

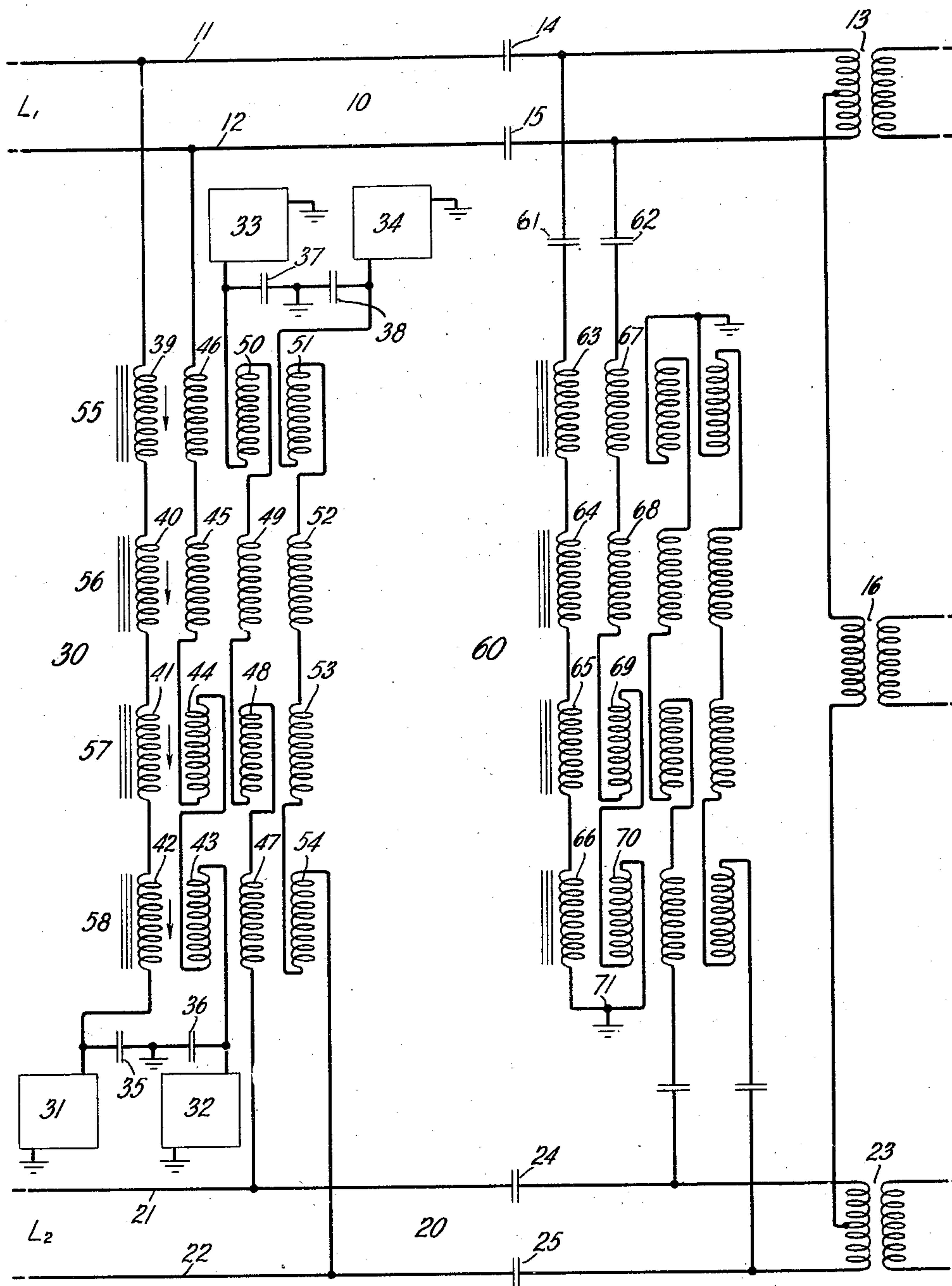
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RETARDATION COIL SYSTEM

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RETARDATION-COIL SYSTEM

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This invention relates to composite sets used in conjunction with superposing direct current signaling channels and telephone channels upon the same line circuits and especially to retardation coils used in conjunction with composite sets applied to phantom circuits.

In order to utilize the ordinary telephone circuit for the double purpose of speech transmission and transmission of direct current signals, such as telegraph or supervisory signals, it is necessary to provide some means at the terminals for separating the signals and directing them into their respective channels. A condenser is usually provided which excludes the direct current signals from the telephone repeating coils, while a coil of high impedance, or retardation coil is provided to prevent the passage of voice currents to the direct current signaling instruments.

Also to prevent cross fire, that is, one direct current instrument responding when a signal is being received by another, it is essential that there be no mutual inductance between the retardation coils. At the same time it is requisite that the inductance of the coils which are associated with each side of the telephone line be always balanced or equal; otherwise when two such telephone lines are used in a phantom circuit cross talk from the phantom to the side circuits would result.

The method of accomplishing the above result which is described in the copending application of Messrs. E. L. Schwartz and A. J. Williams, Serial No. 230,219, consists in providing two cores on which one-half of each retardation coil is placed poled in such a manner that there is no mutual coupling, while at the same time the inductance balance between the coils is maintained.

Whereas in the prior art the balancing has been confined to the individual side circuits it has been found that an unbalance between the branches of the phantom circuit is still

possible. For instance, if only one of the direct current circuits were in operation the retardation coils in one side circuit would have a different impedance from those in the other resulting in noise in the phantom circuit if both side circuits were exposed to some external voltage along the line.

Heretofore unbalancing of the phantom circuits was maintained within certain specified limits by the use of stable cores, thereby involving considerable expense.

One object of this invention therefore, is to maintain the impedance of the side circuits which form the branches of a phantom circuit balanced, when any or all of the direct current signaling circuits which are associated therewith are in operation.

Another object of the invention is to prevent noise currents from being induced in the phantom circuit as a result of external electric disturbances which might be in proximity to the lines somewhere along their length.

A feature of the invention resides in placing a portion of each coil on each of four cores and poling them in such a manner that a current through one coil will not induce voltages in any of the other coils.

Another feature of this invention resides in the use of cheaper cores since the requirement of core stability is abolished by virtue of all the retardation coils having balanced impedances when different currents are flowing in the direct current signaling circuits.

A better understanding of the invention may be had by reading the following description together with the accompanying drawing, the single figure of which shows a phantom circuit employing a composite set having retardation coil systems in accordance with the invention.

In the drawing, only the terminal apparatus of a Morse composited phantom circuit is shown for the sake of simplicity. The phantom circuit may be of any well known

type such as that shown in the U. S. patent to John Mills, 1,351,863 issued September 7, 1920. Lines L_1 and L_2 are the customary wire lines upon which the telephone and telegraph messages are superposed. The talking circuits 10 and 20 are each connected respectively to a winding of the repeating coils 13 and 23 by means of which the speech actuated elements are associated with the line. These circuits together with their associated lines are hereafter designated side circuits. As is customary in phantom circuits, leads are provided connecting the mid points of the side circuit repeating coil winding which are adjacent the lines to a winding of the phantom repeating coil 16. These connections must always be maintained at the electrical mid point of the coil for the proper operation of the phantom circuit. The other winding of the phantom repeating coil terminates in a speech actuated element similar to those associated with the side circuits. The speech actuated elements are not herein shown but may be a telephone transmitter and receiver of any well known design, or a telephone repeater as is customarily used for amplification purposes.

The composite set comprises the retardation coil systems 30 and 60 which are physical identical although serving different purposes, as will be hereafter described.

A Morse telegraph transmitting and receiving set is associated with each line wire of the side circuits through a coil of the retardation coil system 30. In order to direct telegraph signals and speech signals into their respective circuits, condensers 14 and 15 and 24 and 25 in circuits 10 and 20 are provided which exclude the direct current telegraph signals from the telephone repeating coils 13 and 23. The speech signals are in turn excluded from the telegraph sets 31, 32, 33 and 34 by means of a shunt path comprising the retardation coils which have high impedance to voice frequencies.

The shunt path for the side circuit 10 may be traced from the line wire 11 through the retardation coil windings 39, 40, 41 and 42, condensers 35 and 36 in series, the retardation coil windings 43, 44, 45 and 46 in the order named, back to the line wire 12. The shunt path for the side circuit 20 may be traced from the line 21 through the retardation coil windings 47, 48, 49 and 50 in series, condensers 37 and 38, the retardation coil windings 51, 52, 53 and 54 in the order named, to the line wire 22. These coils effectively block the passage of currents of speech frequencies, but have no effect on the direct current signals passing through to the telegraph instruments.

The retardation coil connected to each line wire comprises four windings in series, all of which have the same number of turns and are similar in all respects. All the coils have

one of their windings on each of the four magnetic cores 55, 56, 57 and 58. Thus the telegraph set 31 is connected to one side of the side circuit 10 through the coil which comprises the four windings 39, 40, 41 and 42 which are disposed respectively on cores 55, 56, 57 and 58. Similarly the connections of the other telegraph sets 32, 33 and 34 may be traced to the line wires 12, 21 and 22 of the side circuits 10 and 20 through their associated coils.

Since all the coils have a winding on each of the cores resulting in a common magnetic path therefor, it follows that any change in the inductance of one of the coils will be accompanied by a similar change of inductance in all the others. At the same time, however, that the inductance of the coils are maintained balanced there must be no mutual coupling between any of the coils, since should any be present, cross firing, or one telegraph instrument responding when a message is being transmitted to another, would result.

The mutual coupling between the coils is made zero or at least at a value, which for all practical purposes may be neglected, by the manner in which the windings which comprise the coils are poled on the cores or in the circuit.

As an example of one possible arrangement let it be assumed that the windings as shown are all wound in the same direction on their respective cores, starting from the same end.

If a direct current signal is being transmitted to the Morse set 31, its path may be traced thereto from the line wire 11, through the core windings 39, 40, 41 and 42 in the direction of the arrows. As this current builds up, a flux is established in the cores 55, 56, 57 and 58 which induces voltages in the other windings placed thereon in a direction opposite to the current, and since all the windings are wound upon the cores in the same direction, the induced voltages will likewise be in the same direction. But in order that these induced voltages have no effect upon the telegraph instrument associated with the respective coils, it is necessary that the windings of each coil be poled so that the resultant coil voltage is zero. Thus, in the coil comprising windings 43, 44, 45 and 46, two windings 43 and 44 are poled in one direction, whereas windings 45 and 46 are oppositely poled. Likewise, the coils associated with sets 33 and 34 must also have two windings poled in the same direction and two in the opposite direction to those in the coils associated with set 31. Arranged in this manner it may readily be observed that when the set 31 is in operation, the voltages induced in two windings of each of the other coils will balance and annul those induced in the other two windings of the same coil, thereby leaving the tele-

graph set associated therewith free of any disturbing effect.

It must be remembered that there must be an absence of cross-fire when a signal is traversing any of the coils. The specific arrangement of poling shown in the drawing will accomplish this result. But it must be understood that the invention is not to be limited only to this one arrangement, since specifically different winding arrangements will occur to those skilled in the art within the scope of this invention; the only requisite being that with respect to the windings of each specific coil, the other coils must have two windings similarly poled and two oppositely poled.

Further limitations for the successful operation of the invention are that the cores 55, 56, 57 and 58 must be similar and the windings thereof must have the same number of turns and be exactly alike in all other respects.

Almost any type of core may be successfully employed, the arrangement of windings to be used being dictated by ease and economy in manufacture. For instance, a toroidal core could be used having all the windings in one direction, the proper poling effect being obtained by the manner in which the windings are connected in the circuit. A shell type core could be used having its winding concentrically wound upon the center leg.

Whenever any of the Morse circuits are in operation the condenser for excluding the direct current signal from the repeating coil and which is associated with the circuit being used is intermittently charged at a low frequency of the order of, say, 20 cycles due to these telegraph signals. If this frequency were allowed to pass to the telephone repeating coil harmonics thereof would be generated in the coil, resulting in what is known as Morse thump, which would be audible in the telephone receivers. To prevent this a path to ground is provided from each of the lines 11, 12, 21 and 22 at a point between the above mentioned condensers and the repeating coils 13 or 23, as the case may be. The path to ground from line wire 11 may be traced through condenser 61 and the windings 63, 64, 65 and 66 of the retardation coil, while the path from line wire 12 is traced through condenser 62 and the windings 67, 68, 69 and 70, which comprise a second retardation coil. These two retardation coils are connected together and grounded at the point 71. Corresponding circuits are provided for lines 21 and 22. These paths readily drain the condensers 14, 15, 24 and 25 of charges resulting from the operation of the Morse circuits. The four retardation coils thus provided comprise a system similar in all respects to that used for separating the voice frequencies from the telegraph transmitting and receiving sets. If any or all of the Morse legs are in operation the draining of these condensers

through the respective retardation coils does not disturb the balance of the phantom circuit, as will readily be appreciated from the description of the operation of the coil system 30 already described.

As the inductance of the retardation coils of both side circuits are balanced under all conditions, it follows that not only will the impedance of both sides of the side circuits be balanced for all frequencies traversing the side circuits, but also both sides of the phantom circuit will present the same impedance to currents of different frequencies transmitted over the phantom circuit. Thus, the possibility of cross talk from the phantom to the side circuits due to unbalance in these coils is effectively prevented.

The necessity of using expensive stable cores to maintain the unbalance of the phantom circuit within certain prescribed limits is also obviated since by the invention both sides of the phantom are inherently balanced.

Although the invention has been described with respect to a specific embodiment thereof, it may be used in any part of the phantom circuit wherever the desirability of separating the voice from a direct current signal is presented. It is understood that the invention is to be limited only by the scope of the appended claims.

What is claimed is:

1. In a phantom telephone system, a pair of side circuits, means for simultaneously superposing alternating current signals and direct current signals on said circuits, and means to aid in separating said signals comprising a retardation coil associated with each line wire of each side circuit, said retardation coils each having portions of their windings disposed on a plurality of common cores to produce the same flux linkage for changes of current in any of said coils, the windings on certain of said cores being reversed to neutralize inductive coupling between the coils.

2. In a phantom telephone system, a pair of side circuits, adapted for the simultaneous transmission of alternating current signals and direct current signals, separate terminal apparatus responsive to said alternating current signals and said direct current signals, means to aid in directing said signals into their respective terminal apparatus, said means comprising a retardation coil connected to each line wire of each side circuit, a plurality of cores common to said coils, said cores having windings from each coil disposed on them, certain of said windings being reversed to neutralize the inductive coupling of said coils.

3. In a phantom telephone system a pair of side circuits having terminal apparatus associated therewith, means for simultaneously superposing alternating current signals and direct current signals upon said cir-

cuits, and means to aid in directing said signals into their respective terminal apparatus, said means comprising four retardation coils and four cores, said coils each comprising four windings, each one of said windings being disposed on one of said cores and poled in such a manner that there is negligible coupling between any of the coils.

4. In a signaling system adapted for the simultaneous transmission of telephone and telegraph signals the combination with a pair of side circuits, a plurality of terminal telephone circuits, and a plurality of telegraph circuits of a composite set for directing the telephone and telegraph signals into their respective circuits, said composite set comprising a coil for associating one of said telegraph circuits with each line wire of said circuits, and means comprising cores common to said coils for producing a change of inductance in all of said coils corresponding to a change of inductance in any one of them, said coils having portions of their windings reversed to neutralize the potentials generated in said coils.

5. In a signaling system adapted for the simultaneous transmission of telephone and telegraph signals the combination with a pair of side circuits, and terminal telephone and telegraph circuits of a composite set for directing the telephone and telegraph signals into their respective circuits, said composite set comprising a pair of retardation coils serially bridged across each of said side circuits, said coils having windings disposed equally on a plurality of cores such that the flux paths of all of the coils are common, said windings being poled so that the resultant voltage induced in any of the coils due to a voltage impressed on any of the others is negligible.

6. In a signaling system adapted for the simultaneous transmission of telephone and telegraph signals the combination with a pair of side circuits adapted for phantom operation of terminal telephone and telegraph circuits, of a composite set for directing the signals into their respective channels, said composite set comprising a pair of retardation coils serially bridged across each of said side circuits, said coils having windings disposed equally on four cores such that the flux paths of all the coils are common, said windings being poled so that the voltage induced in any of the coils due to a voltage impressed upon any of the others is negligible.

7. In a signaling system adapted for the simultaneous transmission of telephone and telegraph signals, the combination with a pair of side circuits and telephone and telegraph circuits of a composite set for directing the telephone and telegraph signals into their respective circuits, said composite set comprising a coil having a plurality of windings for associating one of said telegraph

circuits with each line wire of said side circuits, and means for equalizing the inductance of all of said coils when any of them are traversed by signal current, said means comprising a winding from each coil upon a core common to all of said coils, said coil windings being poled with respect to each other so that the resultant voltage induced in any of said coils with said inductance change is negligible.

In witness whereof, I hereunto subscribe my name this 24th day of January, 1928.

HORACE WHITTLE.