

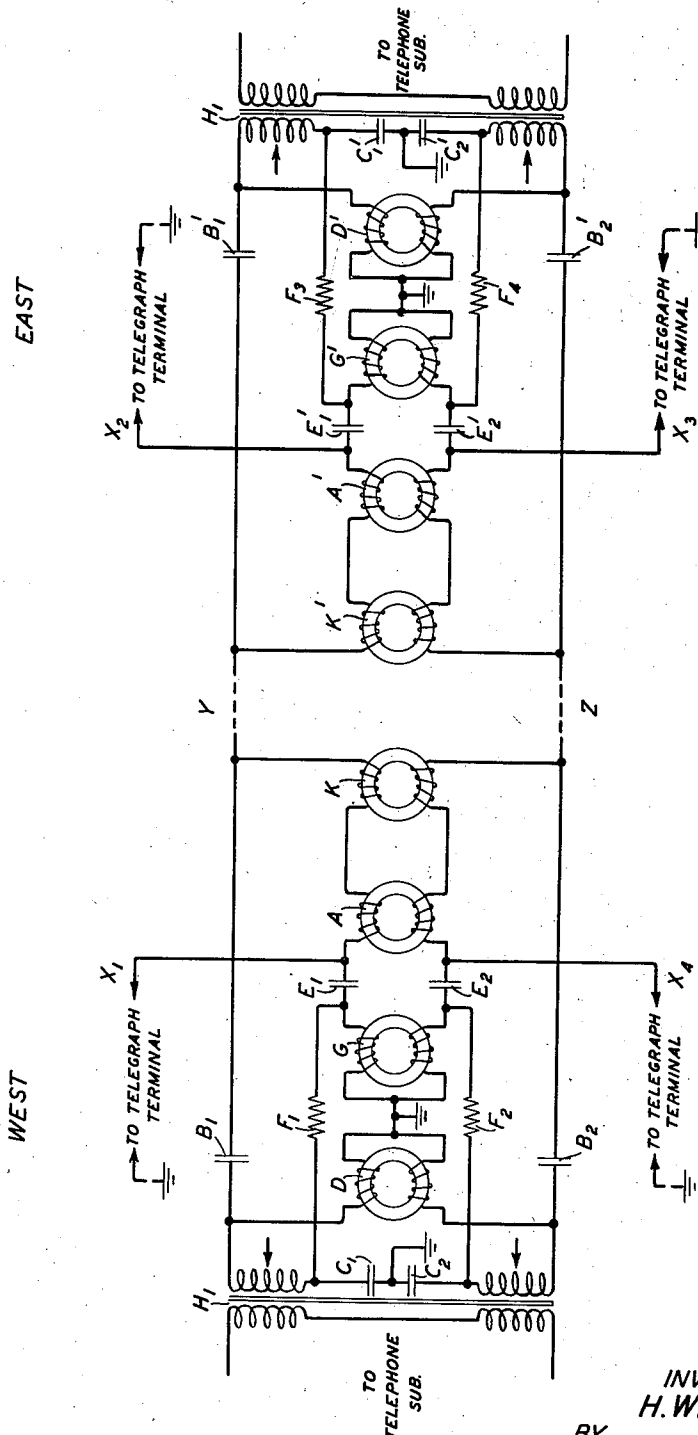
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COMPOSITE SET

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COMPOSITE SET

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This invention relates to multiplex signaling systems and more particularly to improvements in arrangements such as composite sets usually associated with the terminal facilities of the lines of such systems to permit the different currents utilized from interfering with each other.

In a signaling system in which both telephone and telegraph currents are transmitted over the line circuits thereof, it has been the practice to associate, with the terminal facilities of such line circuits, a device known as a composite set whereby the incoming telegraph and telephone currents may be separated and diverted to their respective circuits without interference with each other. The composite set furthermore functions to prevent outgoing telegraph currents from entering the telephone parts of the terminal facilities and vice versa.

It is the primary object of this invention to improve composite sets by providing novel means for preventing the telegraph current originating at the terminal of the line from entering the telephone circuit at the same terminal and thereby obviate any disturbances which might be caused in the telephone circuit by the telegraph signals coming into the terminal.

In accordance with the present invention the composite set makes use of a wave filter of the constant resistance type whose elements are computed by the method described in Patent 2,043,345, issued to S. Bobis, on June 9, 1936.

A clearer conception of the scope and purpose of the invention may be obtained from the following description and attached drawing, which shows a circuit arrangement for obtaining a Morse composite set exhibiting a substantially constant resistance over the greater part of the operating frequency range. The circuit elements of the set are connected to an ordinary telephone interoffice trunk and consist of retardation coils A, G, D and K, condensers B₁, B₂, C₁, C₂, E₁ and E₂, resistances F₁ and F₂, and repeating coil H₁, arranged in relation to each other as shown and located at one end of the interoffice trunk with similar elements similarly arranged at the other end of said trunk and both ends arranged for operation with a composite metallic telegraph circuit or two composite grounded telegraph circuits.

The path of the telegraph signal is as follows: The signal from any transmitting device capable of sending out telegraphic impulses reaches the composite set, say at X₁, flows through the upper coils A and K, thence through the line wire Y, through upper coils K' and A' at the far end of the line,

and thence to a telegraph receiving instrument at X₂. With a grounded telegraph system the return current is, of course, transmitted through the ground while with the metallic system in which the two conductors X₂ and X₃ would be joined at the telegraph sending and receiving apparatus at the east end of the line and the conductors X₁ and X₄ would be joined at the telegraph sending and receiving apparatus at the west end of the line, the return current flows again into the composite set at X₃, through lower coils A' and K', line Z, through lower coils A and K back to the metallic telegraph sender at X₄.

Simultaneously, telephone conversations originating at telephone station extending, say, from a telephone line connected to repeating coil H₁ on the west side of the line, enter the composite terminal through the repeating coil H₁ and are transmitted through condensers B₁, B₂ and C₁ over the line wires Y and Z as a two-wire metallic circuit, through condensers B₁', B₂' and C₁' C₂' at the far end, and repeating coil H₁' to a telephone station extending from a telephone line connected to the repeating coil H₁. Telegraph currents are prevented from interfering with this telephone conversation by the presence of condensers B, C and E at each end of the trunk, while retardation coils A and K, which provide a ready passage to the telegraph currents, exclude the telephone currents from the telegraph circuit. Coils D and G provide a by-pass to ground for any residual telegraph currents which may get through condensers B and E.

The theory of my substantially constant resistance Morse composite circuit is as follows: When the impedance of the subscriber's circuit, as seen through the interoffice trunks and office circuit, is substantially a resistance, which is the usual case in telephone practice, then the impedance measured across the line side of the repeating coils H₁ indicated by arrows will be substantially a resistance. If we substitute a resistance for the two windings of the repeating coil and make these resistances equal to resistances F₁ and F₂, the structure will be a balanced form of the constant resistance low-pass filter disclosed in the above mentioned patent to S. Bobis. If we set the critical or cut-off frequency of this low-pass filter at some frequency above the telegraph and below the telephone range, say at 80 cycles, and the image impedance is such as to match that of the line, then the constants of this circuit can be obtained by using the principles laid down in the above mentioned patent.

There are several features of my arrangement, however, which should be pointed out. If the telegraph arrangement is used as two grounded telegraph circuits each using one side of the line as shown in the drawing, then, in order to prevent cross-fire or interference between the telegraph circuits, there should be no mutual inductance between coils A and K. Separate cores for the two windings, however, would introduce unbalances in the telephone circuit inasmuch as the two cores would vary their inductances independently when telegraph circuits were passing through them, which would cause cross-talk or noise in the telephone circuit. Therefore, for grounded telegraph operation, coils A and K should be wound on two separate cores with the windings arranged in the same way as in the retard coil disclosed in Patent No. 1,762,744, granted to E. L. Schwartz et al on June 10, 1930.

The mutual inductance of repeating coil H₁ should be sufficiently high so as not to affect the impedance of the subscriber's line as viewed through the repeating coil. With the circuit arrangement shown, and with the element values determined as above noted, the circuit operates approximately as a balanced bridge, the impedance at the line side of the repeating coil H and the impedance of the telegraph terminals being conjugate arms of the bridge. This means that impulses entering the circuit through the telegraph legs X will cause no voltage to be impressed across the line windings of repeating coils H₁ on the same end of the circuit. The subscriber on the line connected to repeating coil H₁ on the west side of the line, for instance, will not be affected by the so-called "Morse thump" when telegraph impulses are sent out over telegraph legs X₁ and X₄. Likewise, the subscriber connected to repeating coil H₁ on the east side of the line will not be affected by the impulses sent out over telegraph legs X₂ and X₃. This balance, however, would not prevent the latter subscriber from receiving impulses from telegraph legs X₁ and X₄. Nevertheless, these impulses are attenuated materially by the line YZ and the filtering action of the composite sets, which is usually sufficient to prevent interference. The benefit of the bridge balance is to reduce noise in the telephone circuit by practically eliminating near end interference from the telegraph into the telephone circuit. The only condition necessary to maintain this balance is that the impedance of the line YZ and resistances F₁, F₂ in series, or resistances F₃ and F₄ in series, should be equal at telegraphic frequencies and their harmonics.

Another condition of balance would obtain if the telegraphic terminal impedance and the telephone subscriber's line impedance were equal. Under the latter condition, signals coming in over the line would not produce a difference in potential across resistances F. However, this condition has no advantage from the standpoint of discriminations between telephone and telegraph signals. Nevertheless, if the telephone and telegraph terminal impedance were made equal to the line impedance and also equal to the sum of the resistances F₁ and F₂, then this set would exhibit, in addition to its other advantages, a constant resistance impedance to the line at all frequencies, which is desirable in preventing echoes and singing in repeater circuits.

What is claimed is:

1. A transmission line, a connecting means serially included in said line, a telephone circuit

associated with said line through said connecting means, a composite set including a telegraph bridge across said line, telegraph legs associated with each side of said line circuit through said bridge, and means within said composite set for making its characteristic impedance substantially a constant pure resistance for the range of operating frequencies when said impedance is measured from the transmission line side.

2. A constant resistance composite network for separating telephone and telegraph currents comprising a telephone line circuit, grounded telegraph legs, a retardation coil system having a set of two cores with a plurality of coils disposed thereon, another set of two cores with a plurality of coils disposed thereon and having a common flux linkage and portions of their windings so poled so as to practically eliminate mutual couplings between the coils, condensers connected between the windings of said two sets of cores on the one side, condensers connected between the windings of said two sets of cores on the other side, resistances connected to one side of said first-mentioned condensers extending to said telephone line circuit and said grounded telegraph legs connected to the other side of said first-mentioned condensers.

3. A constant resistance composite network for separating telephone and telegraph currents comprising a telephone line circuit, a telegraph circuit, a retardation coil system having a common flux linkage comprising three cores with a plurality of coils disposed thereon, condensers intermediate the windings of a second core and a third core, condensers intermediate the windings of said first core and said third core, resistances connected to one side of said first-mentioned condensers extending to said telephone line circuit and said telegraph metallic circuit connected to the other side of said first-mentioned condensers.

4. A constant resistance composite network for separating telephone and telegraph currents having one set of opposite arms comprising a line circuit including a capacity on each side thereof and a balancing network, and another set of opposite arms comprising an inductance and a capacity respectively, each of the latter joined to each of the balancing networks, a telegraph leg connected to the junction point of each of said inductance and capacity, a telephone circuit connected to the junction point of said capacity in series with each of the arms of said line circuit, a retardation coil system bridged across the capacity side of said line circuit and grounded at its midpoint, and another retardation coil system bridged across the balancing network and grounded at its midpoint.

5. A line circuit, a constant resistance balancing network comprising a resistance, a capacity and inductance all in series on one side of the line, a similar resistance, capacity and an inductance all in series on the other side of the line, a retardation coil system bridged across side line circuit and another retardation coil system bridged across said condensers, all elements of said network being so arranged to form a bridge substantially balanced for all transmitting frequencies, and a telephone circuit and a telegraph circuit so associated with said elements as to be in conjugate relationship with each other and with said line circuit.

6. A constant resistance bridge substantially balanced for all transmitting frequencies having one set of opposite arms comprising a line cir-

5 cuit and a balancing network of a resistance element and a capacity element, and another set of opposite arms, comprising an inductance and a capacity, signaling circuits of different types connected to the opposite junction points of the arms of said bridge, a balanced retardation coil system connected between the resistance elements of said balancing networks and said inductances, and another balanced retardation coil system
10 connected between the capacity elements and resistance elements of said balancing network.

7. A transmission line and a composite set associated therewith, said composite set comprising a telephone circuit and a telegraph circuit so arranged as to be in conjugate relationship to each other and having the constants of said circuits so adjusted that the impedance presented to said circuits from said transmission line side will be substantially equal to a common pure resistance.

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