

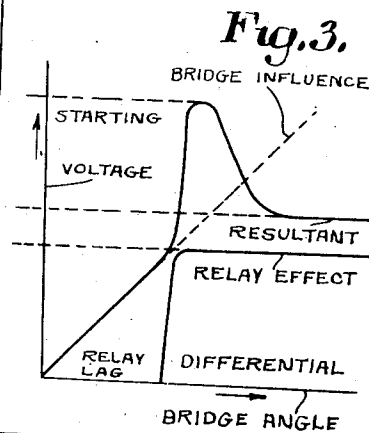
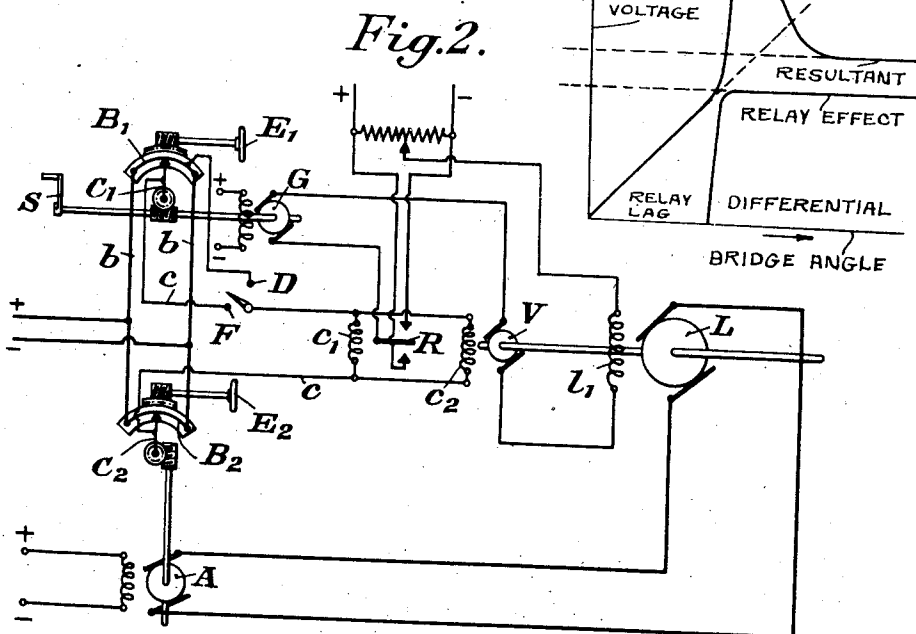
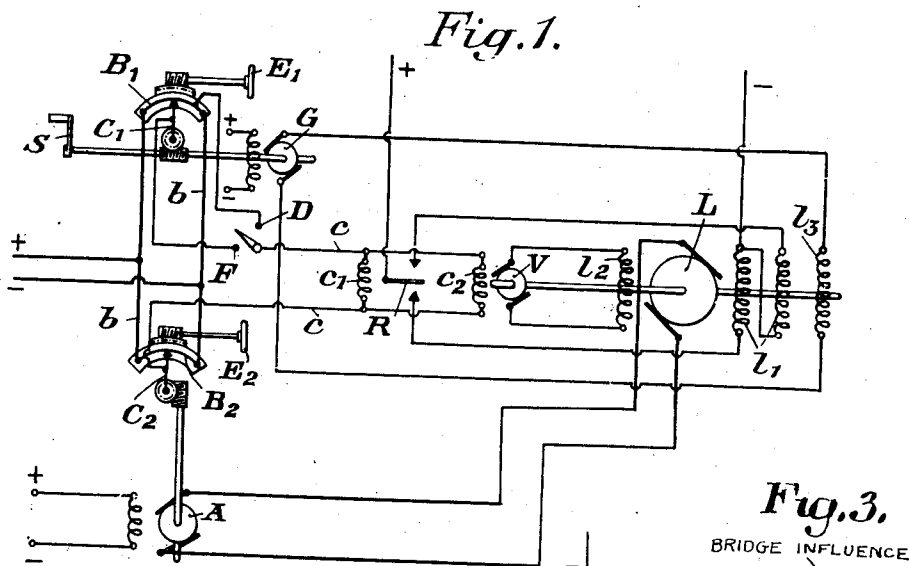
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LONG DISTANCE CONTROLLING APPARATUS

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LONG-DISTANCE CONTROLLING APPARATUS

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My invention relates to a long distance controlling apparatus as used for electrically controlling hoisting machines, searchlights, helms of vessels, guns and the like in such a manner that the direction and alteration of direction of the receiver correspond at any time to that of the transmitter. In apparatus of this class bridge connections have already been made use of; that means, devices in which the current flowing in the equalizer wire or "bridge arm" of a Wheatstone bridge is used for the transmission of controlling motions. In these bridge connections the two arms of the Wheatstone bridge are formed by resistances situated at the transmitter and receiver and either connected with a series of fixed contacts or formed by a non-graduated wire. The equalizing current arising with different positions of the two bridge contacts sliding on the resistances is used to control the motion of the receiver motor, by exciting the motor in the one or other direction of rotation, either directly or through the intermediary of a relay or, where the Leonard control system is provided by exciting the Leonard generator. When the bridge contact of the receiver has reached the position that corresponds to that of the transmitter contact, the equalizing current disappears and therewith also the impulse of motion for the receiver.

Now, in order to exhaustively utilize the peculiar advantages afforded by a bridge connection, according to the invention the equalizing current of the bridge circuit is amplified in a special manner and caused to act upon the receiver motor which is connected in Leonard connection. The bridge equalizing current acts in two steps upon the supply of the driving agent to the receiver, viz. amplified in a constant step and in parallel thereto by means of a generator in a second step which is variable according to the current strength. Preferably the arms of the bridge on the transmitter and receiver consist each of several non-graduated resistance wires connected in parallel and co-operating in groups each with a movable contact piece. In this manner the heat capacity of the bridge arms is increased which thereby are

made insensitive both to outer influences of temperature and to permanent current load so that due to the uniform state of heat of the bridge arms thus obtained the fineness and precision of adjustment of the apparatus are improved.

In order that my invention can be more readily understood, two embodiments of the same are diagrammatically illustrated in the accompanying drawings as applied to gun controlling apparatus, in combination with Leonard connection. In these drawings

Figure 1 illustrates the first embodiment, Figure 2 illustrates the other embodiment, and

Figure 3 shows the working diagram of the connection according to Figures 1 and 2.

Referring to Figures 1 and 2, B_1 and B_2 are the bridge arms formed by uninterrupted non-graduated resistance wires and arranged on the transmitter and receiver, respectively. The two bridge arms are interconnected by the wires b . The whole bridge is permanently fed with current from the mains. The movable bridge contact C_1 of the transmitter can be displaced by the controlling crank S either by hand or by means of a special device, gyroscope or the like. Upon contact C_1 being displaced, a telescope (not shown) serving to sight the aim, or a direction pointer on the gyroscope or the like, has imparted to it a corresponding displacement, so that the transmitter contact C_1 is under the control of the gunner who points the gun. Every displacement ever so slight of contact C_1 effects the disturbance of the equilibrium of the bridge resulting in an equalizing current flowing in the equalizing wire c interconnecting the two bridge contact pieces C_1 and C_2 . This feeble equalizing current is amplified in a suitable manner and causes excitation of the Leonard generator L which by its armature current drives the directing member A . The latter by means of a mechanical transmission device moves the gun (not shown) until the receiver contact C_2 , connected to it and thus to the gun, assumes the same position as the transmitter contact C_1 , whereby the equilibrium of the bridge is restored. Equilibrium exists in the bridge

when the contact pieces C_1 and C_2 assume corresponding positions on the bridge arms B_1 and B_2 . The bridge arms are mounted on segments which by means of hand wheels E_1 and E_2 or the like can be displaced relatively to one another and to the contact pieces C_1 , C_2 sliding thereon. This arrangement affords the possibility of superposing any corrections of the mutual position of transmitter and receiver, such as corrections of the sight, the parallax, in accuracies of the platform; atmospheric influences, alterations of the muzzle velocity and so on.

The equalizing wire c can be disconnected from the movable contact piece C_1 of the transmitter by means of a switch F , D , and connected, after this disconnection, to a fixed contact located on a determined place of the transmitter bridge arm B_1 , to which end this switch is thrown over from F to D . In this manner a determined other position can be given to the receiver (gun) at any time independently of the position of the transmitter contact piece C_1 , for instance the gun can be lowered into loading position.

The amplification of the equalizing current of the bridge is produced firstly in known manner by means of a polarized relay R , the coil c_1 of which is traversed by the equalizing current in wire c in the one or other direction. When current passes through coil c_1 the relay R responds and connects the corresponding exciting winding L_1 of the Leonard generator L to the mains. The change of direction of the current passing through the exciting windings L_1 of the Leonard generator which takes place upon change of the direction of current in the equalizing wire c is obtained in known manner, as illustrated in Figure 2, by division of the voltage by one sole coil L_1 or, as illustrated in Figure 1, by two coils L_1 through which the current flows in opposite directions.

In order to obtain further an extremely low speed of the directing motor A while maintaining the largest possible range of numbers of revolutions thereof, the constant controlling impulse delivered by the relay is preferably so measured and tuned, that it will just suffice for the smallest speed concerned of motor A . In order, however, that the motor may have a sufficiently high starting moment, the bridge equalizing current is caused to act also upon the controlling device of the motor in another step. This is done by connecting in parallel to the relay an amplifying generator. To this end a coil c_2 inserted in the equalizing wire c in parallel to the relay coil c_1 is connected to the field magnet of a small amplifying generator V which is driven at uniform speed independently of, or together with, the Leonard generator L , from a common source. The field of generator V is thus proportional to the bridge equalizing current, that is, to the difference in

position of the contact pieces C_1 and C_2 . The armature current of the amplifying generator V flows as amplifying current through an exciting winding of the Leonard generator L . In Figure 1 it flows through a special coil L_2 whilst in Figure 2 it flows in the circuit including the coil L_1 fed through the relay R . Of course, the bridge equalizing current may act upon the controlling device of the driving motor after having been amplified by more than two steps.

The operation of the described connections is to be seen from Figure 3. In a rectangular coordinate system the bridge sections travelled by the movable bridge contacts are traced as abscissæ, and the appurtenant voltages of the directing motor as ordinates. The zero point or origin of the system denotes the commencement of an adjusting operation. The influence, upon the directing motor, of the bridge current amplified by generator V forms a straight line passing through the zero point at 45 degrees. The influence of relay R begins only after a certain bridge section has been traversed, depending upon the sensitiveness of the relay, that is only after the movable contact piece C_1 of the transmitter has run a certain distance in advance of the receiver contact piece C_2 which at first remains at rest, and then rises steeply up to a normal value which, due to the constant voltage, of the mains remains permanently constant. Both these influences sum up so that at the beginning of the adjusting operation the starting voltage suddenly rises and the motor A starts and entrains the receiver contact piece C_2 . Owing to the fact that the positions of the contact pieces of transmitter and receiver are now quickly becoming similar to one another, the bridge equalizing current and therewith its amplifying effect sink again until in the further course of the adjusting operation the voltage of the motor A always remains above the effect of the relay by an amount corresponding only to the lag of the receiver contact piece C_2 (bridge slip), the damping effect produced by the coils of the Leonard generator L preventing hunting of the voltage. A high starting moment of the motor A without any hunting is thus obtained by the described arrangement, even with a very low directing speed.

The strength of the bridge equalizing current depends upon the amount of difference in position between the contact pieces of the transmitter and receiver (bridge slip). With increasing directing speed at first this difference in position also increases and therewith again also the equalizing current and its exciting effect upon the Leonard generator L , so that a certain compensation of speed arises between transmitter and receiver. An increased bridge slip, however, will remain. In order to avoid this increased

lag, a further additional excitation of the Leonard generator is caused, according to the invention, in dependency on the speed of the transmitter. To this end a generator G is coupled with the drive of the transmitter contact piece C_1 which generator with constant excitation delivers an armature current the strength of which is proportional to the speed of the transmitter. This armature current acts upon the excitation of the Leonard generator L by means of a special coil L_2 in its own circuit, or in the circuit of relay R and amplifying generator V as an additional excitation upon the common coil L_1 . In this manner the speed of the directing motor, in a perfect manner, is rendered dependent on the speed of the transmitter. The controlling apparatus forms a combination of a drive for controlling way and speed.

The described arrangement affords a powerful starting moment of the directing motor within a very wide range of regulation, and an exact regulation of speed between transmitter and receiver and therewith a very small lag.

What I claim is:—

1. A remote control system comprising a transmitter and a receiver, the said transmitter and receiver each including an electrical resistance element, a shiftable contact member cooperating with each resistance element, two conductors connecting the ends of one element to the ends of the other, a source of current connected to said conductors, a polarized relay having a movable contact and two stationary contacts cooperating therewith, conductors connecting the winding of the relay to the respective shiftable contact members, whereby a Wheatstone bridge is formed, with the relay winding connected in the bridge diagonal, a generator, circuits controlled by said relay contacts and including opposing field windings of said generator and a source of electricity, means for producing a current depending upon the speed of operation of the transmitter and a circuit supplying said current to a field winding of the generator and means for operating the shiftable contact member of the receiver by the current generated by said generator due to the combined field excitations.

2. A remote control system comprising a transmitter and a receiver, the said transmitter and receiver each including an electrical resistance element, a shiftable contact member cooperating with each resistance element, two conductors connecting the ends of one element to the ends of the other, a source of current connected to said conductors a polarized relay having a movable contact and two stationary contacts cooperating therewith, conductors connecting the winding of the relay to the respective shiftable contact members, whereby a Wheatstone bridge is formed, with the relay winding

connected in the bridge diagonal, a generator, circuits controlled by said relay contacts and including opposing field windings of said generator and a source of electricity, an exciter for said generator, the field terminals of said exciter being connected to the two shiftable contact members, conductors connecting the output terminals of the exciter to a field winding of the generator, and means for operating the shiftable contact members of the receiver by the current generated by said generator.

3. A remote control system comprising a transmitter and a receiver, the said transmitter and receiver each including an electrical resistance element, a shiftable contact member cooperating with each resistance element, two conductors connecting the ends of one element to the ends of the other, a source of current connected to said conductors, a polarized relay having a movable contact and two stationary contacts cooperating therewith, conductors connecting the winding of the relay to the respective shiftable contact members, whereby a Wheatstone bridge is formed, with the relay winding connected in the bridge diagonal, a generator, circuits controlled by said relay contacts and including opposing field windings of said generator and a source of electricity, an auxiliary generator operated in correspondence with the speed of operation of the transmitter, to produce a current dependent on said speed, and conductors connecting the output terminals of said auxiliary generator to a field winding of the first named generator and means for operating the shiftable contact member of the receiver by the current generated by said generator.

4. A remote control system comprising a transmitter and a receiver, the said transmitter and receiver each including an electrical resistance element, a shiftable contact member cooperating with each resistance element, two conductors connecting the ends of one element to the ends of the other, a source of current connected to said conductors, a generator, an exciter connected to supply current to a field winding of said generator, said exciter having a separately excited field winding the terminals of which are connected to the said shiftable contact members respectively, an auxiliary generator driven by the transmitter and generating a current proportional to the speed thereof, conductors connecting the output terminals of said auxiliary generator to a field winding of the first named generator, and means for operating the shiftable contact member of the receiver by the current generated by said generator.

5. A remote control system comprising a transmitter and a receiver, the said transmitter and receiver each including an electrical resistance element, a shiftable contact mem-

ber cooperating with each resistance element, two conductors connecting the ends of one element to the ends of the other, a source of current connected to said conductors, a polarized relay having a movable contact and two stationary contacts cooperating therewith, conductors connecting the winding of the relay to the respective shiftable contact members, whereby a Wheatstone bridge is formed, with the relay winding connected in the bridge diagonal, a generator, circuits controlled by said relay contacts and including opposing field windings of said generator and a source of electricity, means for producing a current depending upon the speed of operation of the transmitter and a circuit supplying said current to a field winding of the generator, an exciter for said generator, the field terminals of said exciter being connected to the two shiftable contact members, conductors connecting the output terminals of the exciter to a field winding of the generator, and means for operating the shiftable contact member of the receiver by the current generated by said generator due to the combined field excitations.

In testimony whereof I have affixed my signature.

HERMANN SUNDHAUSSEN.