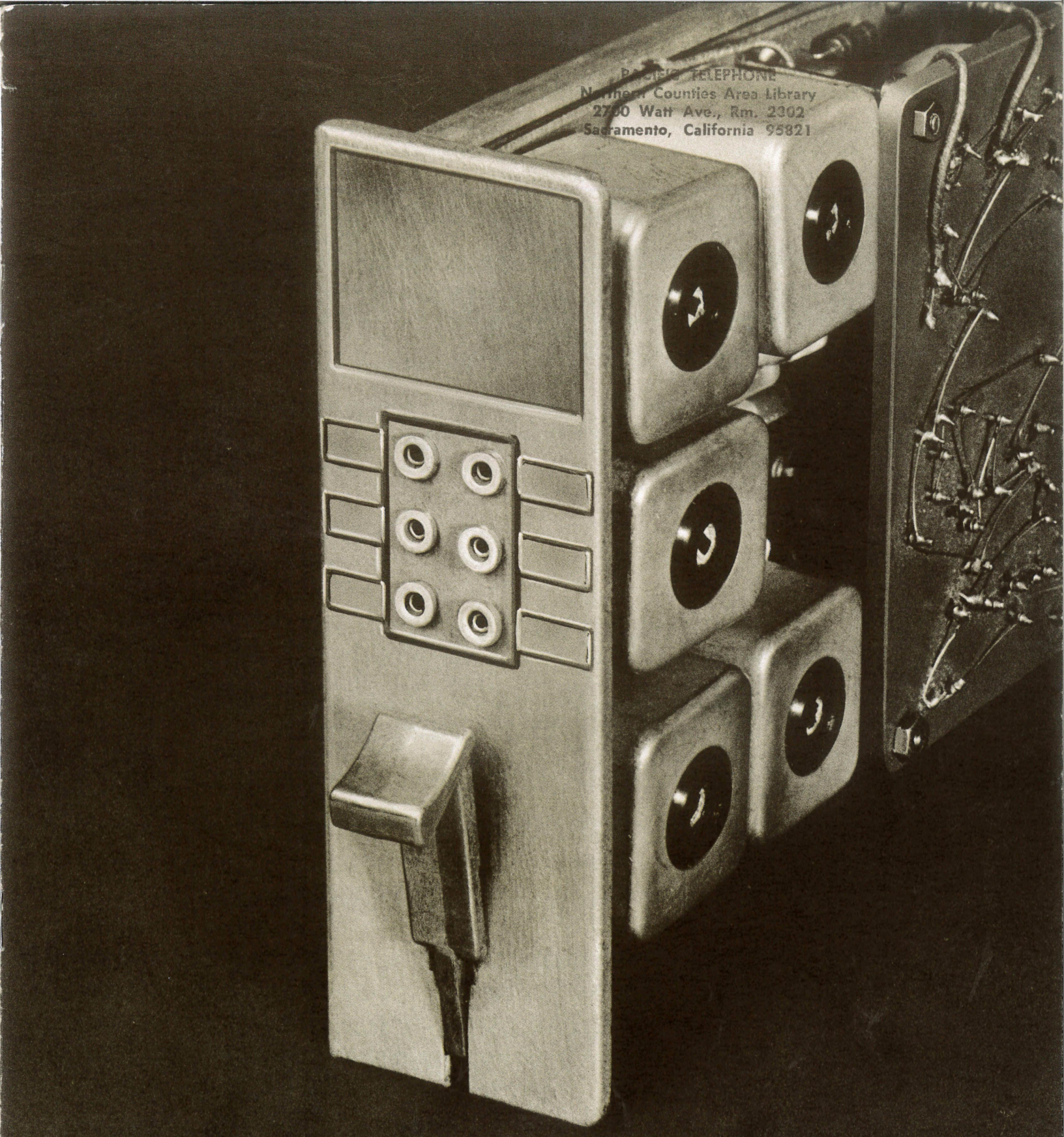


Western Electric's N2 CARRIER

a short-haul facility, with transmission improvements to meet today's requirements

introducing *Western Electric's*
N2 Carrier Terminal (J99272)
Designed by Bell Telephone Laboratories
Part of a new carrier family
for the Bell Telephone Companies

Western Electric's N2 Carrier is part of an across-the-board "new look" in short-haul carrier equipment. It is a solid-state facility designed to help telephone companies make the most efficient possible use of transmission facilities.

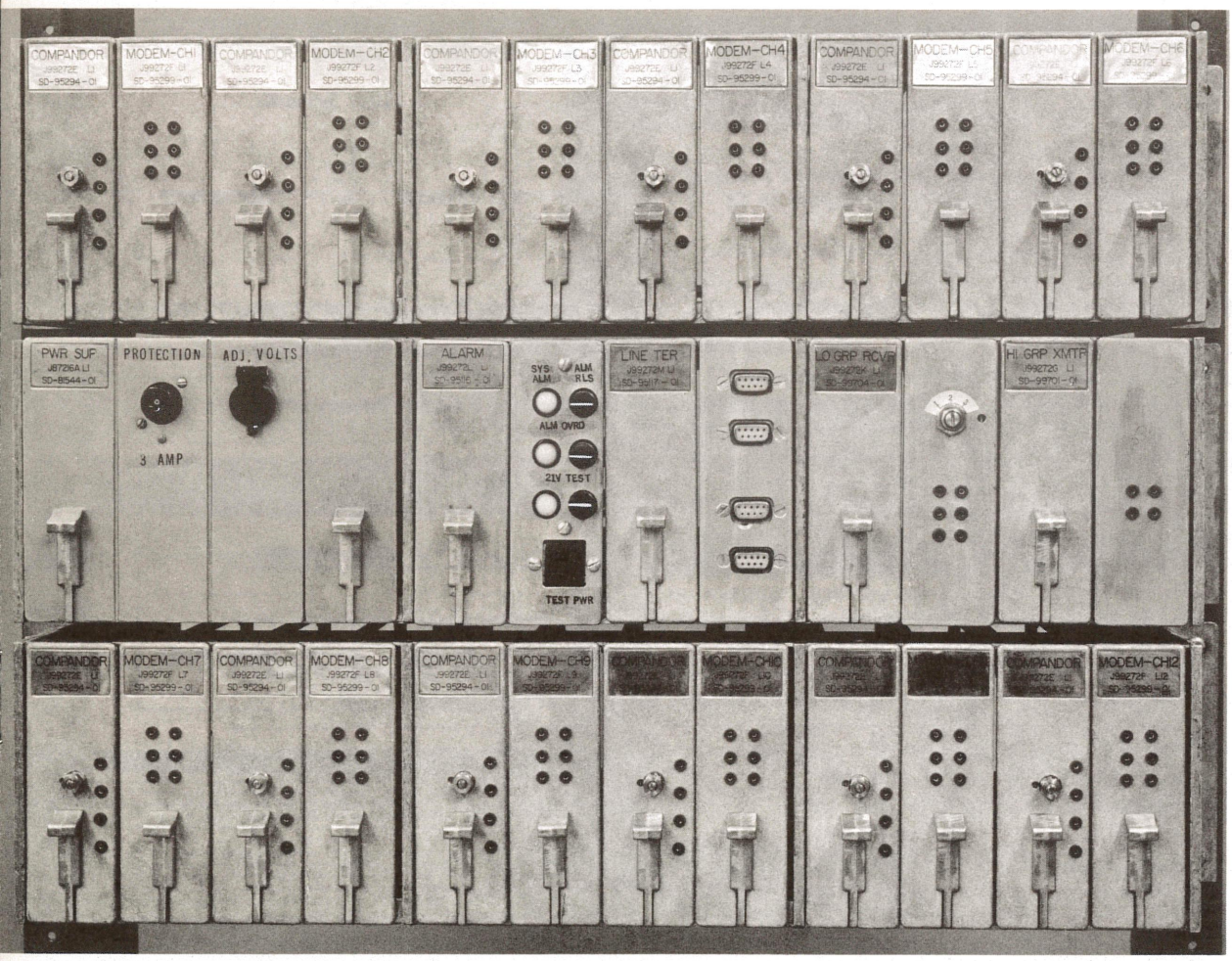
Over Cable or Microwave . . .
N2 provides 12 channels for telephone, data, program, etc., over two cable pairs, or 48 circuits over an equivalent microwave channel.

. . . Improved Services
N2 meets transmission requirements for Direct Distance Dialing and data transmission, and helps open the door to future services.

Meeting new highs in transmission performance at short ranges, the new N2 Terminal offers an economical means of providing circuits over distances from 200 miles down to twelve miles, and over even shorter routes in special cases. In the central office, N2 saves valuable space, reduces power drain, and provides installation and maintenance advantages.

Transmission quality and central office advantages are derived primarily from improved components and advanced design techniques, rather than from the use of elaborate special circuitry in the N2 Terminal.

The New N2 Carrier Terminal



Plug-in N2 units mounted in three die-cast 23″ aluminum shelves provide twelve-channel carrier transmission. An 11′ 6″ bay holds eight of these terminal arrangements, giving a total of 96 carrier circuits. A 9′ bay provides 72 circuits.

Each voice channel entering the N2 Terminal requires two plug-in units for one end of a channel—a compandor (compressor-expandor) and a modem (modulator-demodulator). Twelve of each are mounted alternately in a pair of die-cast aluminum shelves, each 23″ wide for mounting on the central office bay. In a third shelf, between the channel unit shelves, the N2 Terminal houses equipment common to all twelve channels. This equipment consists of a power converter-regulator unit, an alarm unit, a line terminating unit, a group transmitting unit, and a group receiving unit.

N2 equipment mounting provides front access. Following N1 practices, N2 Terminals can be installed against walls or in back-to-back arrangements without losing access for test and maintenance purposes. This permits more efficient utilization of central office floor space.

N2 Saves Valuable Space. The use of solid state devices and extensive application of ferrite filter components in N2 design permits a better than 2:1 reduction from the size of existing N Carrier equipment.

N2 CARRIER

N2 Offers transmission advantages

The N2 Terminal is designed to provide highly-stable service. Both long and short-term variations in stability have been reduced from those encountered with previous N Carrier equipment.

Transmission Characteristics table

N2 has same transmission plan as N1—frequencies, power, levels, etc.

Double sideband amplitude modulation.

12 channels—36-268 kc.

N2 channel gain-frequency characteristics are 2 db down at 250 and 3200 cps.

Net loss stability: Distribution grade of 0.5 db **vs** time, battery, temperature.

N2 regulation range is 20 db, with greater than 50:1 stiffness.

N2 compandor tracks to ±0.5 db over entire range; maximum load capacity is 8 dbm at 0 db system level.

Long-term stability means less frequent adjustments and simplified testing procedures. Transmission variations due to aging components have been greatly reduced by the liberal use of feedback and solid state components in N2 equipment design.

Short-term variations due to normal fluctuations in the central office battery supply have been eliminated by a plug-in DC power converter-regulator which precisely regulates the voltage level.

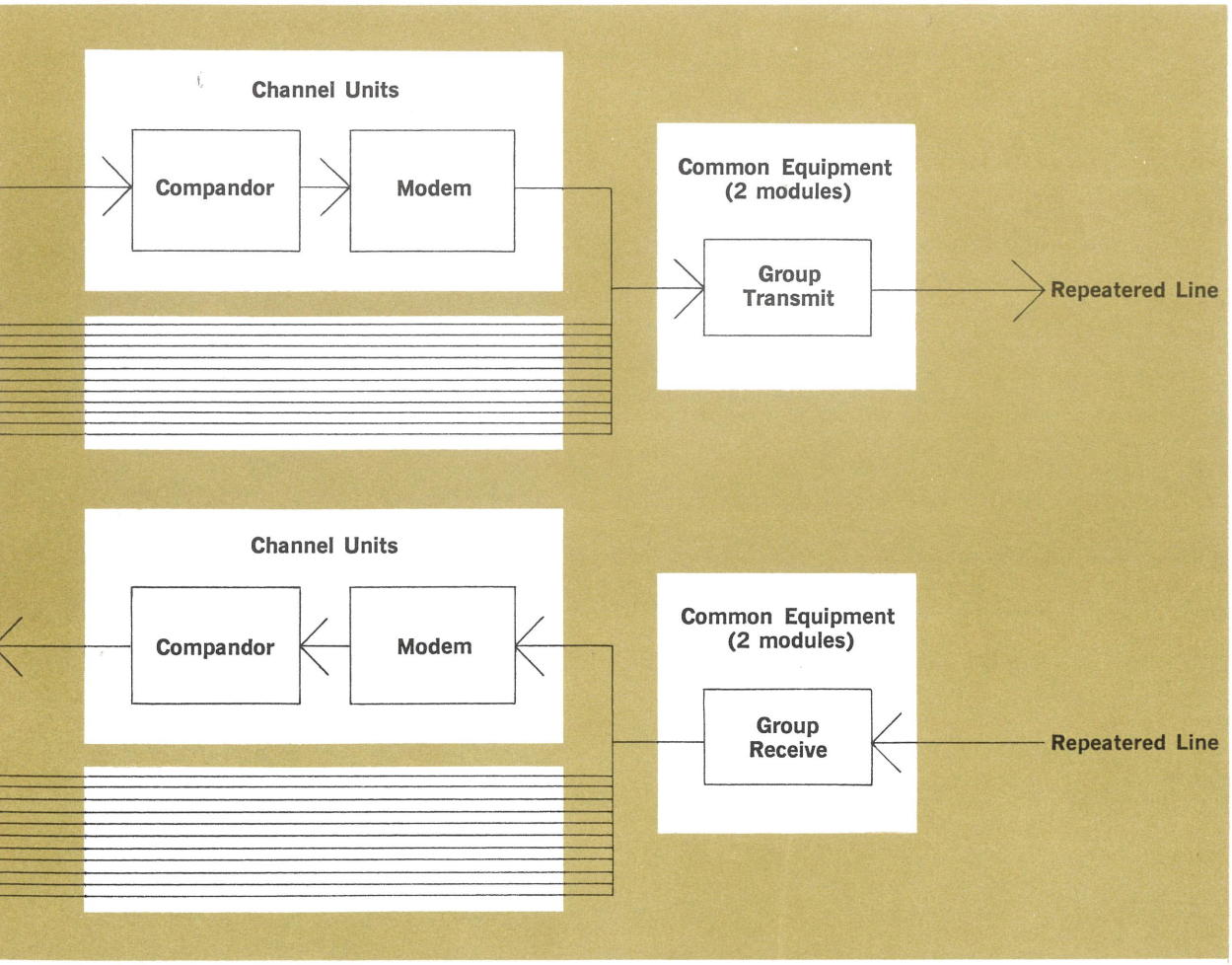
And "beats" have been reduced. Beats are caused by cross-talk between slightly non-synchronous carriers in the repeatered lines, and seriously interfere with the adjustment of net loss. In N2, beats have been reduced by using highly-efficient new ferrite filter components.

Both plug-in and fine grain adjustable slope equalizers in the group transmitting and receiving units help match N2 transmission to a variety of cable types, and span lengths.

How N2 Carrier works

The 12 channels provided by a N2 Terminal can transmit either speech or voice frequency data. In the case of voice, each circuit passes through a compressor to one of the twelve modems mounted in the channel unit shelves. Here they modulate to carrier frequencies, placing each voice in a separate portion of the frequency spectrum between 172 KC and 268 KC. The modulated carrier signals then go to the group transmitting units, where they are combined into a single broadband signal and amplified for transmission over the line.

N2 Carrier Block Diagram



At the receiving terminal the broadband signal enters receiving group units, where it is amplified and regulated. In the modem units, the broadband signal is split by filters into its original twelve bands, and each is tightly regulated. The twelve original voice signals are each reproduced by demodulation. The voice signals are then each sent through an expandor to the output of the receiving terminal. Signals appearing at the receiving terminal output are accurate duplicates of the twelve voice signals which entered the N2 transmitting terminal.

Voice frequency data is processed in a similar fashion, but compressor-expandors (compandors) may be omitted where it is advantageous.

Signaling. N2 Carrier uses E-type in-band signaling. This means lowest possible cost at intermediate points when N2 systems are used in tandem—signaling equipment is unnecessary at such intermediate terminal locations.

E-type signaling units can in the future be mounted in the same bay with the N2 Terminal. Even then an 11′6″ bay will hold 36 channels with their accompanying signaling units, voice frequency test jacks, and the carrier group alarm circuits.

N2 CARRIER

Two Important N2 Modules

Compandor

N2's newly-designed compandor is a device which improves the signal-to-noise ratio of transmission, while allowing normal variations in speech intensity to be faithfully reproduced at the receiving end of the circuit.

Loud and weak signals generate power levels that differ by up to 60 decibels—a ratio of a million to one. The cost of short-haul transmission facilities able to carry this wide range of speech intensities without introducing serious noise or crosstalk is prohibitively high. This problem is overcome by part of the compandor, known as the compressor. It is used in the transmitting terminal to **compress** the range of speech intensities, primarily by boosting the power level of weak signals. This protects weak signals from noise and crosstalk introduced by economically feasible transmission lines.

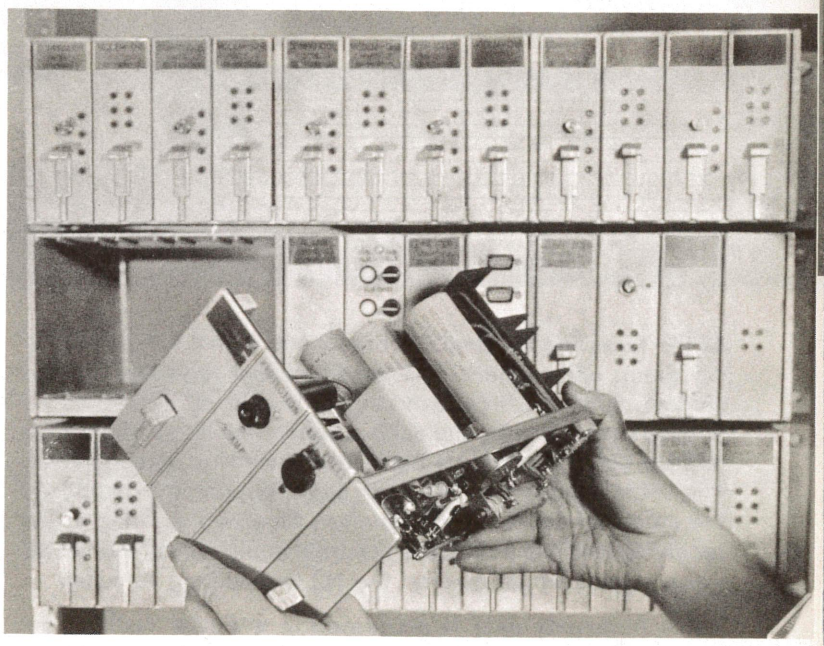
In the receiving terminal, the other part of the compandor **expands** the speech power ratios to reproduce each talker's natural speech intensity. The newly-designed compandor used in N2 performs this compression-expansion function several times more accurately than the present N-type compandor.

Plug-in DC power unit

One of the first featured in Western Electric carrier equipment, a plug-in DC power unit is used in the N2 Terminal to convert and regulate the central office power supply. The normal 48 volt central office power is converted by this unit to a 21-volt supply for the N2 equipment. N2 terminals use no 130-volt power—**only about 1.1 amp of 48 V power per terminal.**

The DC power unit also precisely regulates the power supply, isolating N2 circuits from the effects of normal fluctuations in the central office battery. This isolation makes an important contribution to the stable operation of the N2 Terminal.

An important simplification of maintenance procedures has been made by the power unit's plug-in flexibility, and by the use of solid state components in power unit design.



Four N2 Installation Features

Plug-in line build out networks
Both plug-in span pads and slope networks provide flexibility to compensate for various cable lengths and system arrangements at the N2 Terminal.

Easily adjustable repeater power feed
Screwdriver adjustments provide a simple means of adjusting the dc power feed from N2 Terminals to N Repeaters.

No blowers are needed
A 96-channel N2 bay dissipates half as much heat as a 36-channel N1 bay. N2 can thus be installed in buildings without the blowers required in N1 bays.

One line-up adjustment
Only one potentiometer lines up channel gain as against five in the N1.

The Repeatered Line

First N2 systems will be installed using the transistorized (or vacuum tube) N1 Repeater on the line facility. The transistorized repeater provides transmission performance equivalent to that of the tube-type N1 Repeater, at about 1/6 the power drain. Transistorized N1 Repeaters operate on an average of 4 watts of power, as opposed to the 24-watt drain of the tube-type N1 Repeater. **Seven transistorized N1 Repeaters can be powered over the line from each power feed point—three repeaters, on each side of the power feed point and one at the power feed point itself.**

N2 Repeaters now being designed will use the same solid state amplifiers as the transistorized N1 Repeaters (and consequently the same dc power requirements). In fact, an adaptor is now being developed to permit inserting N2 Repeaters in the space intended for these N1 Repeaters. It will then be possible to fill partially equipped N1 Repeater bays or cabinets with N2 Repeaters. The design of the N2 package will achieve a possible 2:1 reduction due to the use of new ferrite components in filtering arrangements. These filters, and improved transmission performance in the repeaters, will make it possible to reduce "beats" to a satisfactory small size.

N2 CARRIER

Reduced size
Reduced power drain
Reduced time for installation and maintenance
And improved transmission performance

Western Electric

Western Electric Marketing Organization
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For more information refer to:
Bell System Practices (BSP) J99272 (Section AA388.144)