

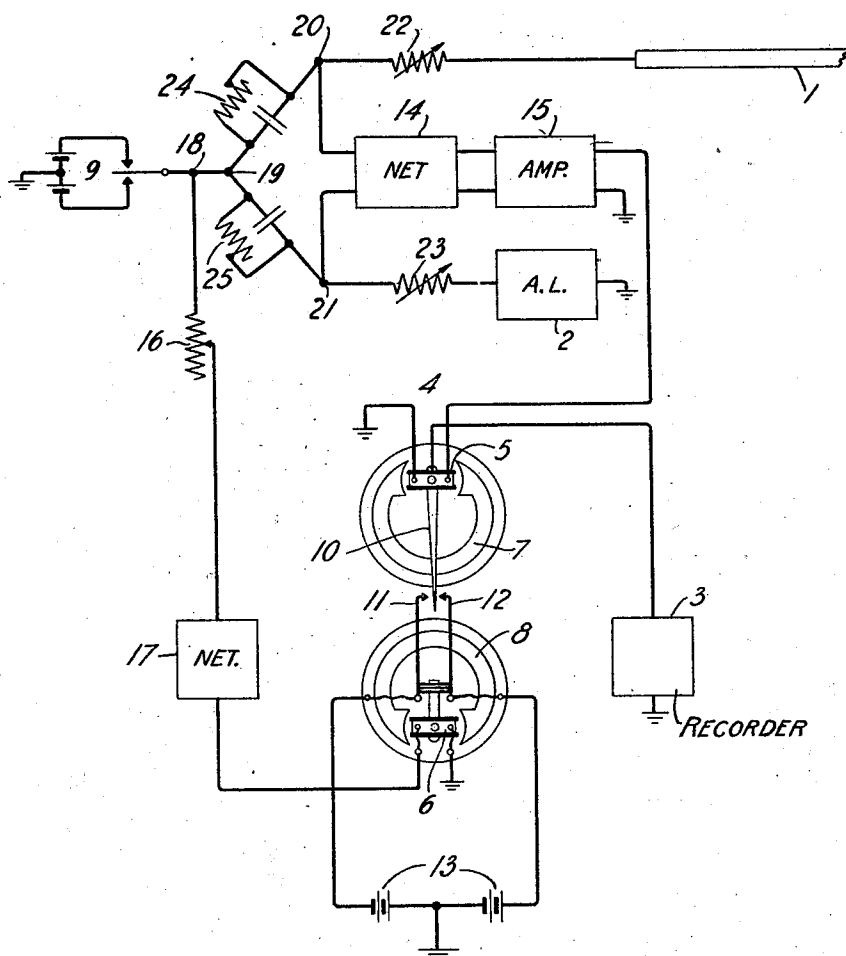
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## DUPLEX TELEGRAPH SYSTEM

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## UNITED STATES PATENT OFFICE.

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## DUPLEX TELEGRAPH SYSTEM.

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This invention relates to telegraphy and more particularly to a duplex submarine telegraph cable system employing receiving apparatus of the moving coil type.

5 An object of the invention is to prevent unbalance currents, due to transmitted signal impulses in a duplex system in which there exists imperfect balance between the main and the artificial line, from affecting  
10 the receiving instrument associated with the duplex network at the sending station.

In duplex telegraph non-loaded submarine cable systems, resistances are ordinarily inserted at the head ends of the cable and  
15 artificial line and at various other points along the artificial line, and adjustable resistances are usually connected in shunt with condensers in the ratio arms and with various other condensers in the artificial line, the  
20 adjustment of which will permit of balancing the entire system quite accurately for the higher frequency components of the signal. This arrangement of adjustable resistances and condensers does not, however, permit of  
25 accurately balancing the cable and the artificial line for very low frequencies which may be caused by differences between the real and artificial cables at great distances from the sending end. A specific object of  
30 the present invention is to compensate in the receiving instrument for this effect of low frequency unbalance currents which cannot be removed by adjustment of the head end balancing resistances and condensers.

35 According to a specific embodiment of the present invention the unbalance currents of low frequencies are rendered ineffective by providing a relay which neutralizes unbalance currents and thereby limits the operation of a recording device to the received  
40 signals only. This relay is of the polarized type and is equipped with two independently rotatable coils having respectively affixed thereto an armature and a pair of contacts, the contacts being arranged in engageable  
45 relation with the armature. One coil is connected to the bridge across the ratio arms in a bridge duplex system and is responsive to both received signals and the low frequency unbalance currents of transmitted  
50 signals, and the other coil is connected through a suitable network to the transmitter and is responsive only to currents similar in wave form and amplitude to the

low frequency unbalance currents of transmitted signals. The armature is connected  
55 directly to the recording device and the contacts are connected to opposite terminals of a source of current supply so that when a received signal causes the armature to engage either of the associated contacts, an  
60 operating circuit for the recording device is closed. When a signal is transmitted over the line the armature is rotated by the low frequency unbalance current and the contacts are moved an equal amount in the same  
65 direction by a current equivalent to the unbalance current, and, therefore, no engagement between the armature and either of its associated contacts is effected to cause the  
70 operation of the recording device. However, should an incoming signal be received while the armature and contacts are under the control of a transmitted signal, the current of the incoming signal, depending upon its  
75 polarity, would cause either an increase or decrease in the movement of the armature and thereby effect an engagement or disengagement with one of the associated contacts to operate the recording device and record  
80 the incoming signal.

This invention will be more particularly described in connection with the accompanying drawing which shows the preferred embodiment of the invention employed at a  
85 terminal station of a bridge duplex submarine telegraph station.

In the drawing submarine cable 1 is shown terminating in a bridge duplex set in which an artificial line 2 is provided for simulating the impedance of the cable. In accordance with the present invention the system is assumed to be in perfect balance for the high frequency components of the signaling currents, which balance is obtained by adjusting resistances 22 and 23 at the head  
90 ends of the cable and the artificial line, respectively, resistances 24 and 25 in the ratio arms, and the impedance elements which are employed in the artificial line 2. This balance however does not hold for the low frequency components of the signaling currents. In this system the recording device 3 which may be any of the well known types, will respond not only to the incoming signals but also to the unbalance low frequency components of the outgoing signal currents. In order to compensate for this unbalance of  
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the low frequency components of the transmitted signals and limit the operation of recording device 3 to the incoming signals only, relay 4 is provided to control the operation of the recording device by neutralizing the effects of the unbalance currents. This relay is equipped with two coils, namely, signal coil 5 and neutralizing coil 6 which are arranged when energized, to rotate independently of each other between the poles of their respectively associated magnets 7 and 8. The coil 5 is responsive to either the signals received from cable 1 or the unbalance low frequency components of the signals transmitted by transmitter 9, and the coil 6 is damped so as to be responsive to only the low frequency components of the transmitted signals. An armature 10 is fixed to coil 5 and contacts 11 and 12 are likewise fixed to coil 6 so that rotation of either coil alone effects an engagement or disengagement between the armature and one of the contacts, thereby connecting or disconnecting the operating circuit of recording device 3 with battery 13. It is understood, of course, that the invention is not to be limited to the embodiment shown, but that other types of relays may be employed, such as one having fixed coils with two movable armatures one of which carries the single contact and the other carries the pair of contacts. In order to make the incoming signals clear and undistorted by unbalance currents, network 14 and amplifier 15 are provided in the circuit of coil 5 and inasmuch as this apparatus will affect the wave form and amplitude of the unbalance currents across the bridge due to the outgoing signals, an adjustable resistance 16 and a shaping network 17 are inserted in the circuit of coil 6 so that the current wave therein will be of approximately the same amplitude and wave shape as that of the unbalance current in the circuit of coil 5.

In describing the operation of the system, let it be assumed that incoming signals are being received from cable 1. The signals pass through network 14, amplifier 15 and coil 5. Coil 5 rotates and moves its armature to one side or the other depending upon the polarity of the incoming signals, to connect one pole of battery 13 to the recording device 3 which operates to make a record of the incoming signals. When a message is being transmitted from transmitter 9, the current of the outgoing signals divides at point 18, part going to the apex 19 and the other part passing through the circuit of resistance 16, network 17 and coil 6. Inasmuch as this invention is concerned principally in the unbalance of the cable and artificial line with respect to low frequency components of the transmitted signals, the cable and artificial line are regarded as being in nearly perfect balance

for the higher frequency components of the signaling currents so that the higher frequency components are ineffective to operate either of the coils. The higher frequency components transmitted to the apex 19 are balanced out by the resistances 22, 23, 24, 25 and artificial line 2 and those transmitted to coil 6 are rendered ineffective by the damping applied to the coil.

In view of the unbalance of the cable and artificial line for low frequency currents a difference of voltage is present between points 20 and 21 and, therefore, an unbalance current flows across the bridge and through network 14, amplifier 15 and coil 5 in series, thereby causing the armature 10 to rotate to one side or the other, depending upon the polarity of the outgoing signal. Simultaneously with the flow of unbalance current through coil 5, the current similar in wave form and of approximately the same amplitude causes the contacts 11 and 12 to rotate in a similar manner and inasmuch as these coils are so connected that the contacts move in the same direction as the armature, no relative movement between the armature and contacts results from the unbalance current and no record is, therefore, made by the recording device.

Should signals be received during the time that transmitter 9 is sending a message over cable 1, the current of the incoming signal would be added in coil 5 to that of the unbalance current flowing therein at the time, and if the currents happen to be of opposite polarities, the movement of the armature 10 would be decreased and if of the same polarity the movement would be increased, so that regardless of what the polarities of the outgoing and incoming signals may be, a relative motion takes place between the armature and the contacts to record the nature of the incoming signal.

The invention has been described above as applicable to ordinary duplex telegraph and non-loaded cable systems. However, it can also be employed with loaded lines and cables or elsewhere wherever the need exists for means for accomplishing the function of the invention.

What is claimed is:

1. A duplex system terminal arrangement comprising a main and an artificial line, a source of current for transmitting signals, a translating device responsive to incoming signals, and means for neutralizing disturbing effects due to imperfect balance between the main and artificial lines, said means including independently movable members arranged to move simultaneously in the same direction in response to outgoing signals and the unbalance currents produced thereby, so as to prevent relative movement therebetween and the subsequent operation of said translating device.

2. In a telegraph system, a terminal duplex bridge arrangement comprising a main and an artificial line, a contact making device having operable contacts, a signal translating device responsive to the operation of said contacts, and separate means for operating said contacts simultaneously to prevent the operation of said translating device in response to outgoing signals and to effect the operation of said translating device by the incoming signals when signals are being simultaneously transmitted.

3. In a telegraph system, a duplex bridge arrangement comprising a main and an artificial line, a contact making device comprising a plurality of coils each of which is arranged to be energized without interfering magnetically with the other, and movable contacts on each of said coils arranged to move in the same direction in response to outgoing signals and unbalance currents produced thereby, to prevent engagement between said contacts.

4. In a telegraph system, a duplex bridge arrangement comprising a main and an artificial line in imperfect balance for the low frequency components of the signaling currents but in substantially perfect balance for the higher frequency components, transmitting means, a signal translating device, a contact making device comprising a signal receiving coil and a disturbance neutralizing coil, movable contacts on each of said coils arranged when interengaged to operate said recording device, and means for diverting a part of the transmitted signal current through said disturbance neutralizing coil at the same time that the disturbing current due to the imperfect balance is flowing through the signal receiving coil to move said contacts in the same direction thereby preventing the interengagement of said contacts and the operation of said translating device in response to low frequency unbalance currents resulting from the transmitted signals.

5. In a telegraph system, a duplex bridge arrangement comprising a main and an artificial line in imperfect balance for the low frequency components of the signaling currents but in substantially perfect balance for the higher frequency components, a transmitting mechanism, a signal translating device, a contact making device for controlling said translating device, a signal receiving coil on said contact making device arranged to be effectively energized by both the received signals and the unbalance currents of the transmitted signals, contacts on said coil arranged to be operated in either direction by said signals, the direction depending upon the polarity of the signal, a disturbance neutralizing coil on said contact making device arranged to be effectively

energized by only the low frequency components of the outgoing signaling currents, and contacts on said neutralizing coil arranged to move in a direction corresponding to that of the contacts on said receiving coil when the latter coil is energized by the unbalance currents only, thereby preventing interengagement of said contacts and neutralizing the effect of the unbalance currents produced in said receiving coil.

6. In a telegraph system, a duplex bridge arrangement comprising a main and an artificial line in imperfect balance for the low frequency components of the outgoing signaling currents and in substantially perfect balance for the higher frequency components, transmitting means, a signal translating device, a contact making device comprising a signal receiving coil and a disturbance neutralizing coil magnetically independent of each other, movable contacts on each of said coils arranged when interengaged, to operate said translating device, means for operating both coils in response to the low frequency components of the outgoing signaling currents whereby relative movement of said contacts is prevented, means for preventing the operation of said coils in response to the higher frequency components of the outgoing signal currents, and means for energizing the receiving coil only in response to incoming signals whereby said contacts interengage to operate said translating device.

7. In a telegraph system, a duplex bridge arrangement comprising a main and an artificial line in imperfect balance for the low frequency components of the outgoing signaling currents and in substantially perfect balance for the higher frequency components, transmitting means, a recording device, a contact making device comprising a signal receiving coil and a heavily damped disturbance neutralizing coil, movable contacts on each of said coils arranged to interengage to operate said recording device, means for operating both coils in response to the low frequency components of outgoing signal currents whereby relative movement of said contacts is prevented, impedance elements in the artificial line and the head ends of said cable and said artificial line for cooperating with said damped neutralizing coil in preventing the operation of said contact making device in response to the higher frequency components of the outgoing signaling currents, and means for energizing the receiving coil only in response to incoming signals whereby said contacts interengage to operate said recording device.

In witness whereof, I hereunto subscribe my name this 12 day of May A. D., 1927.

ALLISON A. CLOKEY.