June 19, 1923. 1,459,434

D. G. BLATTNER

TRANSMISSION SYSTEM

Filed June 24, 1919

Fig. 1.

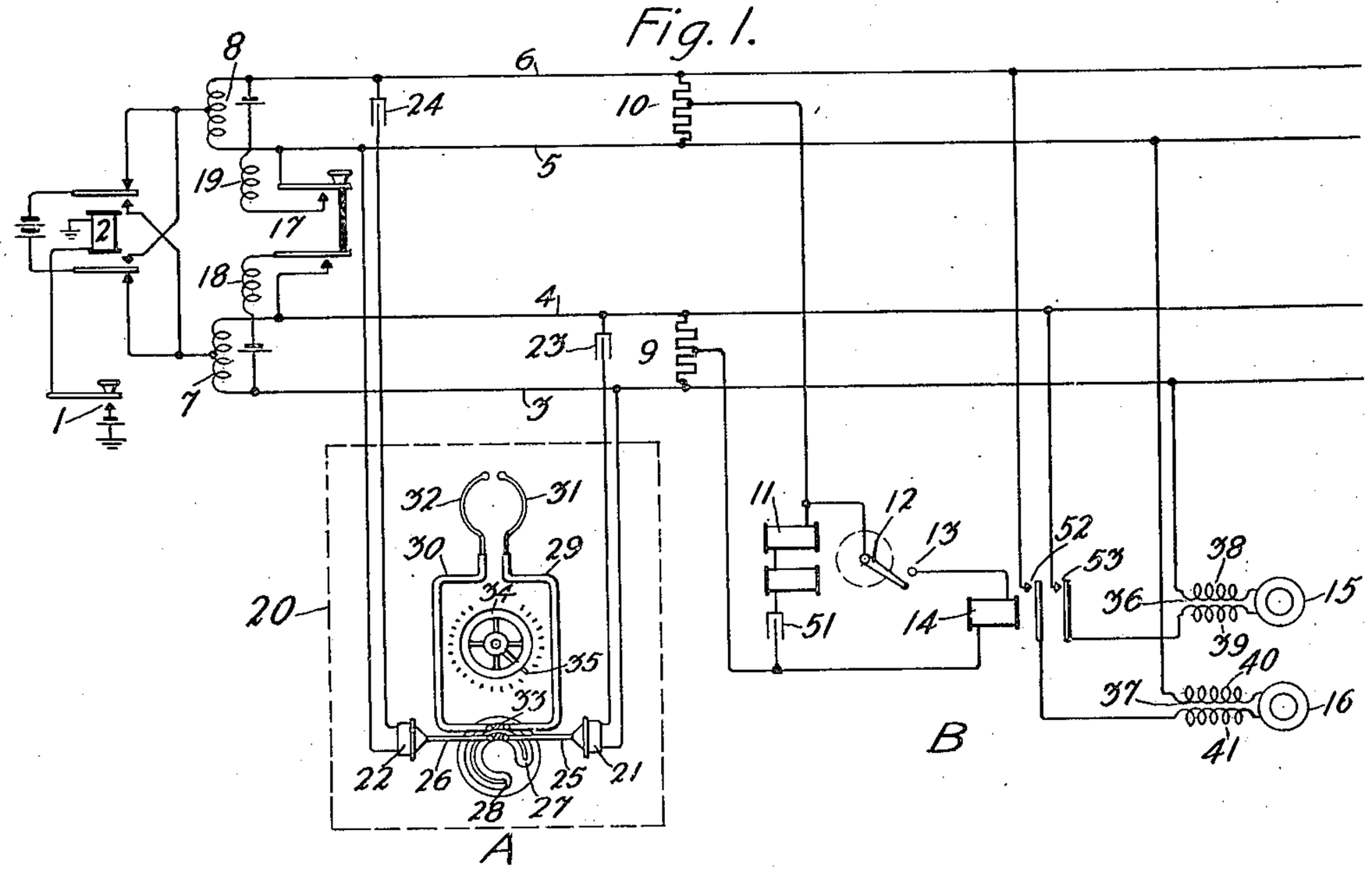


Fig. 2.

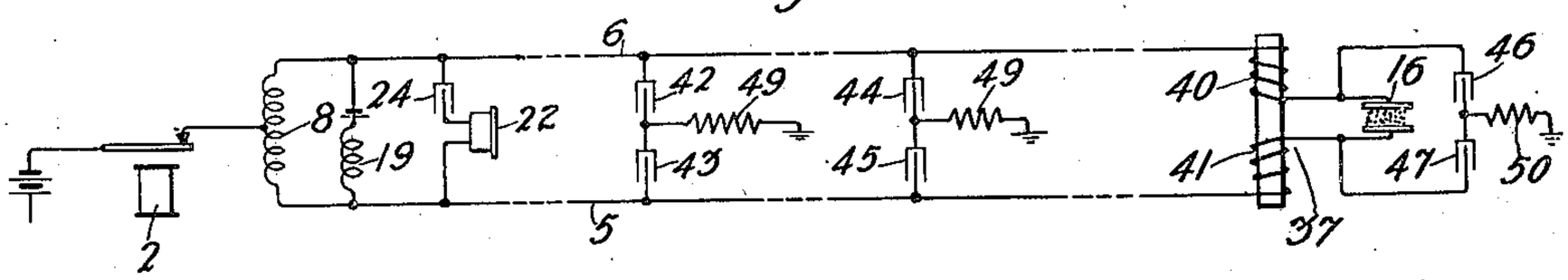
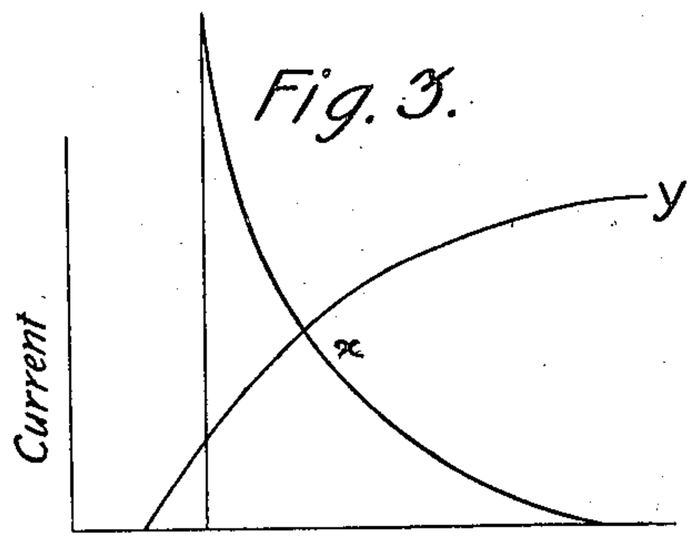


Fig. 3.



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UNITED STATES PATENT OFFICE.

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TRANSMISSION SYSTEM.

Application filed June 24, 1919. Serial No. 306,324.

To all whom it may concern:

Be it known that I, DAVID G. BLATTNER, a citizen of the United States, residing at New York, in the county of New York, State of New York, have invented certain new and useful Improvements in Transmission Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to transmission systems and more particularly to systems in which transmitters are used which contain finely comminuted resistance varying material.

In such systems it is desirable to eliminate, as much as may be possible, the so-called packing and cohering of the particles of the resistance varying material which phenomena deleteriously affect the changes produced by the transmitter in the conditions of an associated electrical circuit.

In some systems employed in the detection and location of marine or submarine vessels, transmitters of this character are used, and since the transmitters in such systems must respond to very feeble mechanical vibrations propagated through the water from a distant source, which vibrations vary over a wide range of frequencies, it is essential that the transmitters be maintained at a high degree of efficiency and also at a high degree of stability at all times. It is therefore desirable to eliminate the effects upon the response of such transmitters due to extraneous or variable conditions which may be impressed upon the operating circuit thereof.

In transmitters of this nature employed in connection with the ordinary telephone, it is possible for the user to dislodge the packed or cohered resistance varying particles by tapping or shaking the transmitter itself and thus cause them to assume their normal operative positions. However, due to the fact that in systems for the detection of marine or submarine vessels the transmitters are usually submerged and are located at considerable distances from the observer, such methods cannot be followed in such cases.

Heretofore it has been proposed in systems of this nature to employ observer controlled electrically operated means located adjacent the transmitter to perform this function, such means being operated before each series of observation, but such methods have not proven entirely satisfactory not only due to the loss of valuable time necessitated thereby but also since the phenomena may occur due to the operation of this means. It is therefore desirable to provide means which will automatically prevent the occurrence of the phenomena and which is independent of the observer.

One system of this nature which has been used successfully in marine and submarine detection work employs a pair of transmitters of this character located at separate fixed positions and the effects produced thereupon by the mechanical vibrations are compared binaurally, that is, the consequent changes in the electrical conditions of the circuit associated with each transmitter are retranslated into observable effects by means of a receiver and the observer, in binaurally listening to the sounds produced, unconsciously makes a comparison therebetween from which the direction of propagation of the vibrations is sensed. In such systems, it is essential that the response of the two transmitters be maintained as nearly uniform and accurate as may be possible, if the direction of the source is to be accurately located. It is evident that any deviation from the expected changes in the electrical conditions of the circuit in response to vibrations of a predetermined character which may be introduced by the cohering or packing of the particles of the resistance varying material of the transmitters may seriously impair the accuracy of the binaural observation. By experimentation and study, it has been determined that these cohering effects are principally due to sudden surges of current through the resistance varying material which cause the particles thereof to assume a somewhat permanent arrangement so that the transmitters do not readily respond to received vibrations and the effects are practically independent of the amount of current flowing through the material. Heretofore, it has been proposed to eliminate these surges by synchronously closing or opening both conductors of the operating circuits of the transmitters and by insuring that the circuits are not closed or opened adjacent the transmitter. However, it has not been possible by these means to entirely prevent the occurrence of the phenomenon especially when caused by other currents which may be impressed upon such circuit for other purposes.

It is an object of this invention to provide

means for so modifying any sudden surges of current which may occur that the cohering of the particles of the resistance varying material caused thereby is minimized and practically eliminated.

To attain this object, in accordance with a feature of the invention, an impedance is included in each conductor of the operating circuit of the transmitter which serves to modify a current surge therethrough before it reaches the transmitter, the impedances in the two conductors being so proportioned and mutually related as to introduce no appreciable impedances into the normal operating circuit of the transmitter. More specifically, an impedance coil comprising two equal windings placed on the same core, in such relation as to be inductively balanced, is employed, one winding being included in each conductor of the circuit adjacent the associated terminal of the transmitter.

This and other features of the invention not specifically mentioned above will more clearly appear from the following specification and the annexed drawing, in which Fig. 1 illustrates one embodiment of the invention, as applied to a binaural system for the detection and location of submarines, while Fig. 2 shows in a simplified form, the operating circuit of one detecting transmitter, and Fig. 3 diagrammatically illustrates the change in wave form of a current surge which is caused by the modifying means of the invention.

Referring to Fig. 1 of the drawing, an observer's station A which may be located at some convenient point on the shore is provided with a sending or selecting key 1, controlling a reversing relay 2 for impressing current impulses of reversed polarity upon a phantom circuit comprising side circuits including conductors 3—4 and 5—6, and suitable simplexing coils 7 to 10, inclusive, leading to the several detecting stations of the system, only one of which, station B, is shown, the others having been omitted for the sake of clearness. A selector 11, which may be of any suitable step-by-step type adapted to individually cause its switch arm 12 to engage a contact 13, thereby bridging relay 14 across the phantom circuit upon receiving a predetermined series of closely succeeding reversed current impulses from the observing station A, is included in the plantom circuit at station B. The selectively operated circuit controlling device disclosed in application, Serial No. 98,384, filed May 18, 1916 by Joseph C. Field, may be used to advantage in this connection. The relay 14 controls the connection of vibration detectors 15 and 16 across the conductors 3—4 and 5—6, respectively. These detectors may be of any suitable type employing finely comminuted resistance varying material and responsive to mechanical vibrations propagated through the water to cause variations in the electrical conditions of an associated circuit and may be suitably mounted upon a fixedly positioned tripod or framework. A key 17 at the observer's station A controls the application of current to the side circuits or transmission lines 3—4 and 5—6 through retardation coils 18 and 19, respectively. A binaural set, as indicated within the dotted rectangle 20, also provided at station A, consists of receivers 21 and 22 which may be of any usual type in series with condensers 23 and 24, respectively, in bridged relation to the physical circuits 3—4 and 5—6, respectively. The sounds produced by receiver 21 are conveyed to ear piece 31 through serially interconnected air tubes 25, 27 and 29, while the sounds produced by receiver 22 are conveyed to ear piece 32 through serially interconnected air tubes 26, 28 and 30. The effective lengths of the adjustable air tubes 27 and 28 are relatively varied by the shifting of a movable stop-member 33 in response to the rotation of the hand wheel 34, the angular position of such member being indicated by a pointer 35 carried by the hand wheel in relation to an associated scale.

In Fig. 2 the operating circuit of detector 16 when associated with the side circuit including the conductors 5 and 6 is diagrammatically shown in a simplified form. Condensers 42 to 47, inclusive, represent the capacitance existing between the respective line conductors 5—6 and ground, while the coils 49 and 50 represent the resistances existing between the various points at which such capacitances are located. Such capacitances and resistances are usually distributed along the cable containing the conductors 5 and 6 but for the purpose of a clear understanding of the invention, may be considered as occurring at certain specific points.

In Fig. 3 a curve X illustrates the wave form assumed by the current in charging a condenser and represents one of the common forms of momentary surges encountered in the operation of the system shown in Figs. 1 and 2, while a curve Y illustrates the modified wave form assumed by such surge with a winding of impedance coil 37 included in the circuit.

It is thought that the invention may be more clearly understood from the following description of the operation of the system shown in the drawing.

Referring more particularly to Fig. 1 and assuming that it is desired to observe the operation of the detectors 15 and 16 at station B in response to some source of vibration, the observer actuates and releases key 1 to cause the relay 2 to transmit a predetermined num-

ber of closely succeeding alternating current impulses over the phantom circuit, one impulse being transmitted for each actuation of the key and another impulse of reversed polarity being transmitted for the release of such key. Such impulses flowing through condenser 51 and the winding of selector 11 at station B cause the selector to advance step-by-step until it reaches its individually selective position, in which it is mechanically retained. Other selectors, which may be associated with the system at other stations, not shown, also advance in response to such impulses but not being adjusted for the completed series and consequently not retained, return to normal upon the cessation of the series for selecting station B. Relay 14 is thereupon operated over the circuit established from one side of battery through one normal contact of relay 2, the side circuit comprising simplexing coils 7 and 9 and conductors 3 and 4, the winding of relay 14, contact 13, arm 12 of selector 11, the side circuit comprising simplexing coils 10 and 8 and conductors 5 and 6, and the other normal contact of relay 2, to the other side of battery. Detector 15 and windings 38 and 39 of impedance or retardation coil 36 are thereby bridged across the conductors 3 and 4 by the closure of contact 53 of relay 14, while detector 16 and the windings 40 and 41 of the associated impedance or retardation coil 37 are bridged across the conductors 5 and 6 by the closure of contact 52 of relay 14. The actuation of key 17 at the observer's station thereupon supplies current to the physical line circuits 3—4 and 5—6 through retardation coils 18 and 19, respectively, so that the current varying devices of detectors 15 and 16 cause variations in the current in such physical circuits in response to the vibrations of the responsive members of the detectors. The characteristics of the simplexing coils and the other apparatus bridged across the physical circuits are so chosen as to prevent no material interference to the transmission of such current variations.

These current variations are transmitted through condensers 23 and 24 to receivers 21 and 22 respectively, of the binaural observation set 20. The sounds being produced by receiver 21 in response thereto are conveyed through air tubes 25, 27 and 29 to the ear piece 31, while the sounds produced by receiver 22 are conveyed through the air tubes 26, 28 and 30 to the ear piece 32. The movable stop-member 33 is then shifted by means of a hand wheel 34 until the observer, upon listening binaurally to the sounds emitted by the ear pieces, receives the impression that the source of sound is straight ahead. The position of the pointer 35, relative to the associated scale when such an impression is obtained, indicates the angular relation of the observed source of vibration to a base line joining detectors 15 and 16. The operating circuit of detector 16 is represented by Fig. 2, all unnecessary apparatus and circuit connections being removed therefrom.

In case additional selecting impulses are impressed upon the phantom circuit while the detector 16 is operatively associated with the line conductors 5 and 6 by the simultaneous closure of both alternate contacts of relay 2, no unbalance should result in the current flowing over conductors 5 and 6 and no momentary surge of current would result. However, in case one of the alternate contacts of relay 2 is closed a short time before the closure of the other alternate contact, the current supplied through such contact would charge the condensers 42 to 47, inclusive, such current assuming the wave form represented by curve X of Fig. 3. If the capacitances of certain of the condensers are slightly unequal, as would frequently happen at different times, there would be a current flow through one winding of the coil 37 and the detector 16 and through one of the other condensers and the associated resistance 50 to ground. However, due to the well-known retarding effect of an impedance winding, such as the windings 38, 39, 40 and 41 of the coils 36 and 37, the current wave would be caused to assume the form shown by curve Y of Fig. 3 upon passing through the impedance winding of the coil 36 or 37. Therefore, the variations in the current passing through the detector 16 would be more gradual and would not cause the phenomenon known as cohering. The same action would take place in connection with the circuit for the detector 15 which would be similar to that shown for detector 16 in Fig. 2.

Due to the fact that the windings 38 and 39 of coil 36 and the windings 40 and 41 of coil 37 are equal in number of turns and are wound upon the same core in such a manner as to mutually balance each other, it is evident that no impedance is introduced in the normal operating circuit of the detectors 15 and 16.

What is claimed is:

1. In a transmission line, a pair of conductors, one of which has a capacitance to a grounded connection, a transmitter electrically connected to said conductors, and means connected in the line immediately adjacent the transmitter for preventing packing of the transmitter due to surges on the other of said conductors.

2. In a transmission line, a pair of conductors, each having a capacitance to a grounded connection, a transmitter electrically connected to said conductors, and a pair of impedance windings connected to the conductors immediately adjacent the trans-

mitter to prevent packing of the transmitter due to surges on the line.

3. In a transmission line, a pair of conductors, each having a capacitance to a grounded connection, a transmitter containing comminuted resistance varying material electrically connected to said conductors, and means inserted in the line adjacent to and on either side of said transmitter to modify the wave front of surges occurring on the line thereby preventing packing of the comminuted material.

4. In a transmission line, a pair of conductors, each having a capacitance to a grounded connection, a transmitter containing comminuted resistance varying material electrically connected to the line, a source of current, means for connecting said source of current to the line, and means for modifying the wave front of surges resulting from the discharge of said capacitances whereby packing of the comminuted material is prevented.

5. In a transmission system, a metallic line comprising a pair of conductors, one of which has a capacitance to a grounded connection, a source of current bridged across the line circuit, a receiver and a transmitter also bridged across the line circuit at separate points, means for impressing a current impulse upon the other conductor of the line circuit from a separate source whereby such capacitance is charged through the transmitter, and means interposed between the second mentioned conductor and the transmitter to retard the flow of charging current through the transmitter.

6. In a transmission line, a receiver, a transmitter containing comminuted resistance varying material, a pair of conductors interconnecting said receiver and transmitter, each of said conductors having a capacitance to a grounded connection, a source of current associated with the conductors, and an impedance coil having a pair of inductively balanced windings, one of such windings being included in each conductor immediately adjacent the transmitter to present high impedance to currents flowing over both conductors of the line circuit in parallel, and to present substantially no impedance to currents flowing over such conductors in series.

In witness whereof, I hereunto subscribe my name this 17th day of June, A. D. 1919.

DAVID G. BLATTNER.