

KELLOGG SWITCHBOARD AND SUPPLY COMPANY
Chicago 38, Illinois

Kellogg Telephone Repeater Brochure, Circa 1949

Published in a vertical format 8 1/4 inches wide and 11 inches high, and lithographed on 60# paper in two colors, black and burgundy.

This piece is unusual in that it does not have any form numbers or printing dates. Also of note is the absence of any Kellogg logos. The products depicted in this piece also appear (with identical artwork) in the 1949 general catalog number 11, page 94.

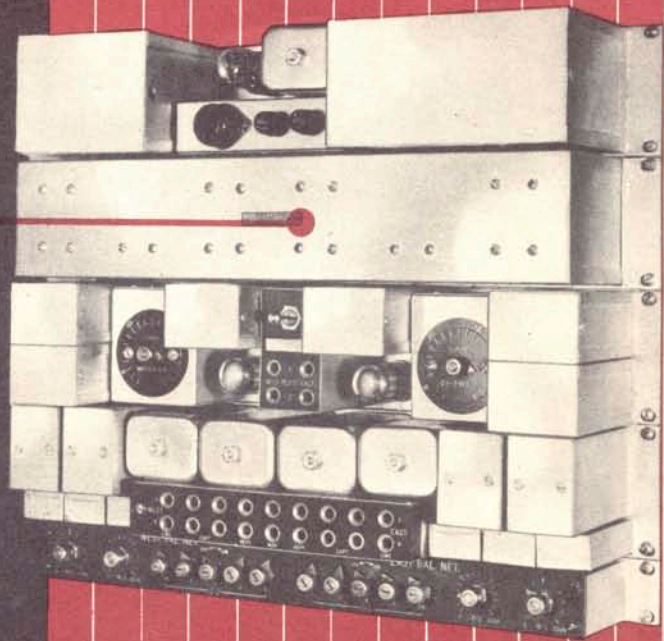
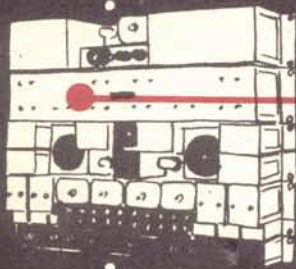
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KELLOGG

Telephone Repeater

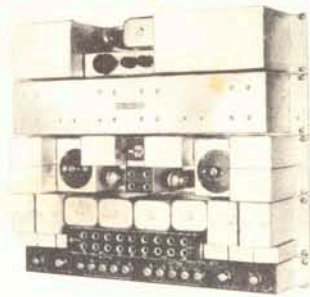


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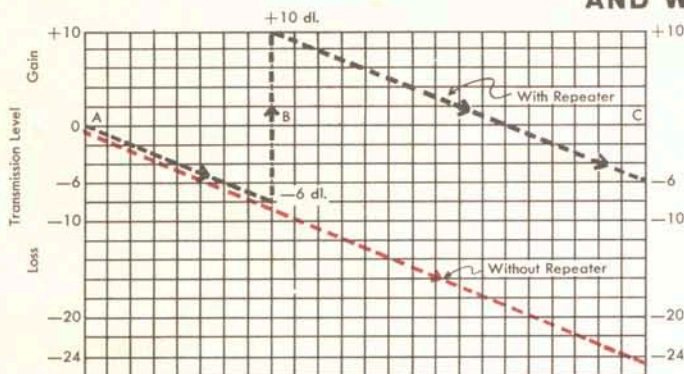
6650 S. Cicero Avenue

Chicago 38, Illinois

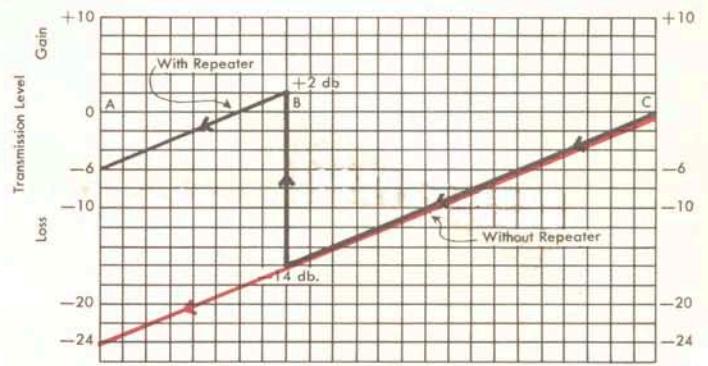
To obtain satisfactory telephone communication over a given line or circuit, there must be a sufficient amount of energy transmitted over the line to provide an adequate sound volume at the receiving end. In practice, the loss in many telephone toll circuits is so great that some provision must be made to counteract the loss if a commercial grade toll circuit is to be realized. A practical solution to the problem is offered through the use of one or more voice frequency telephone repeaters. A repeater consists essentially of two vacuum tube amplifiers so arranged that voice frequency signals may be amplified in both directions in a two-wire telephone circuit without inter-action between the two sides of the conversation in the circuit. This, in effect, is the equivalent of a 4-wire circuit inserted in a 2-wire line.



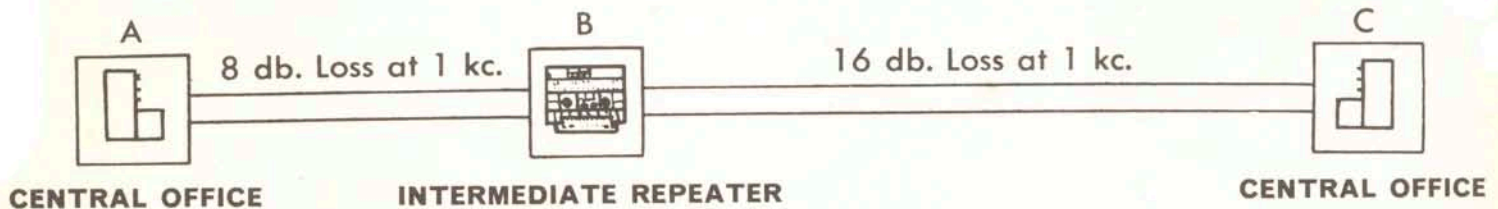
TRANSMISSION LEVEL DIAGRAMS OF A TOLL LINE 24 db LONG MEASURED AT 1KC WITH AND WITHOUT REPEATER



WEST-EAST TRANSMISSION



EAST-WEST TRANSMISSION



Length of various type circuits in which one Kellogg Telephone Repeater will produce an equivalent 6db circuit.

TYPE OF CIRCUIT	LENGTH OF CIRCUIT MILES	LOSS AT 1 KC - db
104 Copper O.W.	288	24
104 Copper Steel 40% O.W.	133	24
109 Galvanized Steel O.W.	77	24
16 Ga. Non-Loaded Quadded Cable	32	24
19 Ga. Non-Loaded Quadded Cable	22	24
22 Ga. Non-Loaded Cable	13	24

Note:

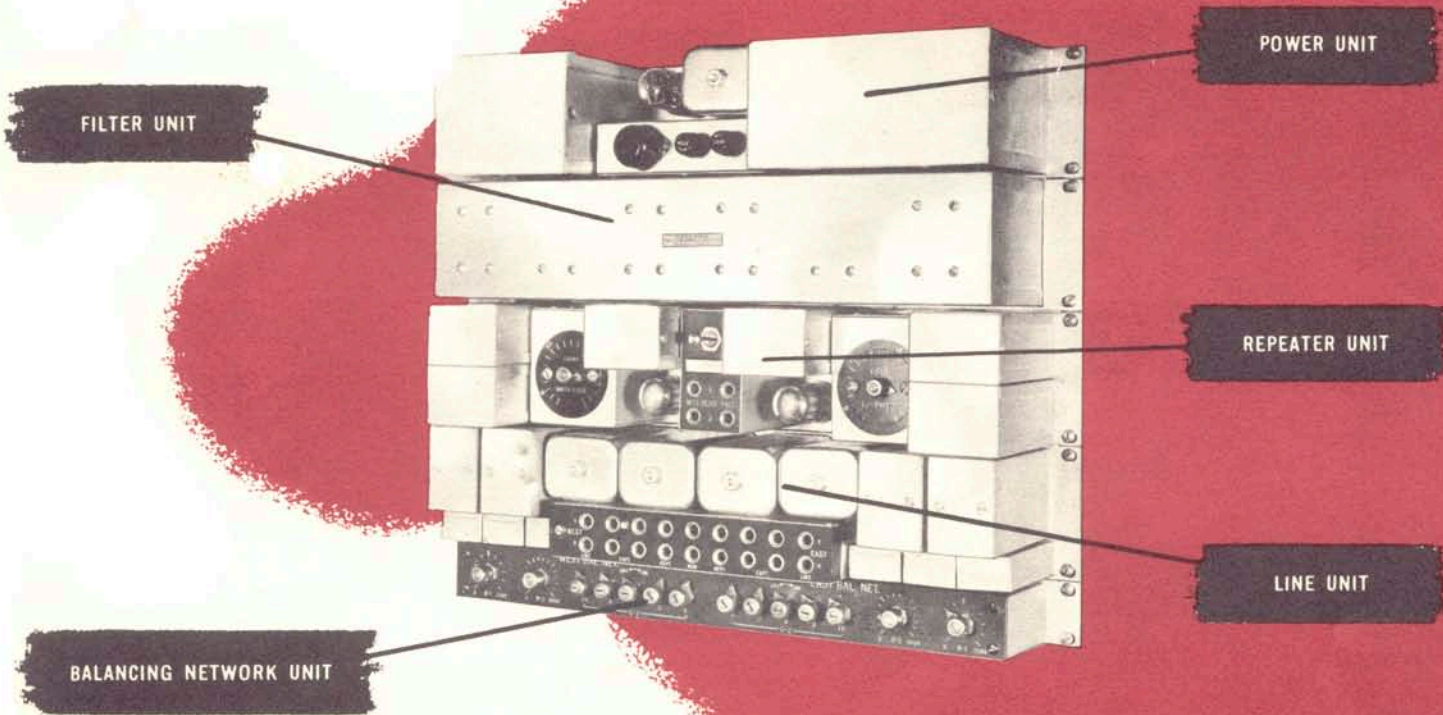
All circuits are side circuits. Attenuation computed on basis of wet weather with insulators in good condition, and no large impedance discontinuities.

KELLOGG

Repeater

The Kellogg Voice Frequency Telephone Repeater is a two-way voice frequency amplifying system consisting of a (1) repeater unit for amplifying the voice level, (2) a filter unit which, by limiting the frequencies to be amplified, makes possible a greater degree of balance and consequently a greater usable gain from the repeater, (3) a balancing network unit which provides the necessary impedance balance between the line side and the network side of the hybrid coil, (4) a line unit which acts as a connecting link between the line and the repeater unit and (5) a power unit used only with the AC operated repeater to furnish plate and heater voltages for the amplifier tubes in the repeater unit.

Voice repeaters may be used as intermediate repeaters, cord circuit repeaters or line terminal repeaters. An intermediate repeater is one which is installed in a telephone circuit somewhere between two central offices which terminate the circuit. It may be located in a central office which is at an intermediate point through which the circuit passes or it may be housed in a weather-proof cabinet at some point along the cable or open wire line. A cord circuit repeater is installed in the switchboard cord circuit at the central office. A line terminal repeater is located in the central office between the termination of the line and the switchboard.



FEATURES OF THE KELLOGG REPEATER

Kellogg voice repeaters are assembled and wired on a unit basis to provide the flexibility necessary to satisfy the requirements of various types of lines and circuit applications. Each of the following units are assembled individually on a panel suitable for mounting on a standard 19" relay rack or in one of the two different types of cabinets: repeater unit, filter unit, balancing network unit, line unit, power unit.

Other important features of the Kellogg repeater are the method and type of controls used to adjust for balance and gain. These adjustments may be rapidly made from the

equipment side of the units by means of accurately calibrated switches and controls without the use of tools or soldering irons. It is therefore unnecessary to strap attenuation pads to control the gain, or to change the components of the balance network as line conditions vary.

Advanced circuit design and the use of Kellogg components manufactured to the highest standards of the telephone industry assures maximum performance with minimum maintenance.

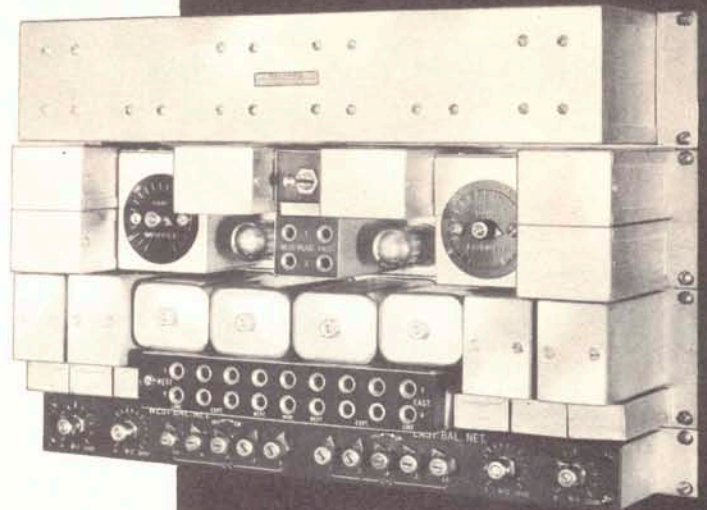
REPEATER UNIT

The repeater unit consists primarily of two vacuum tube amplifiers, two hybrid coils, and two gain controls. To simplify maintenance a series jack is provided in each plate circuit to permit measuring the plate current without taking the repeater out of service. This provision makes it possible to check the operation of the repeater without turning down the circuit. The repeater unit is also equipped with an on-off switch for opening the power supply circuit and releasing the power failure relay in the associated line unit.

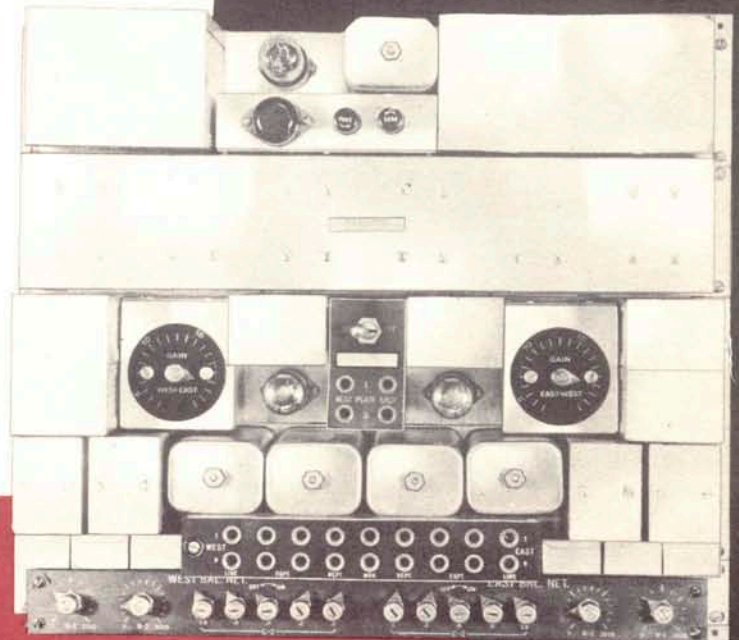
Each amplifier section of the repeater unit is equipped with a dual purpose tube operated at conservative voltages as a push-pull amplifier. Push-pull amplification provides superior performance through the prevention of harmonic distortion and the elimination of cross-talk or other interference which may be introduced through the power source. Thus the number of repeaters which may be operated from a single power source is limited only by the capacity of the power source. This circuit feature coupled with the operation of the tubes at conservative voltage ratings assures a high degree of stability and provides a flat response. The amplification of the repeater in each direction is governed by a variable gain control pad accurately calibrated in 1 db steps indicating the actual gain of the repeater unit itself.

Repeater units are furnished in three different types to operate directly from either 24V or 48V central office batteries or from a 110-120V 60 cy., ac power unit. Specifications on the three follow:

NO. 3 REPEATER



NO. 4 REPEATER



	No. 3A	No. 3B	No. 4
Power Source	20-28 V. d-c exchange battery	40-56 V. d-c exchange battery	A.C. power unit
Type of Tube	28D7	28D7	6SL7
Maximum gain each way	20 db	20 db	20 db
Maximum output level	+13 dbm*	+17 dbm*	+13 dbm*
Plate voltage	20-28 V.	40-56 V.	200 volts
Total Plate Current	.046 amp	.080 amp	.008 amp
Heater voltage supply	20-28 V.	40-56 V.	6.3 volts
Total heater current	.72 amp	.36 amp	.6 amp

*0 dbm = 1 mw in 600 ohm

KELLOGG

Repeater

FILTER UNIT

As has been stated, the maximum gain obtainable from a repeater system is limited by the degree of balance which can be maintained between the line side of the hybrid coil and the network side of the hybrid coil. Since the line impedance which the hybrid coil looks into is a complex quantity, it will have a different magnitude for each frequency. Thus to maintain a balance between the line side and the network side, the network must present the same impedance for every frequency as does the line. From this it can be easily seen that if an unlimited band of frequencies is to be passed, it will be virtually impossible to maintain any degree of balance and thus virtually no gain can be realized from the repeater system.

By limiting the band of frequencies to be passed and amplified, a high degree of balance may be readily maintained with a relatively simple network. As the band of frequencies passed is narrowed, the degree of balance becomes greater and the usable gain of the repeater also greater. The gain obtainable from a repeater system varies inversely with the width of the band of frequencies to be amplified, the theoretical limit being infinite gain if only a single frequency is passed. See illustration on page 8.

To maintain telephone circuits of commercial quality it is necessary that those frequencies between 300 cy and 2700 cy/sec. be amplified uniformly by the repeater system. At the same time the attenuation of frequencies below 300 cy and above 2700 to 3000 cy should be very high. This desirable condition can be met only by carefully engineered band pass filters as used in the Kellogg Filter Unit.

Both the 200 and 204 filters are designed to work between 600 ohm circuits and have a very low insertion loss (less than $\frac{1}{2}$ db.)

Code 204: The No. 204 filter is a sharp cut-off 300 to 2700 cy/sec. band-pass filter.

The filter unit is assembled on a $3\frac{1}{2}$ " x 19" panel.

Due to the sharp-cut-off and narrow band-pass characteristics of the No. 204 filter, its use is recommended where maximum repeater gain is required, especially where the repeater is to be installed on a circuit with heavily loaded cable lines or in circuits upon which a carrier system is superposed. The 204 filter will also produce a quieter telephone circuit since any noise voltages outside of the pass-band are greatly attenuated. Thus any disturbances such as carrier leak or carrier cross-talk and 60 cy hum induced by adjacent power lines will be eliminated from the circuit.

Code 200: The No. 200 filter unit is a general purpose filter suitable for use where the impedance characteristic of the line is smooth and the cut-off frequency of the line is fairly high.

BALANCING NETWORK UNIT

The function of the balancing network unit is to create an artificial line whose impedance at all frequencies in the voice range approximates that of the physical line in which the repeater is installed. When this condition is satisfied the repeater is balanced and maximum gain can be obtained without "singing." When this balance is not maintained the output of one amplifier will be fed into the input of the other across the hybrid coil in the repeater unit causing the repeater to oscillate or "sing."

The balance network unit consists of a network of variable resistance units and a decade condenser unit so designed that a wide range of line impedances may be rapidly balanced by the simple adjustment of accurately calibrated dial controls. Thus should line impedances change due to unusual weather conditions balance may be easily and rapidly restored without the necessity of reducing the repeater gain to prevent singing.

KELLOGG

Repeater

LINE UNITS

The line unit is the connecting link between the line and the repeater unit and between the repeater unit and the balancing network. It provides the terminating apparatus for the line as well as the means for signalling or ringing around the repeater unit.

Each line unit is equipped with a power failure relay which bypasses the toll circuit around the repeater unit should the latter become inoperative because of a power failure or when it may be desirable to take the repeater unit out of service temporarily. This feature makes it unnecessary to turn down the circuit when a repeater unit must be removed for maintenance.

All line units are equipped with a jack field containing line jacks, repeater unit jacks, equipment jacks, and a monitoring jack to facilitate routine testing and maintenance. The line, equipment and repeater unit jacks provide access to any part of the circuit by means of patch cords and greatly facilitate gain measurements and transmission tests. They also make it possible to substitute a spare line or repeater unit by simply patching in the new unit without interrupting service.

The monitoring jack is connected to special windings on the E-W and W-E output transformers in the repeater unit allowing both directions of transmission to be monitored simultaneously with negligible loss in transmission level and without introducing any circuit unbalance. Thus it is possible to monitor the repeated circuit without impairing the quality of transmission. The monitoring circuit may also be used for talking in both directions from the repeater simultaneously, providing an order wire at the repeater itself for ease of line up and maintenance.

Various signalling methods create a need for four types of line units which have been coded 400, 401, 402 and 403.

The No. 400 Line Unit is a relay by-pass line unit using relays either to by-pass the signalling current around the repeater or to apply a new source of signalling current when

repeat ringing is desired. The change from by-pass signalling to repeat signalling is accomplished by merely changing a few straps on the terminal strip. When repeat ringing is used the source of ringing power must be supplied. This line unit consists essentially of five relays to accomplish the ringing by-pass, one power failure relay, four 121-A Repeat Calls to terminate the line and balance network, and a jack field.

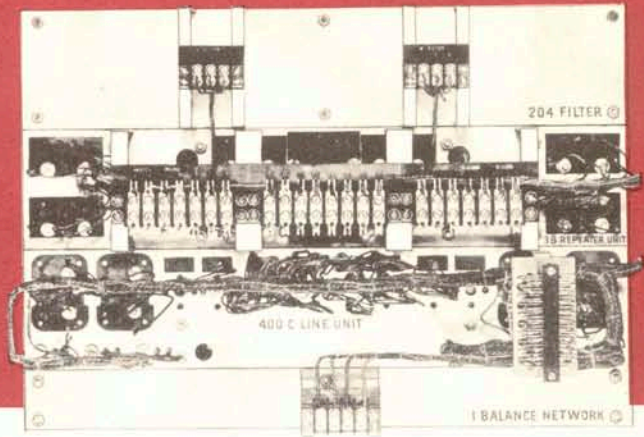
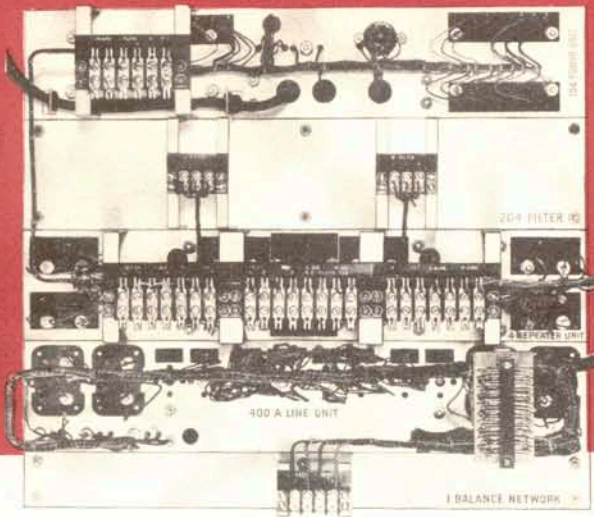
The 400 line unit is available in three different operating voltages, No. 400-A for 6 volts, No. 400-B for 24 volts, and No. 400-C for 48 volts. The 400-B line unit is used in connection with the No. 3A Repeater Unit when both are operated from the 24 volt central office battery. Similarly the 400-C Line Unit is used with the No. 3B Repeater Unit for 48 volt operation. The No. 400-A Unit is used with the No. 4 Repeater Unit (A.C. operated) and obtains the required 6 volts D.C. from a 6 volt Rectifier unit.

No. 401 Line Unit—The 401 Line Unit is a filter by-pass unit designed to by-pass all frequencies from 3 cycles to 150 cycles. It is used on railway dispatching circuits as well as for by-passing any signalling current within the specified frequency range. The principal components are 4 No. 121-A Repeat Coils to connect the repeater unit to the lines and the balance networks, the jack field, a low frequency band pass filter to by-pass the signalling current and a power failure relay. The power failure relay may obtain its operating voltage from either a 24 volt or 48 volt central office battery when used with a 3-A or 3-B Repeater Unit. When used with a No. 4 AC operator Repeater it may be operated on 200 V D.C. obtained from the Repeater Unit Power Supply.

The 401 Line Unit may be used on any phantom or simplex circuit although such circuits cannot be terminated at the repeater location.

No. 402 Line Unit—The No. 402 Line Unit is a filter by-pass unit designed to by-pass frequencies from 15 cycles to 150 cycles. It is a general purpose unit which may be used on any line, metallic or phantom, simplex or composite, and is arranged to terminate both simplex and composite circuits.

REAR VIEWS OF NO. 4 AND NO. 3 REPEATERS



With these exceptions the No. 402 Line Unit is the same as the No. 401 previously described.

No. 403 Line Unit—The No. 403 Line Unit is designed for use in circuits where the signalling is accomplished by means of a simplex or composite leg. Four 121-A Repeat coils, a power failure relay and a jack field are all of the components required for this unit.

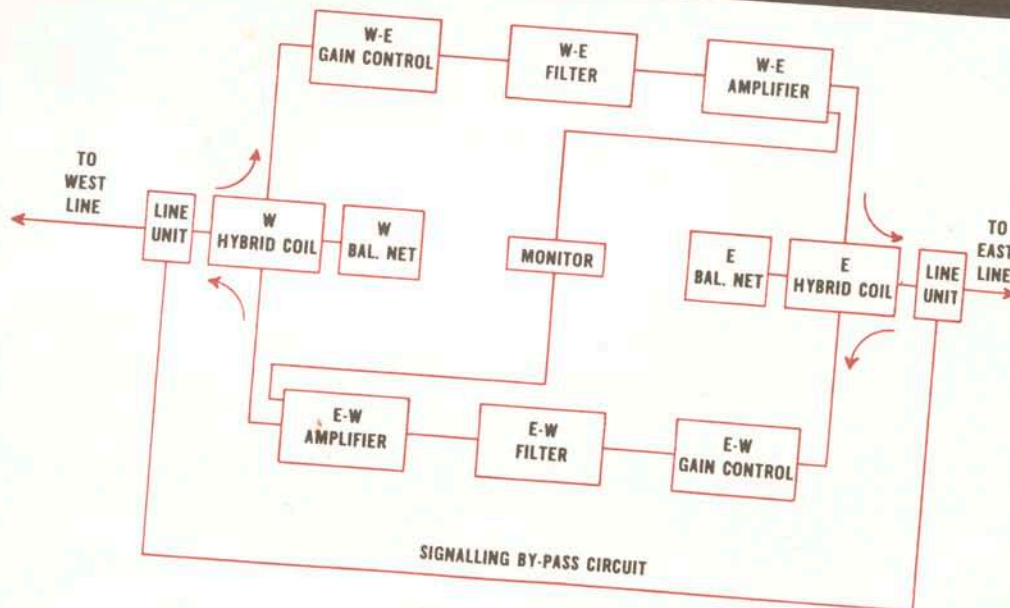
POWER UNIT

The No. 104 power unit, required only with the No. 4 voice repeater unit, supplies the proper plate and heater voltages for the amplifier tubes in the repeater unit. It operates directly

from the regular 110-120 volt, 50-60 cycle AC power or lighting circuit.

A 6X5GT/G full-wave rectifier tube and a choke input filter are used to obtain the 200 volt d-c plate supply. One unit is capable of supplying power for one to six repeaters. The power transformer is supplied with a tap switch to adjust for varying line supply voltages or varying loads occasioned by the use of more than one repeater on the same power supply unit.

The power unit is provided with local protection by a fuse in each side of the AC input supply. It is also equipped with a power failure relay wired to release the power failure relays in all associated line units. This relay may also be used to operate an alarm circuit.



Block Diagram
Of Kellogg #3A, #3B, and #4 Telephone Repeater

Frequency Response of
Kellogg Telephone Repeaters
#3A, #3B, and #4
Installed in an Average Toll Line



With 204 Filter

With 200 Filter

INSTALLATION

Kellogg Repeaters are shipped as completely assembled units ready for mounting on a standard 19" relay rack.

Interconnection of Line, Balancing Network, and Repeater Units is accomplished through flexible wire leads extending from the line unit cable form to clearly marked barrier-type screw terminal blocks. Other wiring includes leads from the power source to the repeater location, connections to the line, and, when required, connection to a 20 cy. ringing source.

After installation, the Kellogg Repeater can be rapidly balanced and adjusted for maximum gain through the simple adjustment of accurately calibrated dial controls on the balancing network and repeater units. The use of these calibrated dial controls eliminates strapping to control the gain of the repeater unit or the balance of the balancing network.

MAINTENANCE

Routine maintenance of Kellogg Repeaters is extremely simple and may be accomplished without turning down the circuit.

The condition of the vacuum tubes may be readily determined by measuring the plate current using a meter plugged in the Plate Jacks on the Repeater unit. "Singing Point" and monitoring tests are greatly simplified by the tests jacks provided in the line unit and by the calibrated gain and balance controls.

The only components of the Kellogg repeaters required as operating spares are the vacuum tubes. These were carefully selected from the Joint Army-Navy list of preferred tube types, assuring maximum protection against obsolescence.