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1,808,540

SIGNALING SYSTEM

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Fig. 1

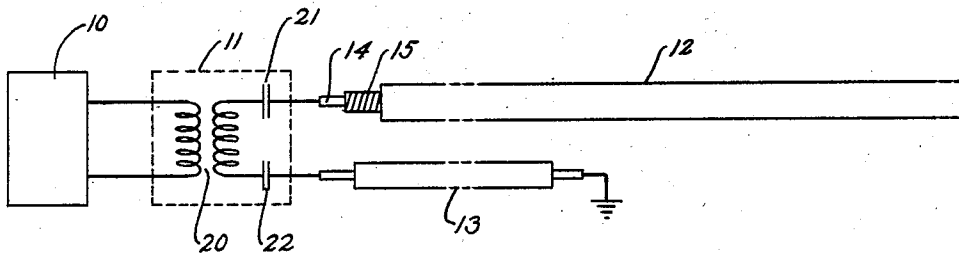
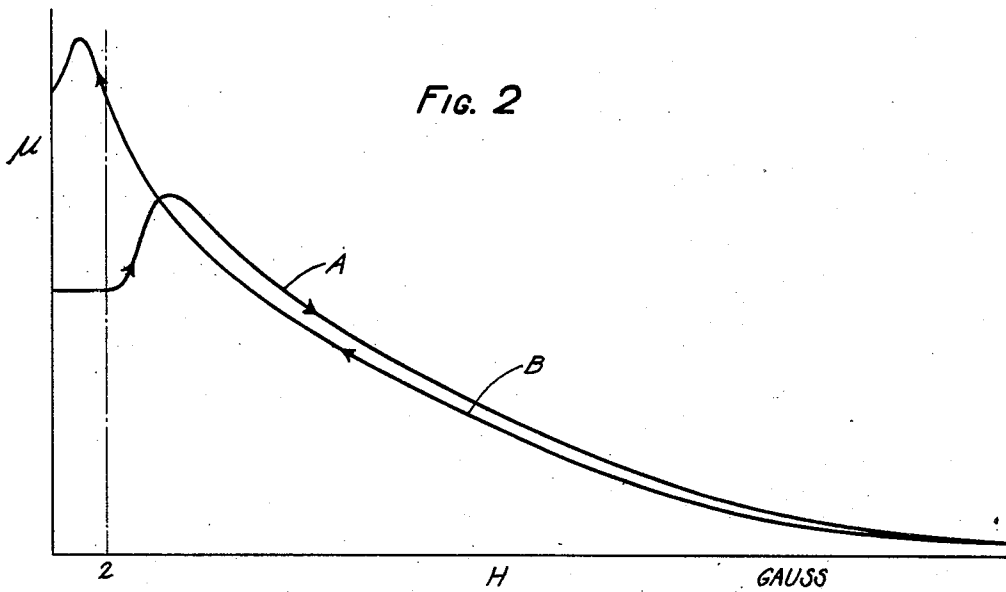


Fig. 2



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SIGNALING SYSTEM

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This invention relates to signaling systems and more particularly to such systems in which the signaling line constitutes a continuously loaded conductor.

5 In systems of this type, where the transmission line is of considerable length, such as 500 miles or more and which are operated with ground or sea return, it has been observed that earth currents may arise in the line conductor with considerable strength. Such currents may be induced into the line conductor through its capacity to ground or sea, as the case may be, and will flow along the line conductor to the point where 15 this conductor is grounded. These currents are of a very low frequency, ordinarily below one or two cycles per second. It is evident that when the point in the earth, at which the potential rise occurs which is the cause of such currents, is comparatively close to the line terminal, the currents may become quite heavy since the resistance to the nearest ground is comparatively low.

20 It has lately been found advantageous to use for the loading material on long transmission lines, magnetic alloys which, at the low magnetizing forces produced by the signaling currents, have a substantially constant permeability and hardly measurable hysteresis losses. One such material comprises an alloy of iron, nickel and cobalt which, when properly heat treated and in the proper proportions, has the desired properties referred to above. It has been 35 found that the properties of such loading materials may be seriously impaired when the material is subjected to magnetizing forces beyond the range within which those properties ordinarily prevail.

40 An object of the invention is to provide a signaling system using a long continuously loaded signaling conductor and earth return in which the conductor is loaded with magnetic material such as described above and in which the disturbing currents, such as earth currents, are reduced to such an extent that the loading material will not be deleteriously affected by them.

50 In accordance with the invention a network is provided at the terminal end of the

signaling line, the impedance of which is such that signaling currents may be passed without appreciable attenuation, whereas disturbing currents of lower frequencies than those of the signaling currents are greatly attenuated.

In the accompanying drawings Fig. 1 is a simplified diagram of a signaling system arranged in accordance with the invention, and

Fig. 2 is a graph showing the variations with the magnetizing force of the permeability of a loading material used in accordance with the invention.

The invention will now be described in connection with a submarine telegraph system such as shown in a simplified form in Fig. 1. In this figure 10 represents a terminal equipment which may be arranged for either transmission or reception of signals or for both. The equipment 10 is connected through a network 11 to a submarine cable 12 of considerable length, one end only of which is shown, and to a sea earth return 13. The sea earth return 13 may be a separate cable or may be built into the cable 12 for the desired distance. The cable 12 comprises a central conductor 14 surrounded by a layer 15 of loading material, which may be in the form of a helical wrapping of wire or tape or in any other desired form. The loading material 15 may be an alloy comprising nickel, iron and cobalt in proportions and produced in accordance with the disclosure in a copending patent application to G. W. Elmen, Serial No. 119,623, filed June 30, 1926 and which has issued as Patent 1,715,647 on June 4, 1929, or as disclosed in a copending patent application to G. W. Elmen, Serial No. 220,387, filed September 19, 1927 and which has issued as Patent 1,715,541 on June 4, 1929, in accordance with which other ingredients, such as molybdenum and manganese, are added to the main ingredients.

In accordance with these disclosures certain of the alloys described have a constant permeability for magnetizing forces up to about 4 gauss. The constancy of permeability in several other of the alloys disclosed

is not maintained beyond one or two gauss.

When a cable of this type is connected through a metallic circuit to ground at its terminal, disturbing currents will flow in the conductor due to variations in potential difference between the grounded conductor and the sea water at the ocean bottom. Such earth currents may assume considerable magnitudes, especially when the point of potential rise is comparatively near to the terminal of the cable, in which case the comparatively weak signaling currents may be considered as being superimposed upon the strong low frequency current. As has been described in the copending application, Serial No. 220,387, referred to above, particularly in connection with Fig. 24 of that application, such a condition is detrimental to those properties of the loading material which are desirable for the efficient operation of the cable. The condition is illustrated graphically in Fig. 2 in which the abscissae represent the magnetizing force exerted by the superimposed signaling and earth currents in the conductor, and the ordinates represent the corresponding permeabilities of the loading material. From this graph it will be observed that the permeability remains constant for magnetizing forces up to about two gauss, and it has been found that this fixed permeability will prevail as long as the magnetizing force is varied below this limit. However, when the disturbing current increases beyond this limit the permeability is no longer constant but varies in accordance with the branch A of the graph until the disturbing current has reached its maximum. Then as this current recedes the permeability varies in accordance with branch B of the curve and attains a greatly increased value when the magnetizing force reaches below two gauss, at the same time as it loses its constancy below that value. It is evident that the characteristics of the cable are changed by such excessive magnetization and that the loss of constancy of the permeability results in serious distortion of the signaling current, which is particularly detrimental in the case of telephonic communication. Several methods have been proposed whereby the virgin condition of the loading material may be restored, but such methods involve the use either of automatically operated equipment or constant vigilance on the part of the station attendant.

In the preferred embodiment shown in Fig. 1 the rise of the earth currents to values, at which the magnetizing force will exceed the range within which the permeability remains constant, is prevented by the insertion of the network 11. This network may be built in various ways but in accordance with the system illustrated it comprises a transformer coupling 20 between the ter-

minal equipment 10 and the cables 12 and 13. Condensers 21 and 22 are connected in the cable side of this transformer in such a manner as not to disturb the balanced condition of the system. By properly dimensioning the condensers and the transformer, in a well known manner, the impedance of this network presented to the earth currents and at the frequency of those currents may be given a sufficiently high value to reduce the intensity of these currents in the desired degree.

It should be understood that a similar network may be introduced at the other terminal of the cable, which is not shown, to protect the other end of the cable in a similar manner and for a similar purpose.

A form which the network may assume is that of a high pass filter suppressing all frequencies below a certain range and passing all frequencies above that range with a practically negligible attenuation. For telephony, where the lower frequencies below a few hundred cycles are not utilized, the filter may suppress all frequencies up to or almost up to the utilized range.

What is claimed is:

1. A continuously loaded signaling conductor having a magnetic loading with a desired magnetic property which is impaired by disturbing current impulses in said conductor excessively strong as compared with signaling current impulses and a network associated with a terminal of said cable for passing signaling current impulses and having a high impedance to disturbing current impulses of frequencies below those of the signaling current impulses said impedance being high enough to prevent the impairment of said magnetic property by said disturbing impulses.

2. A continuously loaded signaling conductor in which the loading material has a desired magnetic property under the influence of signaling currents in the conductor, said property being impaired by disturbing impulses of excessive strength, and a network connected to a terminal of said cable comprising an inductance and a capacity and having a low impedance for frequencies within the range of signaling impulses and a high impedance for frequencies below that range to reduce disturbing impulses sufficiently to prevent appreciable impairment of said magnetic property.

3. A continuously loaded conductor in which the loading material has a substantially constant permeability within the range of intensities of the signaling currents, the constancy of permeability within said range being impaired by disturbing currents in excess of said range of intensities, and a network connected to one terminal of said cable comprising a transformer winding and a stopping condenser and having a low

impedance at frequencies within the signaling range and having a high impedance at frequencies below that range to reduce disturbing impulses sufficiently for the retention of the constancy of said permeability.

- 5 4. A continuously loaded cable having a loading material of an alloy mainly comprising nickel, iron and cobalt and heat treated to have a constant permeability at the
- 10 magnetizing forces exerted by the signaling currents in the conductor and the constancy of permeability of which is impaired by excessive disturbing currents in the conductor, a transmitting circuit, and a network con-
- 15 nected between said circuit and one terminal of said cable, said network comprising a transformer winding and a condenser in series with said winding and the impedance of said network being such as to inapprecia-
- 20 bly attenuate the signaling currents and to substantially attenuate disturbing currents of frequencies below those of the signaling currents to substantially reduce their effect upon the constancy of said permeability.

25 In witness whereof, I hereunto subscribe my name this 15th day of May, 1929.

JOHN J. GILBERT.

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