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TELEPHONE AND TELEGRAPH CIRCUIT

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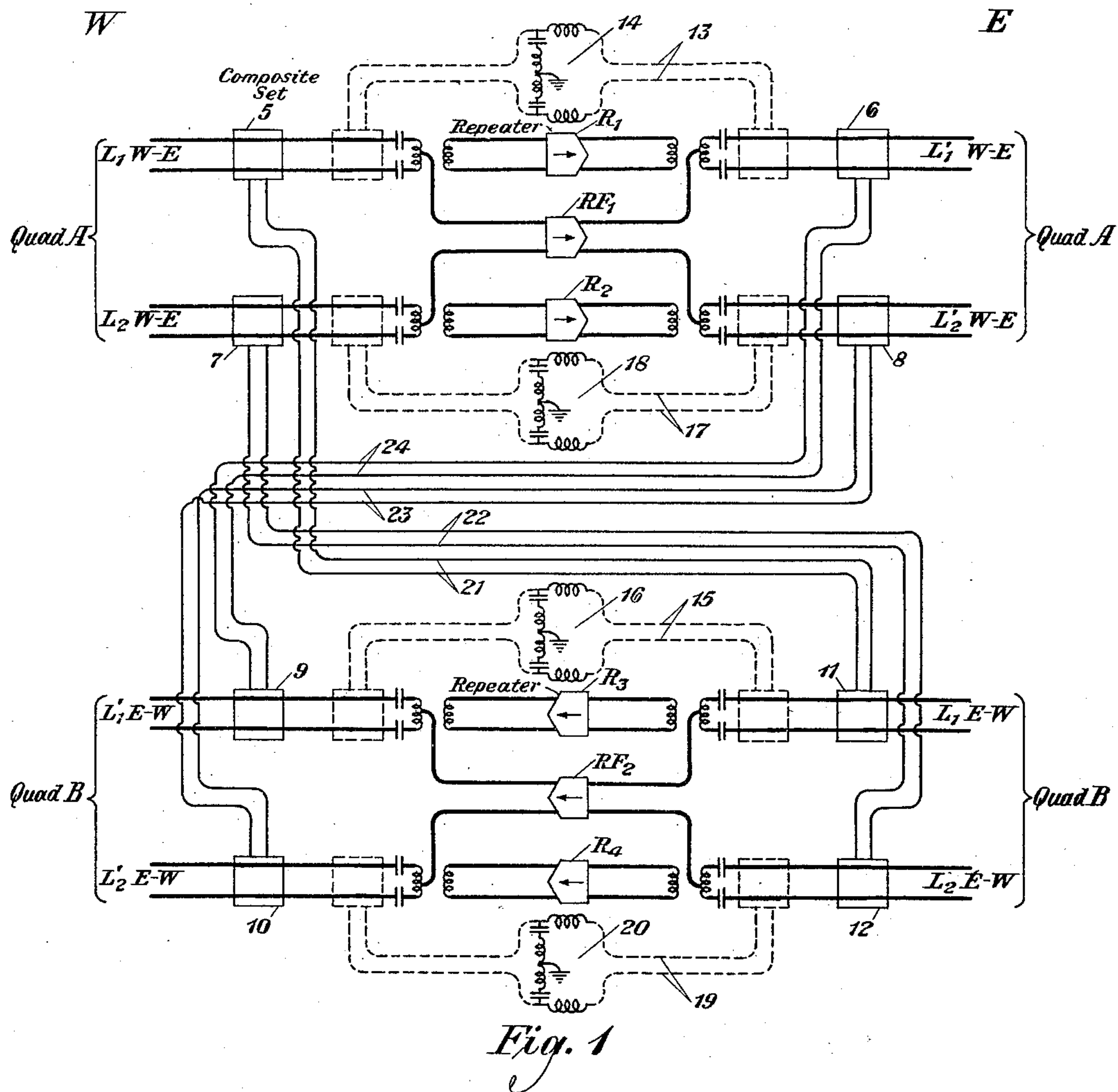


Fig. 1

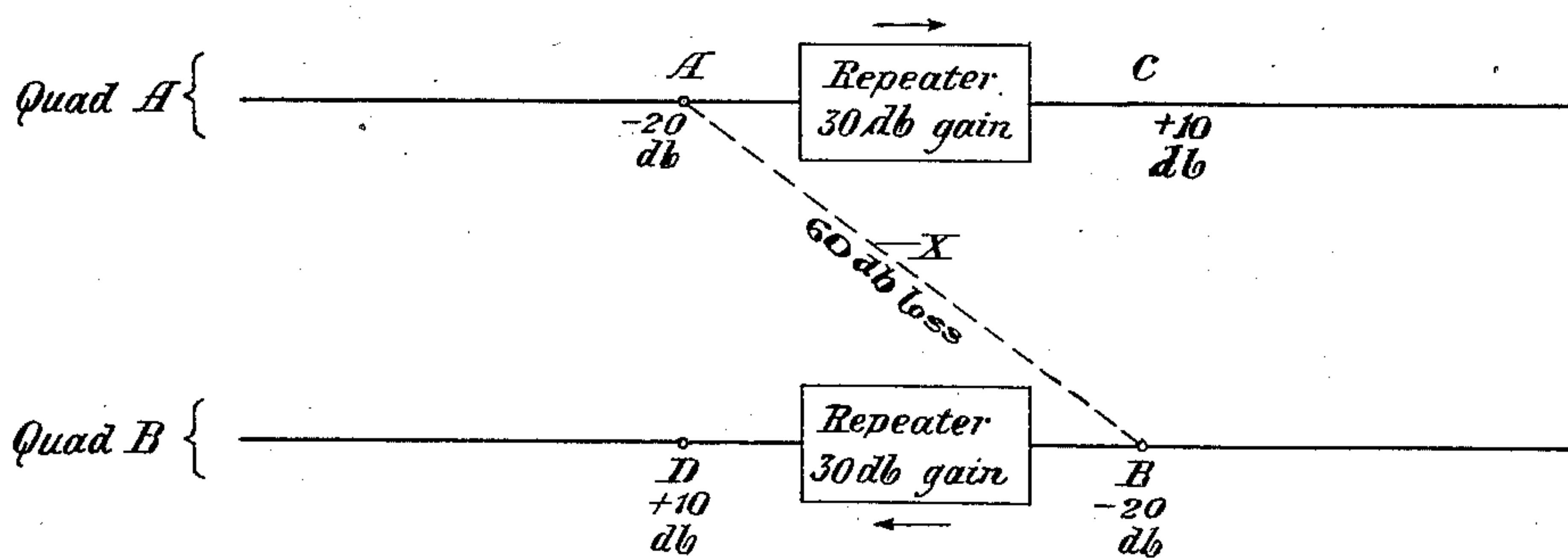


Fig. 2

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TELEPHONE AND TELEGRAPH CIRCUIT

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This invention relates to telephone systems of the well known four-wire type and more particularly to arrangements for utilizing the conductors of such systems for telegraph as well as telephone purposes.

The four-wire type of telephone system comprises two one-way line sections each for transmission in opposite directions. One-way repeaters would ordinarily be included in these one-way line sections at various points. Furthermore, two one-way line sections each transmitting in the same direction and being parts of different four-wire circuits might be arranged in quad relationship and a phantom telephone circuit produced from these two one-way line sections. When the conductors in the quads in such a system were composited for telegraph service as well as telephone service it would be necessary to provide at the repeater points by-pass circuits around the repeater elements. In such circuits would be provided an arrangement of inductance and capacity known as a by-pass set. This set would pass the currents used for telegraph purposes but would serve to prevent the telephone currents transmitted through the repeater from circulating back over the by-pass circuit to the repeater input to cause singing or change of the gain. Such systems are well known in the prior art.

It has been found that in furnishing certain types of telegraph service, such for example as high speed printing telegraph service, over the above types of systems, that the by-pass coils will adversely affect the telegraph service. Accordingly it is one of the primary objects of this invention to provide a novel arrangement of the telegraph conductors at a repeater point in such systems, whereby the by-pass coils may be omitted entirely and the telegraph service may be materially improved. In the arrangements of the invention a telegraph circuit is not connected from the one-way telephone circuit connected to the input of a repeater element to the telephone circuit connected to the output of said repeater, but the telegraph circuit is connected from the telephone circuit connected to the input of a repeater to the one-way telephone circuit of the same four-

wire line connected to the input of a repeater for transmission in the opposite direction. In accordance with the arrangements of this invention the points connected by the telegraph legs on the two pairs of conductors will be at approximately the same transmission level and any telephone energy which passes from one pair to another through the telegraph branches will cause no cross talk but only echo to a degree not materially undesirable. Accordingly the arrangements of the invention make it practicable to transfer a metallic telegraph circuit at an intermediate telephone repeater point from one pair of a four-wire circuit to the other pair without the use of a by-pass set. Further objects and features of the invention will appear more fully from the detailed description thereof hereinafter given.

The invention may be more fully understood from the following description, together with the accompanying drawing, in the Figures 1 and 2 of which the invention is illustrated. Fig. 1 is a circuit diagram illustrating a preferred embodiment of the invention. In Fig. 2 is illustrated schematically certain principles of operation of the invention. Similar reference characters have been utilized to denote like parts in both of the figures.

In Fig. 1 there is shown a portion of two four-wire telephone systems together with the telegraph connections of this invention. One of the four-way telephone circuits will comprise the one-way line comprising the section L_1 W—E interconnected by the repeater R_1 with the line section L'_1 W—E. The other side of this four-wire circuit will comprise the line section L_1 E—W connected by the repeater R_3 with the line section L'_1 E—W. The other four-wire circuit will comprise the line section L_2 W—E interconnected by the repeater R_2 with the line section L'_2 W—E. The other one-way section of this four-wire circuit will comprise the line section L_2 E—W interconnected by the repeater R_4 with the line section L'_2 E—W. The line sections L_1 W—E and L_2 W—E are arranged in quad relationship and are phantom to provide an additional circuit which

may be established through the repeater R—F₁ and thence over the line sections L'₁ W—E and L'₂ W—E. Line sections L₁ E—W and L₂ E—W are arranged in a different quad and are phantom-
 5 ed to provide an additional circuit which may be established through the repeater R—F₂ and thence over line sections L'₁ E—W and L'₂ E—W.

When the line sections L₁ W—E and L₂ W—E were to be utilized for telegraph purposes there might be provided, as indicated in the dotted lines, the circuit 13, including the by-pass set 14. This circuit and by-pass set
 10 would readily allow the transmission of certain types of telegraph currents from one line section to the other and would serve to prevent the telephone currents from being transmitted from the output of the repeater back to the input of the repeater to cause singing.
 15 In a similar manner the other line sections would be connected by the circuits such as 17, 15 and 19 which would include the by-pass sets 18, 16 and 20 respectively, and such arrangements have been indicated in dotted
 20 lines as they are old in the art. It has been found that in furnishing certain types of telegraph service, such for example as high speed printing telegraph service, that by-pass sets of this type will adversely affect the
 25 transmission of the telegraph signals. In accordance with the arrangements of this invention the metallic telegraph circuit utilizing line section L₁ W—E will be extended through the composite set 5 over the circuit
 30 21 through the composite set 11, and thence over the line section L₁ E—W. In other words, the metallic telegraph circuit at the intermediate telephone repeater point is transferred from one pair of a particular
 35 four-wire circuit to the other pair of said four-wire telephone circuit. In a similar manner circuit 22 would connect the composite set in line section L₂ W—E with the composite set 12 in line section L₂ E—W.
 40 Circuit 23 would connect line section L'₂ W—E with line section L'₂ E—W and circuit 24 would connect line section L'₁ W—E with line section L'₁ E—W. It is pointed out that in all of these telegraph circuits the
 45 by-pass sets may be omitted.

Any telephone energy coming in from line section L₁ W—E which might possibly be transmitted over circuit 21 would be transmitted through the repeater R₃ and thence
 50 over line section L'₁ E—W back to the subscriber, and would cause an echo effect. However, this energy would not cause any cross talk effect. In a similar manner the other telegraph circuits might cause echo ef-
 55 fects, but would not cause any cross talk effects. It has been found that the echo effects caused by such connections will not materially affect transmission.

In Fig. 2 the arrangements of Fig. 1 are
 60 shown schematically to illustrate why, in

accordance with the arrangements of this invention, the telegraph connections are established between points of approximately the same transmission level. Let it be assumed that at point A, which would be at the
 70 input of the repeater on one side of the four-wire circuit, the transmission level would be -20 db. In accordance with the arrangements of this invention, the telegraph connection would be established by
 75 a circuit such as X between the telegraph legs of the input composite sets on the two sides of the line. The loss through the composite sets and this connection increases with frequency and with a particular design
 80 commonly used is about 60 db at 300 cycles. The transmission level at points A and B, for purpose of illustration, might be approximately the same, namely -20 db. If we assume that the repeaters give a gain of
 85 30 db at 300 cycles, the transmission level at points C and D will be +10 db. The energy at this frequency, which might cause echo effects, would then be only at -50 db when it arrives at the point D. This would
 90 not cause serious echo effect. The above illustrates the way the arrangement works at one frequency. Though the repeater gain and the loss through the connection X vary with frequency, they may be so proportioned
 95 that excessive echo is not experienced at any frequency.

It will be seen that the omission of the by-pass sets will materially aid the transmission of the telegraph signals. Furthermore,
 100 when the connections are made between points of the same transmission level from one pair of a four-wire circuit to the other pair, as shown by this invention, no serious echo effects or cross talk will appear. While
 105 the arrangements of the invention have been shown as embodied in certain specific forms which are deemed desirable, it is understood that they are capable of embodiment in many and other widely varied forms without departing from the spirit of the invention as
 110 defined in the appended claims.

What is claimed is:

1. A four-wire telephone circuit comprising two one-way line sections for transmission in opposite directions, repeaters in said one-way line sections, and a telegraph circuit connected between said one-way line
 115 sections at the inputs of said repeaters.

2. A four-wire telephone circuit comprising two one-way line sections for transmission in opposite directions, repeaters in said one-way line sections, and a telegraph circuit connected between said one-way line
 120 sections at the outputs of said repeaters.

3. A four-wire telephone circuit comprising two one-way line sections for transmission in opposite directions, repeaters in said one-way line sections, and a telegraph circuit connected between said one-way line sec-
 125 130

tions at points thereon of about the same transmission level.

4. A four-wire telephone circuit comprising two one-way line sections for transmission in opposite directions, repeaters in said one-way line sections, a telegraph circuit connected between said one-way line sections at the inputs of said repeaters, and a second telegraph circuit connected between said one-way line sections at the outputs of said repeaters.

5. Two four-wire telephone circuits each having two one-way line sections with repeaters therein for transmission in opposite directions, the conductors of said one-way line sections for transmission in opposite directions being arranged in quads and phantom at repeater points for the production of additional circuits, and telegraph conductors connecting the one-way line sections of each of said four-wire circuits together at points thereon of approximately the same transmission level.

In testimony whereof I have signed my name to this specification this 26th day of September, 1929.

PAUL E. RITTER.