A" Type frames, it will be necessary to change cable pairs on the protectors when changing from a regular line to a trunk or paystation line, with the unused cable pair rolled up.

6. PACKING FOR SHIPMENT

The switchboard units, auxiliary frames, battery charger, etc., are packed in wooden packing cases.

All packing cases will be marked with the destination given on the purchase order.

The shipping papers will be contained in a small manila envelope placed in a conspicuous location on the outside of one of the packing cases.

The line, line-finder and connector units will usually be shipped singly, with no other equipment units in the cases.

The method employed in shipping the auxiliary frames will depend upon the layout of the equipment. When two or more frames are to be installed in the same line-up, and some interconnecting is involved,

they will be shipped assembled in their relative positions, with the cabling in place.

Occasionally, two or more auxiliary frames of different line-ups will be shipped in the same case, bolted together.

The main frame equipment and battery rack will usually be shipped knocked down in separate cases.

7. UNPACKING THE SWITCHBOARD

The switchboard cases should be unpacked as near to the location in which the switchboard is to be installed as is convenient.

Before unpacking a switchboard unit case, care should be taken to see that the packing case is right side up, and properly positioned as to front and rear.

The packing cases should be taken apart by removing the top of the case. This will permit the front and back to be removed easily. In no case should an attempt be made to remove the sides of the packing cases before the front and back. The sides of the packing case are bolted to the switchboard unit proper with shipping bolts.

The sides of the packing case should be unbolted, a side at a time, replacing the removed shipping bolts by the cabinet bolts, which will be found in a sack tied to the framework inside of the switchboard cabinet.

After unpacking as described above, the switchboard units may be moved into position in the switch room.

If the switchboard units have to be moved any considerable distance from the place of unpacking, some form of roller should be used to roll the unit. (Two or more lengths of iron pipe will be suitable for this purpose).

The auxiliary units should now be unpacked and brought into the switch room.

8. ERECTING

The switchboard units and the auxiliary framework units should be placed in position in accordance with the floor plan.

All of the frameworks and cabinets have bolts and details which permit the bolting of auxiliary frames and cabinets in the same line-up together. When the equipment units in the line-up are bolted together the line-up should constitute a rigid unit. It will usually not be found necessary to bolt adjacent line and link units together as the 36" and 72" wide units are self-supporting on a level floor.

If it is found that the floor is too irregular to permit a good horizontal alignment of the units, shimming of the base of the switch-

board unit should be resorted to. The shims required may be made up locally of thin strips of wood slightly wedge shaped, or of thin sheet metal strips. If it is found that the result of shimming is unsightly, the shims may be concealed by a quarter-round wood strip nailed or glued to the floor. Light finishing nails or cabinet-makers glue should be used for this. The material required will be purchased locally.

The auxiliary units should be erected as shown on the floor plan, bolting them to the auxiliary frames adjacent or the adjacent switchboard unit itself as the case may require. The apparatus layout drawing furnished with the job, which shows the equipment units in each line-up, may be used to identify the various cabinets and frameworks.

A separate floor type main frame will be installed in accordance with the floor plan, and fastened to the floor with expansion bolts or lag screws.

If a wall type distributing frame is used, wooden cleats to support the frame should be attached to the wall by lag screws or expansion bolts. The framework of the distributing frame should be screwed to the cleats.

If the distributing frame is mounted on the end of the switchboard unit, the framework should be bolted to the switchboard framework using the cabinet end bolts.

After assembling the battery rack and placing it in accordance with the floor plan the battery should be mounted on it. Care should be taken that the indicators of the pilot cell can be easily seen.

9. CABLE RACK, RUNWAYS, ETC.

With the equipment there will be shipped loose lengths of strap iron, rack, or cable running boxes to be used for cable support. Usually, the cable rack or running boxes will be cut to length in accordance with the floor plan. The floor plan will indicate location of the various items of cable runway.

The cable supporting details or running boxes should be run between the switchboard line-ups, the main frame and the battery rack, as shown on the floor plan.

No supports will be furnished for the leads from the power service entrance to the battery charger. When a support is required it will be made up locally.

10. SUPPORTING SWITCHBOARD AND FRAMEWORK

If it is found on completion of the work up to this point, that the switchboard line-ups, the main frame, battery rack, or isolated units of equipment are not sufficiently rigid, it will be necessary to provide additional supports.

It will be found that the need for auxiliary support will be relatively infrequent. The cable supports will usually, if installed properly, insure the necessary rigidity of the equipment units.

Additional supports for rigidity may be made of lengths of strap-iron formed and drilled suitably to permit attachment to the switchboard units or auxiliary frames. The following types of supports for this purpose may be found necessary:

- a) Brace between line-ups.
- b) Brace from one or more line-ups to nearest wall.
- c) Brace to ceiling.
- d) Braces to floor.

Care should be taken to see, in the use of supports for bracing, that they are formed so that there is headroom for convenient passage under them.

No difficulty will be found in attaching supports to the switchboard units or to the auxiliary framework. However, some problems may be met with in attaching to walls and ceilings.

11. ATTACHING TO WALLS OF BUILDING OR ROOMS

In attaching supports or framework to the wall, the installer should satisfy himself that the work to be done will not be objectionable to the customer company from the stand-point of appearance. If there is any doubt on this point, a representative of the customer company should be consulted. If the wall should be covered with a hard surface plaster that cannot be easily replastered, or bricks with a vitreous surface are involved, the customer company should always be consulted.

12. SWITCHBOARD GROUND

The customer company will ordinarily have provided the switchboard ground and will have brought the connections of the switchboard ground into the building.

If the ground connection has not been supplied, the customer company must be notified at once.

13. INTER-UNIT CABLING AND WIRING

As much of the interconnection as can be permanently done at the factory will be in place, the installer need not concern himself with this.

Lengths of switchboard cable for the purpose of inter-connecting will be connected to the terminals of the various units at one end.

the loose ends coiled up suitably for shipping. When possible, the loose ends will be formed out at the factory.

It may be noted that when units are shipped bolted together to be erected in the same relative position the interconnection of the two units will usually be completed at the factory.

When either end of a connection can be made at the factory, loose lengths of wire or cable will be shipped.

All cables, forms and wires, one end or both ends of which have to be connected on the job, will be tagged to show the terminals to which connection should be made. These tags should not be removed until final inspection is made.

The installer should, after making a first inspection of the equipment to assure himself that everything is in place, and that everything is ready to start interconnection, cut the laces with which the free ends of the cables are tied to the various units.

The cabling, forms, leads and the tags attached to them should be checked against the interconnecting diagrams furnished with the switchboard. If there is any discrepancy, it should be investigated, reference being had to the supplementary installation instruction for explanation. If one or more cable tags should have fallen off during shipment, the interconnecting diagrams will usually give sufficient information to permit making out a new one.

If the installer should decide that one or more cables, forms or leads are missing, his district supervisor should be informed at once.

After completion of the checking of the inter-unit cabling, the installer should lay in place on the runways or in the running boxes the cables, forms and leads.

The installer should then run such leads as are required to be run on the job. The following is a list of those generally required:

- a). Positive and Negative battery leads between battery and power panel. (See Power Board Wiring Plan.)
- b). Lead from the entrance of the ground connection to the positive pole of the battery, the main frame bus bar, and the ringing ground connection. If a lead covered wire is used for this purpose, it is advisable to bond the lead sheath to the conductor at both ends.

Spliced and soldered connections or solderless connectors may be used to splice to the incoming ground lead.

The ground connection should be sweated to the lug.

on the main frame bus bar.

Cables from the power service entrance to the charger unit are not normally furnished, and are supplied by the customer company.

The installer should then lace, suitably to the racks or supporting details, all cables, etc.

METHOD OF REMOVING AND REPLACING SWITCHBOARD TOPS

To remove the top of a switchboard cabinet, the rear of the top should be lifted from its guide first. (The front of the cabinet top is free to move while this is done and will pivot in its guides.) After lifting the rear of the top several inches, it should be moved forward to unseat the front. A slight movement forward is all that is necessary.

The top may now be lifted off in any direction.

To replace a switchboard top, hold it on an angle above the switchboard and first seat the front. The rear will then drop into position in its guides without difficulty.

If a closed cable runway is used which is run over the junction of two cabinets, it will be necessary to remove the collar which is placed around the cable support and which is placed over top of the cabinets. This can be easily done by unscrewing the plates which make up the collar.

14. CONNECTING SWITCHBOARD

(Reference should be made to the drawings involved and supplementary installation instructions to obtain details for this work. The following information is a general summary only, of the usual items of work in a CX board). (A color coding arrangement is used for cross connect cables and a chart indicating the codes used, is appended to these instructions.)

After butting and forming or fanning all cables, connect as follows:

1. Connect the loose ends of the cables to the power board
2. Connect the loose ends of the cables to the misc. frame
3. Connect the loose ends of the cables to the main frame
4. Connect the power, charger and battery leads
5. Connect the service entrance leads.

15. INSPECTION

The installer should make a complete inspection of the equipment before proceeding to test out the switchboard. He should satisfy himself that all the equipment called for on the layout sheet, and required by the circuits has been furnished. If any items of equipment appear to be missing, this fact should be immediately reported.

The installer should make a visual inspection of the relays to determine that no damage has occurred in shipment.

The installer should inspect the battery to see that the level of the electrolyte is such that the plates are at least 1/2" below the surface.

Note: If the battery plates have been exposed to the air for a considerable length of time, they should be considered defective. The matter should be referred for decision at once before placing the batteries in for service.

16. TEST

The installer should check the battery voltage, to determine the condition of the battery.

The installer should put in the charger and battery supply fuses as shown on the power circuit drawings and turn on the charger switch if one is supplied.

BATTERY CHARGER

The following refers to a self-regulating charger with dry disc rectifying stacks. If any other type is furnished, supplementary instructions will provide information regarding it.

If the battery is not fully charged, the charger will immediately start to deliver current to the battery to bring it up to full charge. The amount delivered will depend upon the condition of the battery and the rating of the charger.

The charger will continue to deliver current to the battery until it is fully charged, when its output will drop to an amount just sufficient to maintain the battery at full charge. This amount will be a fraction of an ampere.

As the tests proceed, as outlined below, with varying load conditions imposed upon the battery supply, the installer should check to see that the charger functions properly. The instructions covering the battery charger, CO-4928 furnished with the circuit descriptions, should be read in this connection.

It may be pointed out that the charger is designed to keep the battery as near to full charge as is practicable without over-charging. Consequently, by a constant check of the battery voltage

and current drain, the output of the charger is increased or decreased, as may be required, to bring this about.

As the load on the battery increases, a point will finally be reached when the charger will not increase its output materially, unless a substantial drop in the battery voltage occurs by reason of a sustained load. A condition of this sort, in which the charger delivers beyond its rating, should not be permitted to continue for a period lasting more than a few minutes, and in no event should the charger be permitted to deliver more than 20 percent in excess of its rating.

The full load voltage and no load voltage of the charger are shown on the rating sheet included in the information supplied with each equipment.

Note: The overcharge switch on the charger should be used with caution, when the battery is partially discharged. The operation of the overcharge switch removes a part of the control from the circuit. If the battery is partially discharged, the charger may deliver a current which is considerably in excess of its rating.

The overcharge switch may be used to bring a partially discharged battery up to full charge. The limitation regarding over loading of the charger beyond its rating must be observed.

The installer, after checking in accordance with the foregoing to see that the battery is brought up to full charge, should insert the discharge cartridge fuses on the power board.

The installer should, using lengths of 1 amp fuse wire or other temporary fusing, fuse all of the individual circuits on the switchboard.

If none of the fuses blow, the installer may proceed with the tests. If any individual circuit fuses or common cartridge fuses should blow, the installer should correct the trouble before proceeding.

The circuit tests will be conducted in the order shown:

a). Landing-in test on all lines.

The landing in test should be made from the end of the multiple, this will require that the last equipped link be used. The other links should be busied out by means of their make busy switches.

The installer will, using a test set, short each equipped line in succession at the main frame, testing for dial

tone, observing the line-finder used for test seizes the proper line. The line-finder should release when the short on the line is removed.

- b). A test should be made to see that the links are allotted in sequence (link rotation scheme.) With all links in service, land calls and release. Observe that when a link has been engaged once, it remains out of service until all links have been in use, when it, together with the other free links, are again made available for seizure. (Note that the links restored do not include the last link which was engaged. This link will be restored on the next cycle.)
- c). A test should be made for all group and unit selections on each link. This may be made by dialling Tens and Units digits on each link accompanied by the prefixed digit if there should be one, without dialling the ringing digit. The selection should be checked and immediately after the selection is checked, the call should be disconnected.

This test may be made with two line conditions on the test line:

- a). 0 ohm loop, 5000 ohms leak across line.
- b). 1000 ohms loop, no leak across line.

In the CX-100 type switchboard the following test numbers (with proper prefixes) may be used, following the sequence shown:

221, 232, 243, 254, 265, 276, 287, 298, 209 and 210

On the 30, 60 and 200 line boards or units partially equipped, suitable combination of TENS and UNITS digits can be worked out by the installer so that all TENS and UNITS are checked.

- d). A test should be made on all codes, polarized rings, frequencies or other types of party ringing used on the switchboard. This test should be made on the last equipped link on the switchboard.
- e). A test call should be made over each link dialling a test number, observing that ringing tone is received and on answering at the called station, during ringing, that tripping is instantaneous or in the next succeeding silent period, as specified.
- f). A check of circuit condition can be made in connection with this test. If the aid of another person can be obtained a talking test can be made in both directions. If the test

is made by one person, the test may be made by tapping the transmitters of the test telephones.

- g) A test should be made of all links for reverting call. This test is made by dialling the station number from which the call is being made, receiving the busy signal, hanging up, ringing the calling line and tripping the connection. On tripping the ringing it should be observed that the link is dismissed and the line put on lockout.
- h). When considered advisable, a test of all lines in the connector multiple may be made at this point. Test all lines for ringing, tripping and transmission. This test should be made from the main frame, with a subset arranged to connect to the terminals or protectors as required. It is suggested that the last link equipped be used, so that continuity of multiple circuits may be checked at this time. Test all lines in succession, starting with the first equipped.
- i). A check of trunks should now be made. This check should include calls to and from the switchboard. The connecting office equipment should be in place and included in this test. This test should include making all trunks in a group busy and then make an additional call to this group to verify that the busy tone is obtained. Operator's control and other features in connection with trunk service should also be checked during this test. It is suggested that the last link equipped be used for these tests so that continuity of multiple can be checked concurrently. (When all trunks busy meters are used, registration of the busy condition of the trunk group in connection with this test should be made.)
- j). A test of automatic trunk selection, if equipped, should now be made on all trunk and PBX groups so equipped checking that the calls land successively on the trunks in rotation.
- k). A test of all miscellaneous features should now be made. This will include fuse alarm, grounded line alarm and line lockout.
- l). Test the alarm checking and sending circuit and associated alarms by simulating the various alarm conditions, one after another and checking to see that the various alarm indications are sent over the trunk and received when the test number is dialled.
- m). Test all outside lines for grounds and shorts by means of the voltmeter test circuit on the power board and record the result.

(This test should only be made by the installer,

when requested to do so by the customer company and such request is confirmed by the supplementary instructions for the job.)

This test can be made before the cutover when dial phones are installed prior to the cutover. If new phones are installed line by line during the cutover the test must be done immediately after the new phones have been installed, before the line is placed in service.

The following formula may be used to determine insulation resistance of a line:

$$R_i = \frac{(E_b - E_v)R_v}{E_v} \quad \text{Ohms}$$

In the above formula: R_i represents insulation resistance, to be determined; R_v represents the total resistance of the voltmeter; and E_v represents the voltmeter reading.

17. LINE CROSS CONNECTIONS

The installer will, ordinarily, not be required to run the line cross connections at the main frame. If the installer should be required to run the cross connections he should assure himself that his cross connection list is complete before starting.

18. CUTOVER

Two methods of cutover are employed in small exchanges. If new telephones are not installed prior to the cutover, but installed line by line during the cutover, the cutover must be done line by line. In such a case the new switchboard must have one or more temporary trunk lines to the old switchboard for interconnection during the period of cutover.

When the new phones are all installed prior to the cutover, or the instruments have all been modified for dial operation it is possible to make the cutover of all lines simultaneously. In such a case, the installer will, immediately before cutover, place all cut-off relay armatures in the operated position by inserting toothpicks under the armatures, thus opening the line to the dial switchboard. The heat coils will then be inserted in the protectors. The cutover operation consists simply of the pulling of the heat coils on the old main frame and the removal of the toothpicks on the cutoff relays at the new switchboard. No temporary trunk lines between the old and new office will, in this case, be required.

COLOR CODE FOR CABLES

Pairs 1-20

	<u>Color</u>	<u>Abbreviation</u>	<u>Mate</u>	<u>Abbreviation</u>
Pair 1	Blue	1C	White	1M
2	Orange	2C	"	2M
3	Green	3C	"	3M
4	Brown	4C	"	4M
5	Slate	5C	"	5M
6	Blue-white	6C	"	6M
7	Blue-orange	7C	"	7M
8	Blue-green	8C	"	8M
9	Blue-brown	9C	"	9M
10	Blue-slate	10C	"	10M
11	Orange-white	11C	"	11M
12	Orange-green	12C	"	12M
13	Orange-brown	13C	"	13M
14	Orange-slate	14C	"	14M
15	Green-white	15C	"	15M
16	Green-brown	16C	"	16M
17	Green-slate	17C	"	17M
18	Brown-white	18C	"	18M
19	Brown-slate	19C	"	19M
20	Slate-white	20C	"	20M

Pairs 21-40

<u>Color</u>	<u>Abbreviation</u>	<u>Mate</u>	<u>Abbreviation</u>
As in pairs	21C to 40C	Red	21M to 40M

Pairs 41-60

<u>Color</u>	<u>Abbreviation</u>	<u>Mate</u>	<u>Abbreviation</u>
As in pairs	41C to 60C	Red	41M to 60M
1-20		white	

Pairs 61-80

<u>Color</u>	<u>Abbreviation</u>	<u>Mate</u>	<u>Abbreviation</u>
As in pairs	61C to 80C	Blue-	61M to 80M
1-20		Red	

Pair 81-100

<u>Color</u>	<u>Abbreviation</u>	<u>Mate</u>	<u>Abbreviation</u>
As in pairs	81C to 100C	Orange-	81M to 100M
1-20		Red	

Note 1:

All other wires appearing in cables are spares.

Note 2:

On inter-unit cross-connecting plans, the abbreviations shown will

be used to indicate the sequence in which the conductors of the cables used are connected.

COLOR CODE FOR CABLES

Triples 1-10

	<u>Color</u>	<u>Abbreviation</u>	<u>Color with Tracer</u>	<u>Abbrev.</u>	<u>Note</u>	<u>Abbrev.</u>
Triple 1	Blue	1C	Blue & red	1T	White	1M
Triple 2	Orange	2C	Orange & red	2T	White	2M
Triple 3	Green	3C	Green & red	3T	White	3M
Triple 4	Brown	4C	Brown & red	4T	White	4M
Triple 5	Slate	5C	Slate & red	5T	White	5M
Triple 6	Blue-white	6C	Blue-white & red	6T	White	6M
Triple 7	Blue-orange	7C	Blue-orange & red	7T	White	7M
Triple 8	Blue-green	8C	Blue-green & red	8T	White	8M
Triple 9	Blue-brown	9C	Blue-brown & red	9T	White	9M
Triple 10	Blue-slate	10C	Blue-slate & red	10T	White	10M

Triples 1-20

Triples 1 to 10 Same as shown for above cable Triples 1 to 10

Triple 11	Orange-white	11C	Orange-white & red	11T	White	11M
Triple 12	Orange-green	12C	Orange-green & red	12T	White	12M
Triple 13	Orange-brown	13C	Orange-brown & red	13T	White	13M
Triple 14	Orange-slate	14C	Orange-slate & red	14T	White	14M
Triple 15	Green-white	15C	Green-white & red	15T	White	15M
Triple 16	Green-brown	16C	Green-brown & red	16T	White	16M
Triple 17	Green-slate	17C	Green-slate & red	17T	White	17M
Triple 18	Brown-white	18C	Brown-white & red	18T	White	18M
Triple 19	Brown-slate	19C	Brown-slate & red	19T	White	19M
Triple 20	Slate-white	20C	Slate-white & red	20T	White	20M

Note 1 =

All other wires appearing in cables are spares.

Note 2 =

On Inter-unit cross-connecting plans, the abbreviations shown will be used to indicate the sequence in which the conductors of the cables used are connected.