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M. E. STRIEBY

CARRIER TRANSMISSION OVER POWER CIRCUITS

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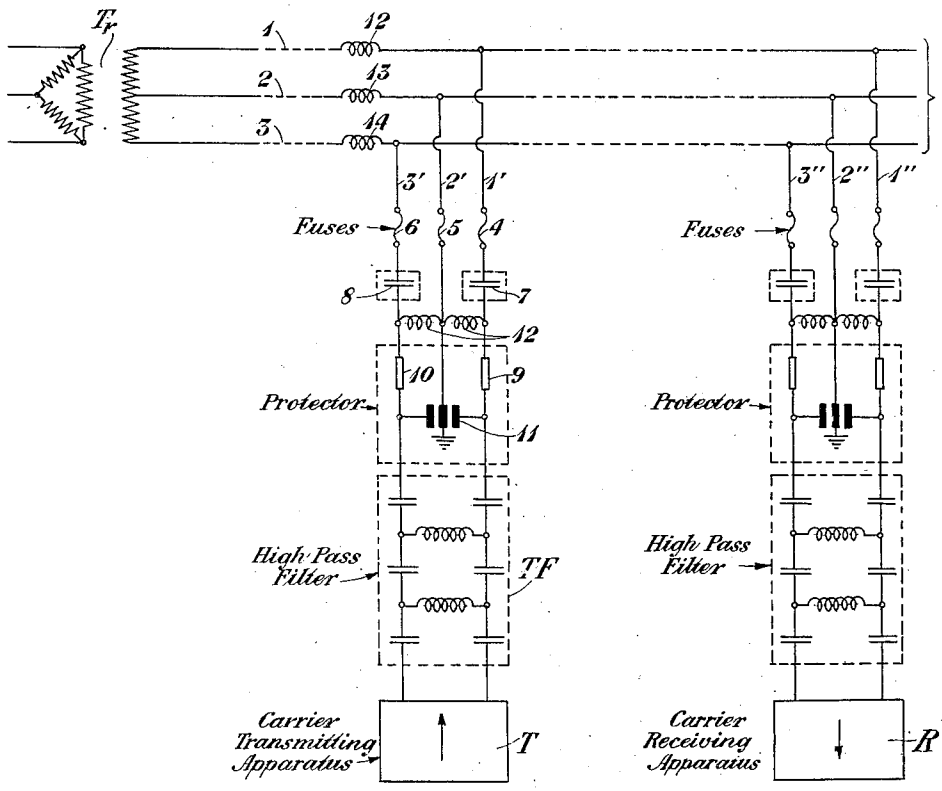

INVENTOR

M. E. Strieby

BY

ATTORNEY

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MAURICE E. STRIEBY, OF MILLBURN, NEW JERSEY, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

CARRIER TRANSMISSION OVER POWER CIRCUITS.

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To all whom it may concern:

Be it known that I, MAURICE E. STRIEBY, residing at Millburn, in the county of Essex and State of New Jersey, have invented certain Improvements in Carrier Transmission Over Power Circuits, of which the following is a specification.

This invention relates to the use of power circuits for the transmission of signaling currents, and more particularly to arrangements whereby carrier transmission channels may be capacitatively related to the conductors of a power system.

In accordance with the present invention, a carrier channel is conductively connected to the conductors of a power circuit in such a manner that the carrier apparatus will be protected from the high voltages impressed upon the power conductors. The conductive connection is preferably obtained through a capacity coupling, the condensers forming the coupling being so designed as to offer a very large impedance at the relatively low frequencies employed in power transmission but being mechanically constructed so as to withstand the high voltages of the power conductors. Between the condensers and the carrier apparatus an inductive shunt is connected across the carrier conductors to form a low impedance path for the low frequency currents employed in power transmission so that any current of power frequency passing through the condenser will be by-passed through the low impedance path. Preferably the inductance of the low impedance path and the capacity of the condensers will be so proportioned with respect to the frequency used for carrier transmission that these elements will constitute the first section of a high-pass filter included in the carrier circuit to separate the power frequencies from the carrier frequencies.

The invention will now be more fully understood from the following detailed description thereof when read in connection with the accompanying drawing, the figure of which illustrates an embodiment of the invention.

Referring to Figure 1, T_r designates a two-phase transformer of the type ordinarily employed in power transmission, the windings of the transformer being connected in the usual manner to the power conductors 1, 2 and 3. In order to superpose a carrier transmitting channel upon the power conductors, branch conductors 1′, 2′ and 3′ are provided. Suitable fuses of the well known type are indicated at 4, 5 and 6 for protecting the carrier apparatus which may be associated with these conductors. The carrier can be connected to any two of the three conductors. In the sketch connection is made to conductors 1′ and 3′. Coupling capacities 7 and 8 are included in the connections.

These capacities comprise condensers which are so constructed as to withstand the high voltages of the low frequency power transmission currents which are impressed upon the conductors 1, 2 and 3, and the capacities of these condensers are so proportioned that they will form elements of a high-pass filter as hereinafter described. In order to withstand the high voltages, the plates of the condensers have a wide separation, and special dielectric materials are employed in a manner well known in the art. In order that the desired capacity may be obtained, it therefore becomes necessary to make the elements of the condensers mechanically quite large as compared with the type of condenser ordinarily employed in signaling circuits. Below the condensers 7 and 8 protectors of a type well known in the art are employed, these protectors comprising fuses 9 and 10 included in the conductors 1′ and 3′ and the usual carbon block type of lightning protector 11. The outer terminals of the device 11 are connected to the conductors 1′ and 3′ while the third conductor 2′ is connected to ground through the third terminal of the device 11 in order to balance the circuit to ground.

A high-pass filter TF is included between the carrier apparatus T and the power conductors as indicated. This filter, which is preferably of the well known Campbell type, may comprise a number of sections each including series capacity and shunt inductance. A shunt inductance 12 is also connected between the conductors 1′ and 3′ between the condensers 7 and 8 and the protector. This inductance is primarily for the purpose of by-passing power currents transmitted through the condensers 7 and 8 thereby protecting the carrier apparatus from these currents. Accordingly the resistance

of the inductance 12 is made very low so that the shunt path offers a very low impedance to the low frequency power currents which ordinarily have a frequency of about 60 cycles. The inductance of the shunt 12 and the capacities of the condensers 7 and 8 are so proportioned that at the carrier frequency these elements may form the first section of the high-pass filter TF.

Let us assume that the power currents have a frequency of 60 cycles and that the voltage impressed upon the power conductors is 2700 volts. The condensers 7 and 8, because of the large separation between their plates and the efficient dielectrics employed, will withstand these high voltages without breaking down and arcing between the plates, and their impedance at the power frequency will be so large that only a very small current of the power frequency flows through them. For example, the normal current flow of power frequency through these condensers and across the shunt 12 may be in the neighborhood of one-tenth of an ampere. If the impedance of the coil 12 at 60 cycles is 5 ohms, the voltage drop across the terminals of the inductance 12 will only be one-half a volt. Consequently the voltage across the terminals of the high-pass filter TF will only be one-half of a volt, and the signaling conductors will consequently not be exposed to the high voltages transmitted over the power conductors.

Suppose, now, one of the condensers, for example, the condenser 8, breaks down so that it is, in effect, short-circuited, the 60 cycle power current at once begins to build up in the by-pass through the inductance 12. In order to protect the carrier circuit, the fuses, such as 4 and 6, are designed to blow as soon as the current builds up to a value materially higher than that normally permitted to flow through the inductance 12. For example, these fuses may be made to blow as soon as the current reaches a value of 3 amperes. A current flow of 3 amperes through the inductance 12 will be equivalent to a voltage drop across its terminals of only 15 volts at the 60 cycle frequency, and as this is below the maximum voltage which can be impressed upon the carrier conductors at the power frequency, no harm can occur in the carrier apparatus. The inductance 12 should be so designed as to carry a somewhat larger current than that at which the fuses 4 and 6 break down. For example, if the fuses are designed to blow at 3 amperes, the inductance 12 might be designed to carry 5 amperes. Even for a current flow of 5 amperes the voltage drop across the terminals of the inductance 12 would only be 25 volts at the power frequency, and this would be a safe voltage for the carrier apparatus. If through any fault in the fuses 4 and 6 a greater voltage than this should appear across the terminals of the inductance 12, the fuses 9 and 10 of the protector will become effective and prevent damage to the carrier apparatus.

The apparatus for connecting a carrier receiving channel to the power conductors, as indicated at the right of the diagram, will be similar to that already described, and its operation will be the same, so that no detailed discussion thereof is necessary. If desired, the choke coils 13, 14 and 15 may be included in the power conductors between the carrier transmitting terminals and the generator to prevent the carrier currents from being transmitted to the generator.

It will be obvious that the general principles herein disclosed may be embodied in many other organizations widely different from those illustrated without departing from the spirit and scope of the invention as defined in the following claims.

What is claimed is:

1. In a system for signaling over power conductors, a power source, power conductors for transmitting power from said source to a load, carrier apparatus, means for coupling said carrier apparatus to said power conductors comprising condensers so designed mechanically as to withstand high voltages, a high-pass filter for preventing the transmission of power frequencies and harmonics thereof to the carrier apparatus, the capacity of said condensers at the carrier frequencies being such that said condensers may constitute elements of said filter.

2. In a system for signaling over power conductors, a power source, power conductors for transmitting power from said source to a load, carrier apparatus, means for coupling said carrier apparatus to said power conductors comprising condensers so designed mechanically as to withstand high voltages, said condensers being included in the carrier conductors, a shunt inductance bridged across said carrier conductors, said inductance constituting a low impedance by-pass for the relatively small currents of power frequencies transmitted through said condensers, a high-pass filter included in said carrier circuit to prevent the transmission of power frequencies and harmonics thereof to the carrier apparatus, the capacity of said condensers at the carrier frequency being such and the inductance of said by-pass at the carrier frequency being such that said elements may constitute a section of said filter.

3. In a system for signaling over power conductors, a power source, power conductors for transmitting power from said source to a load, carrier apparatus, means for coupling said carrier apparatus to said power conductors comprising condensers so designed mechanically as to withstand high voltages, said condensers being included in

the carrier conductors, a shunt inductance bridged across said carrier conductors, said inductance constituting a low impedance by-pass for the relatively small currents of power frequencies transmitted through said condensers, a high-pass filter included in said carrier circuit to prevent the transmission of power frequencies and harmonics thereof to the carrier apparatus, the capacity of said condensers at the carrier frequency being such and the inductance of said by-pass at the carrier frequency being such that said elements may constitute a section of said filter, and fuses included in the carrier conductors between said condensers and the power conductors, said fuses being so designed as to open said conductors upon one of the condensers breaking down, before the current builds up in said by-pass to produce a greater voltage drop across its terminals than that which the carrier apparatus is designed to withstand.

4. In a system for signaling over power conductors, a power source, power conductors for transmitting power from said source to a load, carrier apparatus, means for coupling said carrier apparatus to said power conductors comprising condensers so designed mechanically as to withstand high power voltages, said condensers being included in the carrier conductors, a shunt inductance bridged across said carrier conductors, said inductance constituting a low impedance by-pass for the relatively small currents of power frequencies transmitted through said condensers, a high-pass filter included in said carrier circuit to prevent the transmission of power frequencies and harmonics thereof to the carrier apparatus, the capacity of said condensers at the carrier frequency being such and the inductance of said by-pass at the carrier frequency being such that said elements may constitute a section of said filter, fuses included in the carrier conductors between said condensers and the power conductors, said fuses being so designed as to open said conductors, upon one of the condensers breaking down, before the current builds up in said by-pass to produce a greater voltage drop across its terminals than that which the carrier apparatus is designed to withstand, and fuses included in the carrier conductors between said by-pass and the succeeding section of the high-pass filter designed to blow if the voltage drop across said by-pass should become greater than the maximum voltage which it is desired to impress across the terminals of the carrier apparatus.

5. In combination, a power transmission line, a high frequency wave translating system, and a broad band filter, said filter comprising a group of impedance elements adapted to withstand the normal voltage of said power line and a second group of impedance elements adapted to withstand the lower voltages of signal transmission.

6. In combination, a power transmission line, a high frequency wave translating system, and a broad band filter, said filter comprising a plurality of impedance elements and being terminated at one end in series elements adapted to withstand the normal voltage of said power line, the others of said elements being adapted to withstand the lower voltages of signal transmission.

7. In combination, a power transmission line, a high frequency wave translating system, and a broad band filter, said filter comprising a plurality of sections each including series and shunt impedance elements, and being terminated at one end in a series termination, said series termination including a condenser adapted to withstand high voltage and the others of said impedance elements being adapted to withstand the lower voltages of signal transmission.

8. In combination, a power transmission line, a high frequency wave translating system, and a broad band filter, said filter comprising a group of impedance elements including series elements adapted to withstand high voltages, a second group of elements adapted to withstand the lower voltages of signal transmission, and a voltage operated protective device, said protective device being connected between said groups and being adapted to protect the elements of said second group.

9. In combination, a power line, a source of high frequency waves, and means for impressing upon said power line high frequency waves derived from said source, said means comprising a network of impedance elements including series condensers adapted to withstand the normal voltage of said power line, and a second network connected thereto comprising impedance elements adapted to withstand the lower voltages of said high frequency source, the elements of said networks being arranged to cooperate with each other to constitute a broad band filter.

10. A broad band filter comprising impedance elements adapted to the low voltages of speech transmission, and terminal impedance elements adapted to withstand the normal voltages of power transmission.

11. A broad band filter comprising impedance elements adapted to the low voltages of speech transmission, and terminal condensers adapted to withstand the voltages of high voltage power transmission and including voltage operated protective devices.

12. A broad band filter comprising a plurality of sections each including series and shunt impedance elements, and being terminated at one end in a series termination, said series termination including a con-

denser adapted to withstand high voltage and the others of said impedance elements being adapted to withstand lower voltages.

13. A broad band filter comprising a group of impedance elements including series elements adapted to withstand high voltages, a second group of elements adapted to withstand lower voltages, and a voltage operated protective device, said protective device being connected between said groups and being adapted to protect the elements of said second group.

In testimony whereof, I have signed my name to this specification this 26th day of April 1924.

MAURICE E. STRIEBY.