TYPE N AND ON CARRIER TELEPHONE SYSTEMS
LINE BUILD-OUT AND CROSS-CONNECTING EQUIPMENT
DESCRIPTION

CONTENTS PAGE

1. GENERAL

1.01 This section describes the physical and functional characteristics of line build-out bays and cross-connection cabinets designed for the N repeatered lines. Equipment panels and plug-in units which are component parts of the line build-out bays and cross-connection cabinets are also described.

1.02 The N2 repeatered line equipment offers new integrated packages which not only improve transmission but also simplify the engineering, installation, and maintenance of short-haul carrier lines. Unlike the present N1 or N1A line equipment, which requires a large amount of installer wiring for interconnecting the many associated units, the N2 line equipment is furnished in packaged shop-wired bays and cabinets for the repeaters, shop-wired bays for the line build-out features, and separate shielded cabinets for cross-connecting purposes. Repeaters, line build-out apparatus, and constant-current regulators are furnished as plug-in units to supply the gain, equalization, and power feed arrangements required for the carrier lines.

1.03 In offices where it is not necessary to make frequent reassignments of the carrier line pairs to terminals and repeaters, the centralized cross-connection cabinet is probably not required. In these cases N2 repeater bays can be obtained with complete line build-out functions to equalize the line for slope and loss, to receive power over the line or send power for operating N2 repeaters and 240-type amplifiers, and to apply sealing current to the carrier lines.

1.04 Offices which require frequent reassignments of carrier line pairs to terminals or repeaters can best use a centralized cross-connect cabinet. In these offices the complete line build-out features can be omitted from the repeater and terminal bays and the equivalent functions obtained in line build-out bays. These bays are frame-like structures arranged with mounting shelves for plug-in line build-out units, which include equalization networks, input and output span pads, power feed arrangements, and optional use of primary protectors for protection of the cable pairs.

1.05 The line build-out apparatus is contained in a plug-in unit which includes noise control circuitry; sockets for plug-in slope, bulge, cubic, and quartic equalizers; and sockets for plug-in span pads for adjusting the carrier lines to the natural slope method. A constant-current regulator is provided, where required, as a part of the line build-out unit. It is used at power feed points to supply constant values of current to the cable pairs for operating remote repeaters and to supply sealing current or power for 240-type flat-gain amplifiers in the same power string. The unit may be optionally equipped to feed sealing

current or power to a 240-type flat-gain amplifier only. The unit may also be optionally equipped for terminating sealing current received from a distant power feeding point. With this arrangement, all of the build-out equipment, including power feed arrangements when required, becomes part of the carrier line and is disassociated from the terminal and repeater equipment. The carrier pairs, at each office, can usually be built out to a common value of slope and loss and cabled to a cross-connection cabinet. At this point, any carrier line pair can be cross-connected to any N- or ON-type terminal or repeater without any changes in the power feed arrangement and with only occasional changes in the plug-in equalizer and span pads which may be required for coordination purposes.

2. EQUIPMENT DESCRIPTION

A. General

2.01 ***The cross-connection cabinets*** are completely enclosed metallic structures with roll-up overhead doors to provide shielding against office impulse noise for the unshielded cross-connecting wiring. Horizontal rows of terminal strips are mounted in the cabinet to terminate the inputs and outputs of the carrier lines and the inputs and outputs of the carrier equipment. Several rows of terminal blocks are available in the cabinets to terminate large groups of cable pairs. Insulated rings are provided for running both horizontal and vertical connections. For expansion purposes, the side plates are removable so that additional cabinets can be mounted side-by-side to increase the cable pair capacity. When this arrangement is used, space is provided at the rear of the cable-duct compartment for running cross-connections between adjacent cabinets without the use of tie cables. These N2 cross-connect cabinets, however, cannot be used with or interconnected to the earlier N1 types of cross-connection cabinets which included both line build-out and cross-connecting facilities in the same package.

2.02 Built-in cable ducts are provided in the cross-connection cabinet to furnish sufficient space for an orderly arrangement of the line and equipment cables. The cable ducts are provided with removable rear-cover plates for convenient installer access to the compartments. Tie bars are provided inside the ducts to fasten the cables in place.

2.03 Access to the cable ducts is obtained through the adjustable ports at the top of the cabinet. The aluminum sheaths of ABAM cables are exposed for approximately 6 inches where they pass through the port and all of these sheaths are connected to the ground bar along the top of the cabinet. After all cabling is run through the port, phosphor bronze wool is wrapped around the cables to ensure good bonding between all cable sheaths and the adjustable gland is tightened to seal the port. This prevents office impulse noise from entering the cabinet.

2.04 Single-bay cabinets, 26-3/8 inches wide, and double-bay cabinets, 52-7/8 inches wide, are available in 7-foot, 9-foot, and 11-foot 6-inch heights for mounting on 26-1/2 inch centers. In addition, single 7-foot bays, 26 inches wide for mounting on 26-1/8 inch centers, and 7-foot double-bay frames, 52 inches wide for mounting on 52-1/8 inch centers, are available for No. 1 ESS offices.

2.05 The line build-out bays are completely assembled and wired (without the plug-in units) in the shop. The bay framework is cable duct type arranged for 23-inch mounting plates with 12-inch guard rails. All external cabling from the cable vault to the protectors and from the line build-out shelf positions to the cross-connecting cabinet is run in the ABAM cable, separated by at least 6 inches from all other noncarrier cables to ensure quiet circuits.

2.06 The bays are available in three heights: 11-1/2 feet, 9 feet, and 7 feet. The 11-1/2 foot and 9-foot bays are 26-3/8 inches wide for mounting on 26-1/2 inch centers. The 7-foot bays are 1/2-inch narrower for mounting on 26-inch centers for compatibility with ESS-type frames.

B. Line Build-Out Bays (11 Feet 6 Inches High)

2.07 ***The J99323B line build-out bay,*** shown in Fig. 1, is an 11-foot 6-inch bay with primary line protectors and power feed arrangements. The bay is arranged to provide line build-out equipment for 192 carrier pairs in aerial or buried cable facilities. The fully equipped bay

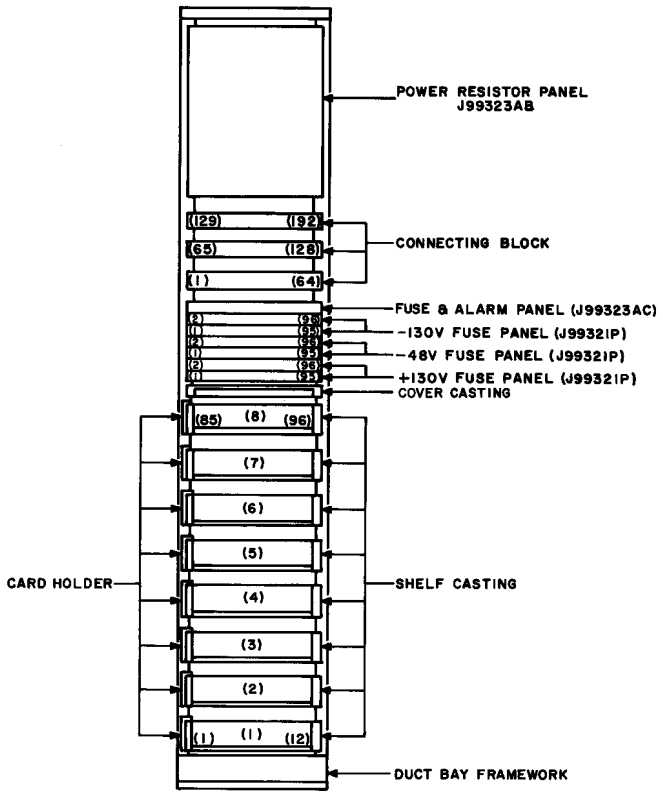

Fig. 1 — J99323B N2 Line Build-Out Bay Equipped with Line Protectors and Power Feed (11 Feet 6 Inches High by 26-3/8 Inches Wide)

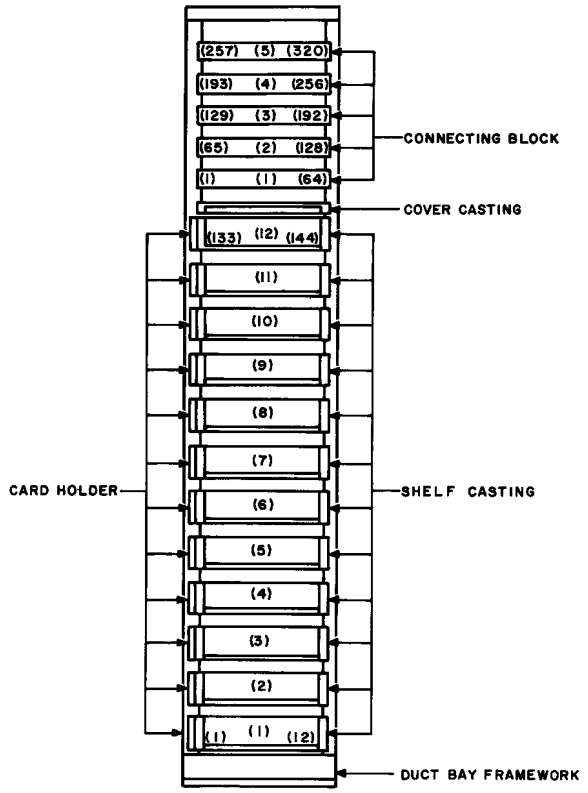

Fig. 2 — J99323C N2 Line Build-Out Bay Equipped with Line Protectors and Without Line Power Feed (11 Feet 6 Inches High by 26-3/8 Inches Wide)

contains eight mounting shelves for ninety-six J99323AA plug-in line build-out units with constant-current regulators, six J99321P fuse panels (two each for −48, −130, and +130 volt potentials), one J99323AC fuse alarm panel, three 62A1A-64 connecting blocks with protectors, and one J99323AB power resistor panel to dissipate power not required to operate remote repeaters.

2.08 ***The J99323C line build-out bay,*** shown in Fig. 2, is an 11-foot 6-inch bay with primary line protectors but ***without*** power feed arrangements. It is arranged to provide build-out equipment for 288 carrier pairs in aerial or buried cable facilities. A fully equipped bay will contain 12 mounting shelves for one hundred and forty-four J99323AA plug-in line build-out units without constant-current regulators and five 62A1A-64 connecting blocks to provide the primary protection for the cable pairs.

2.09 ***The J99323D line build-out bay,*** shown in Fig. 3, is an 11-foot 6-inch bay without primary line protectors and power feed arrangements. This bay provides build-out equipment for 360 carrier pairs in underground cable facilities. The fully equipped bay contains 15 mounting shelves for one hundred and eighty J99323AA plug-in line build-out units without constant-current regulators.

2.10 ***The J99323E line build-out bay,*** shown in Fig. 4, is an 11-foot 6-inch bay without primary line protectors. The bay is arranged to provide line build-out equipment and power feed arrangements for 192 carrier pairs in underground cable facilities. The fully equipped bay will include eight mounting shelves for ninety-six J99323AA line build-out units with constant-current regulators, six J99321P fuse panels (two for —48 volt power, two for —130 volt power, and two for +130 volt power) for supplying power to the cable pairs, one J99323AC fuse alarm

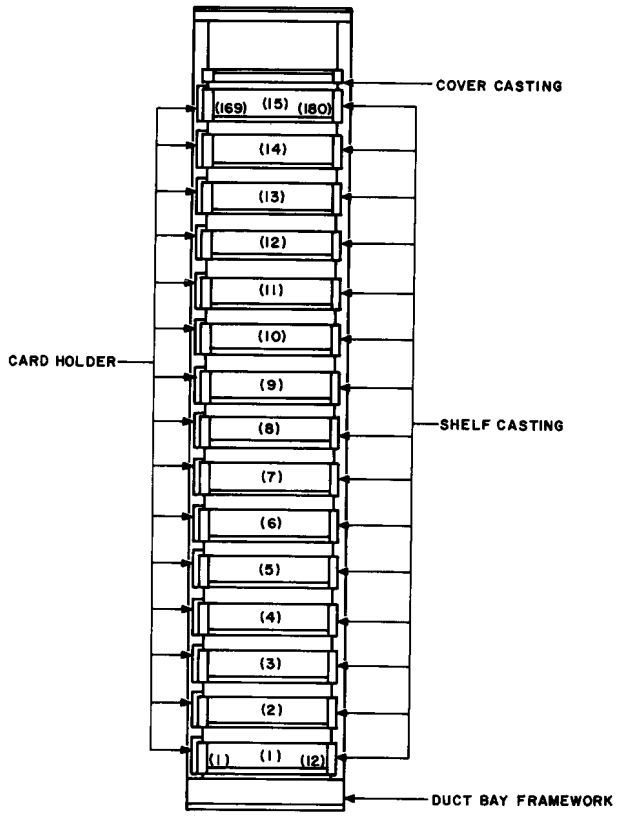

Fig. 3 — J99323D N2 Line Build-Out Bay Equipment Without Line Protectors and Without Power Feed (11 Feet 6 Inches High by 26-3/8 Inches Wide)

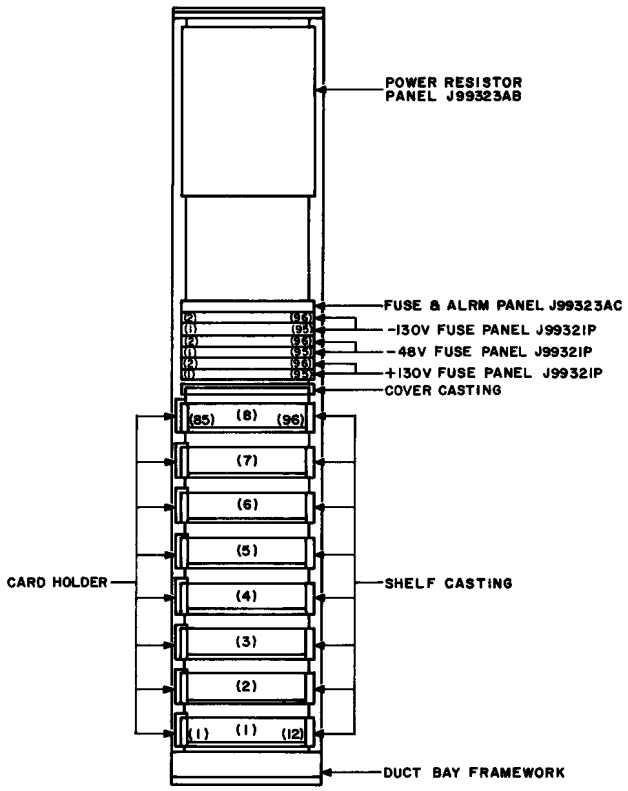

Fig. 4 — J99323E N2 Line Build-Out Bay Equipped With Power Feed and Without Line Protectors (11 Feet 6 Inches High by 26-3/8 Inches Wide)

panel for operating office alarms, and one J99323AB power resistor panel to dissipate the excess power created in maintaining the proper line current.

C. Line Build-Out Bays (7 Feet High)

2.11 ***The J99323F line build-out bay*** is similar to the bay shown in Fig. 1 except that the equipment has been reduced to fit into a 7-foot bay. It provides build-out equipment, protectors, and power feed arrangements for building-out 96 carrier pairs in aerial or buried cable facilities. The fully equipped bay includes four mounting shelves for forty-eight J99323AA line build-out units with constant-current regulators, three J99321P fuse panels (one for —48 volt power, one for —130 volt power, and one for +130 volt power) for supplying power to the cable pairs, one J99323AC fuse alarm panel for operating office alarms, two J62A1A-64 connecting blocks for primary protection of the cable pairs, and one J99323AD power resistor panel to dissipate the excess power created in maintaining the proper line current.

2.12 ***The J99323G line build-out bay*** is similar to the bay shown in Fig. 4 except that the equipment has been reduced to fit into a 7-foot bay. Line protectors are not furnished but the bay includes line build-out equipment and power feed arrangements for building-out 96 carrier pairs in underground cable facilities. The fully equipped bay includes four mounting shelves for forty-eight J99323AA line build-out units with constant-current regulators, three J99321P fuse panels (one for —48 volt power, one for —130 volt power, and one for +130 volt power) for supplying power to the cable pairs, one J99323AC fuse alarm panel for operating office alarms, and one J99323AD power resistor panel to dissipate the excess power created in maintaining the proper line current.

2.13 ***The J99323H line build-out bay*** is similar to the bay shown in Fig. 2 except that the equipment is reduced to fit into a 7-foot bay. The frame is equipped with primary line protectors but without power feed arrangements. It provides line build-out equipment for 168 carrier pairs in aerial or buried cable facilities. The fully equipped bay includes seven mounting shelves for eighty-four J99323AA line build-out units without constant-current regulators and two 62A1A-64 connecting blocks for primary protection of the cable pairs.

2.14 ***The J99323J line build-out bay*** is similar to the bay shown in Fig. 3 except that the equipment has been reduced to fit into a 7-foot bay. The frame comes without primary line protectors and without power feed arrangements. The bay provides line build-out equipment for 216 carrier pairs in underground cable facilities. The fully equipped bay contains nine mounting shelves for one hundred and eight J99323AA plug-in line build-out units without constant-current regulators.

D. Line Build-Out Bays (9 Feet High)

2.15 ***The J99323P line build-out bay*** is similar to the bay shown in Fig. 1 except that the equipment has been reduced to fit into a 9-foot bay. The unit provides build-out equipment, protectors, and power feed arrangements for building-out 144 carrier pairs in aerial or buried cable facilities. The fully equipped bay includes six mounting shelves for seventy-two J99323AA line build-out units with constant-current regulators, six J99321P fuse panels (two for —48 volt power, two for —130 volt power, and two for +130 volt power) for supplying power to the cable pairs, one J99323AC fuse alarm panel for operating office alarms, three 62A1A-64 connecting blocks for primary protection of the cable pairs, and one J99323AF power resistor panel to dissipate the excess power created in maintaining the proper line current.

2.16 ***The J99323R line build-out bay*** is similar to the bay shown in Fig. 4 except that the equipment has been reduced to fit into a 9-foot bay. The frame comes without line protectors and provides line build-out equipment and power feed arrangements for building-out 168 carrier pairs in underground cable facilities. The fully equipped bay includes seven mounting shelves for eighty-four J99323AA line build-out units with constant-current regulators, six J99321P fuse panels (two for —48 volt power, two for —130 volt power, and two for +130 volt power) for supplying power to the cable pairs, one J99323AC fuse alarm panel for operating office alarms, and one J99323AG power resistor panel to dissipate the excess power created in maintaining the proper line current.

2.17 ***The J99323S line build-out bay*** is similar to the bay shown in Fig. 2 except that the equipment has been reduced to fit into a 9-foot bay. The frame is furnished with primary protectors but not with power feed arrangements. The bay provides line build-out equipment for 216 carrier pairs in aerial or buried cable facilities. The fully equipped bay includes nine mounting shelves for one hundred and eight J99323AA plug-in line build-out units without constant-current regulators, and four 62A1A-64 connecting blocks for primary protection of the cable pairs.

2.18 ***The J99323T line build-out bay*** is similar to the bay shown in Fig. 3 except that the equipment has been reduced to fit into a 9-foot bay. The unit comes without line protectors and without power feed arrangements and provides build-out equipment for 288 carrier pairs. The fully equipped bay includes 12 mounting shelves for one hundred and forty-four J99323AA plug-in line build-out units without constant-current regulators.

E. Cross-Connection Cabinets (11 Feet 6 Inches High)

2.19 ***The J99323A cross-connection cabinet*** shown in Fig. 5 is a double-bay arrangement 52-7/8 inches wide and mounts on 53-inch centers. The 15 terminal strip and cable ring assembly panels can be mounted in the framework to connect up to 1800 carrier pairs to N-type terminals, to N- and ON-type repeaters, and to other miscellaneous equipment. The equipment is assembled and wired in the field.

2.20 ***The J99323M cross-connection cabinet*** shown in Fig. 6 is a single-bay arrangement 26-3/8 inches wide and mounts on 26-1/2 inch centers. The 15 terminal strip and cable ring

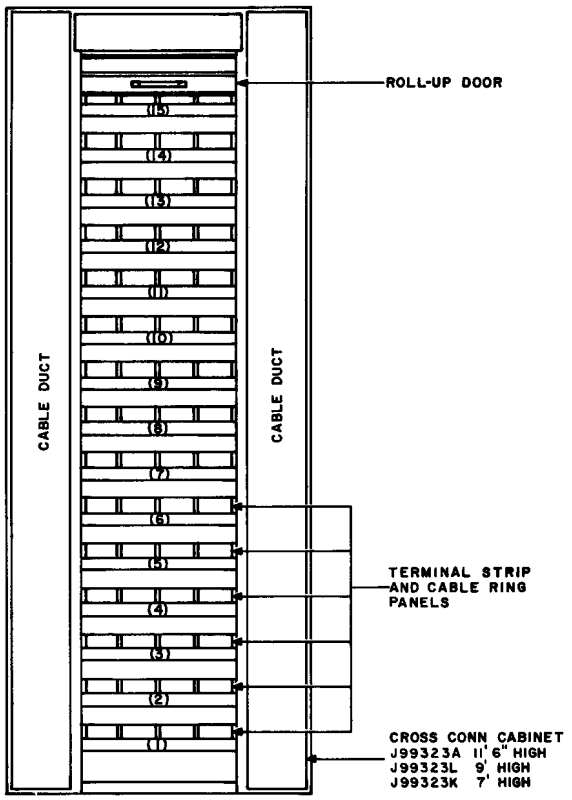

Fig. 5 — N2 Cross-Connection Cabinet Double-Bay Framework

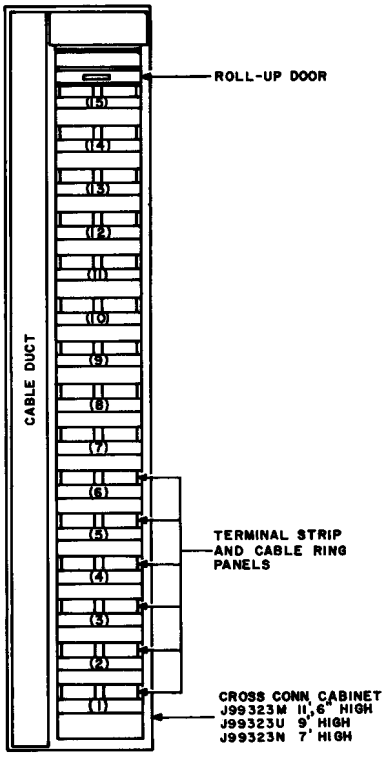

Fig. 6 — N2 Cross-Connection Cabinet Single-Bay Framework

assembly panels can be mounted in the framework to connect up to 900 carrier pairs to N-type terminals, to N- and ON-type repeaters, and to other miscellaneous equipment. The equipment is assembled and wired in the field.

F. Cross-Connection Cabinets (9 Feet High)

2.21 ***The J99323L cross-connection cabinet*** is a double-bay arrangement 52-7/8 inches wide, mounts on 53-inch centers, and is similar to the unit shown in Fig. 5 except that the height has been reduced to 9 feet. The 11 terminal strip and cable ring assembly panels can be mounted in the framework to connect up to 1320 carrier pairs to N-type terminals, to N- and ON-type repeaters, and to other miscellaneous equipment. The equipment is assembled and wired in the field.

2.22 ***The J99323U cross-connection cabinet*** is a single-bay arrangement 26-3/8 inches wide, mounts on 26-1/2 inch centers, and is similar to the unit shown in Fig. 6 except that the height has been reduced to 9 feet. The 11 terminal strip and cable ring assembly panels can be mounted in the framework to connect up to 660 carrier pairs to N-type terminals, to N- and ON-type repeaters, and to other miscellaneous equipment. The equipment is assembled and wired in the field.

G. Cross-Connection Cabinets (7 Feet High)

2.23 ***The J99323K cross-connection cabinet*** is a double-bay arrangement 52 inches wide, mounts on 52-1/8-inch centers, and is similar to the unit shown in Fig. 5 except that the height has been reduced to 7 feet. The eight terminal strip and cable ring assembly panels can be mounted in the framework to connect up to 960 carrier pairs to N-type terminals, to N- and ON-type repeaters, and to other miscellaneous equipment. The equipment is assembled and wired in the field.

2.24 ***The J99323N cross-connection cabinet*** is a single-bay arrangement 26 inches wide and 7 feet high and mounts on 26-1/8 inch centers to be compatible with No. 1 ESS bays. The cabinet is similar to the unit shown in Fig. 6 except that the height has been reduced to 7 feet. The eight terminal strip and cable ring assembly panels can be mounted in the framework to connect up to 480 carrier pairs to N-type terminals, to N- and ON-type repeaters, and to other miscellaneous equipment. The equipment is assembled and wired in the field.

H. Line Build-Out Unit

2.25 ***The J99323AA line build-out unit*** is a plug-in package which includes all of the functions required to build out the cable pair to a common value of slope and transmission level. The unit contains balanced line transformers with a center tap and a noise filter for feeding power to the line; secondary diode protectors to prevent undesirable voltages from damaging the repeater circuitry; two equalizer sockets for line equalization; input and output span pad sockets for level adjustments; and three power feed options for sending power to remote repeater points, for sending power to 240-type amplifiers or sending sealing current, and for receiving sealing current from remote locations.

2.26 Three lists of equipment are provided to meet the varied conditions of power feed. The List 1 equipment provides the circuitry and components for terminating the sealing current received from the remote power feeding point; the List 2 equipment provides a constant-current regulator unit which applies a constant value of current to the carrier pairs for powering remote repeaters and 240-type amplifiers and to furnish sealing current to the cable pairs in the same repeater string; and the List 3 equipment provides components and circuitry for transmitting sealing current and/or power to the 240-type amplifiers only.

2.27 Since many of the carrier pairs will not require two equalizers or an output span pad for building-out purposes, one equalizer position (EQL 2) is equipped at the factory with a shorting plug (0-db loss) and the output span pad socket terminals are strapped through to complete the connections to the line. When only one equalizer (391-type) is required, it is inserted into the EQL 1 position and the shorting plug is left in the EQL 2 socket. If two equalizers are required, the shorting plug is removed and saved for future changes and the equalizer inserted into the EQL 2 position. Where an output span pad is required, the straps on the socket terminals are cut and the correct value of the pad (54-type span pad) inserted into the socket.

2.28 The plug-in line build-out unit is approximately 1-3/4 inches wide, 8 inches high, and 10 inches deep.

I. Line Test Unit

2.29 ***The J99323AE line test unit*** is a plug-in package which can be inserted into any line build-out unit position on a mounting shelf to gain access to the cable pair and the carrier equipment for test purposes. When used in place of a line build-out unit, the office equipment is disconnected from the cable pair and the cable pair leads are extended to the front faceplate of the line test unit and terminated on insulated terminals which can be connected to the cable test equipment. At the same time, the leads to the associated carrier equipment are also terminated on insulated terminals on the faceplate. The line test unit does not disconnect any primary line protector blocks from the cable pairs. Each unit is approximately 1-3/4 inches wide, 8 inches high, and 11 inches deep.

J. Equipment Panels

2.30 ***The J99323AB power resistor panel*** for line build-out bays contains 96 pairs of power dissipating resistors. One of the pairs, a multipled tapped unit, is associated with the constant-current regulator circuit in a line build-out unit and provided with optional strapping for minimizing the power dissipation in the constant-current regulators under different power feed conditions. The second resistor is used as the 1 ohm-per-volt current limiting device, connected between the —130 volt battery feed and the simplex lead to the line, to limit the power supply current under short circuit conditions and to permit the arc across the protector gaps to extinguish upon discharge of the surge potentials. The equipment is contained on a mounting plate 30 inches high and 23 inches wide.

2.31 ***The J99323AC fuse alarm panel*** for line build-out and N2 repeater bays contains relays for operating the office minor and major alarm circuits. It is used in line build-out bays to indicate power feed fuse failures. The equipment is mounted on a 2- by 23-inch mounting plate.

2.32 ***The J99323AD power resistor panel*** for line build-out bays contains 48 pairs of power dissipating resistors. One of the pairs, a multipled tapped unit, is associated with the constant-current regulator circuit in a line build-out unit and provided with optional strapping for minimizing the power dissipation in the constant-current regulator under different power feed conditions. The second resistor is used as the 1 ohm-per-volt current limiting device, connected between the —130 volt battery feed and the simplex lead to the line, to limit the power supply current under short circuit conditions and to permit the arc across the protector gaps to extinguish upon discharge of the surge potentials. The equipment is contained on a mounting plate 15 inches high and 23 inches wide.

2.33 ***The J99323AF power resistor panel*** for line build-out bays contains 72 pairs of power dissipating resistors. Again, one resistor is associated with the constant-current regulator circuit in a line build-out unit and provided with optional strapping for minimizing the power dissipation in the constant-current regulators under different power feed conditions. The second resistor is used as the 1 ohm-per-volt current limiting device, connected between the —130 volt battery feed and the simplex lead to the line, to limit the power supply current under short circuit conditions and to permit the arc across the protector gaps to extinguish upon discharge of the surge potentials. The equipment is contained on a mounting plate 20 inches high and 23 inches wide.

2.34 ***The J99323AG power resistor panel*** for line build-out bays is similar to the J99323AF panel except that it contains 84 pairs of power dissipating resistors. The equipment is contained on a mounting plate 27 inches high and 23 inches wide.

2.35 ***The J99323AH longitudinal noise suppression coil panel*** for line build-out bays mounts four coils which are to be used with the order-wire, alarm circuits, gas-pressure alarm, or subscribers line pairs. These coils are required when the maintenance circuits are routed through an otherwise all-carrier cable to prevent impulse noise induced on the circuit from getting into the cable and causing noise on the carrier pairs. In general, protection against longitudinal noise will not be needed if the leads involved are in the same cable run as the office cabling to the carrier bays. The 23-inch coil mounting plate has space for four 231N inductors and one coil is furnished with the plate. Provision is made for testing the cable pair at the line build-out cabinet by including turn switches with test point pins between the coils and the cable. When more than one coil is required, extra coils may be ordered in addition to the one supplied with the mounting plate for assembly by the installer.

2.36 ***The J99323AJ longitudinal noise suppression coil panel*** for line build-out bays mounts four coils on the wiring side or back of the bay where there is not sufficient room for a mounting plate on the front of the bay. The coil mounting is arranged to support four 231N inductors but only one inductor is furnished with the mounting plate. The coil mounting is arranged so it can be located behind the power resistor panel in a vertical position. The panel is shop-wired and a wire-wrap type terminal has been provided which will permit connections to the panel after the panel has been mounted on the bay. A strip of screw-down switches with test point pins has been provided to permit testing of cable pairs without disconnecting the cable pairs from the coils or terminal strips. Provision has been made to mount protector blocks on this panel when there are no spare protectors in the bay for the maintenance lines.

3. POWER

3.01 Certain codes of the line build-out bays are arranged to transmit power through the line build-out units to the cable pairs to operate remote repeaters, 240-type amplifiers, and to supply sealing currents to the carrier pairs. Office power from the +130, —130, and —48 volt batteries, as required, is connected to fuse panels in the bay and distributed to each line build-out

connector. Each line build-out unit can be equipped with a constant-current regulator which maintains a steady value of line current and includes screw-type switches for selecting the required voltage supply and current to operate the various combinations of N1, N1A, N2, and ON repeaters and 240-type amplifiers and to supply sealing current to the cable pairs. The line build-out unit may also be optionally equipped to feed sealing current, or power, to 240-type flat gain amplifiers only. Another option provides equipment to terminate sealing current received from a distant power plant.

3.02 Since a large number of carrier channels will be concentrated in the 9-foot and 11-foot 6-inch line build-out bays, two sets of power leads are provided from the fuse panels for each voltage (+130, −130, and −48 volt potentials) and run to the top of the bay for connection to the office feeders. Fuse panels and power feeders are provided only for those potentials actually used in each bay. Two sets of feeders (A and B), one set for each of the required battery voltages, are run to the battery distribution fuse board and each set of feeders equipped with separate discharge fuses. The 7-foot bays which have a smaller number of channels use one feeder and one discharge fuse for each of the battery voltages.

4. DRAWINGS

4.01 The following schematic and equipment drawings (not attached) provide detailed information.

SD-97391-01	Line Build-out and Cross-Connecting Circuits
SD-97399-01	N and ON Carrier Telephone — Repeater Power Distribution Circuits
SD-30010-01	Maintenance Pairs — Noise Suppression and Terminating Circuits