Oct. 17, 1933. R. B. SHANCK 1,930,627

MEANS FOR IMPROVING CONTACT OPERATION

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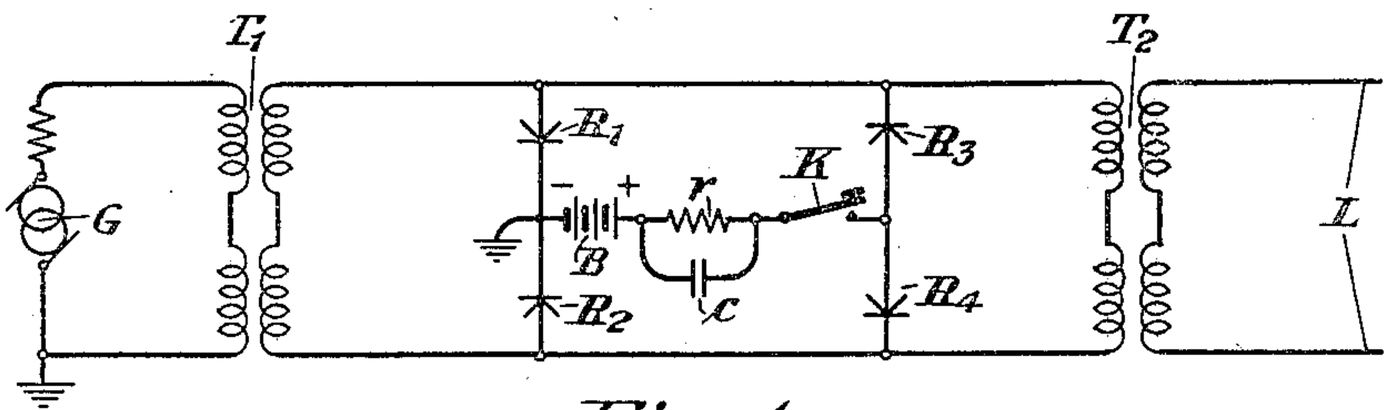

Fig. 1

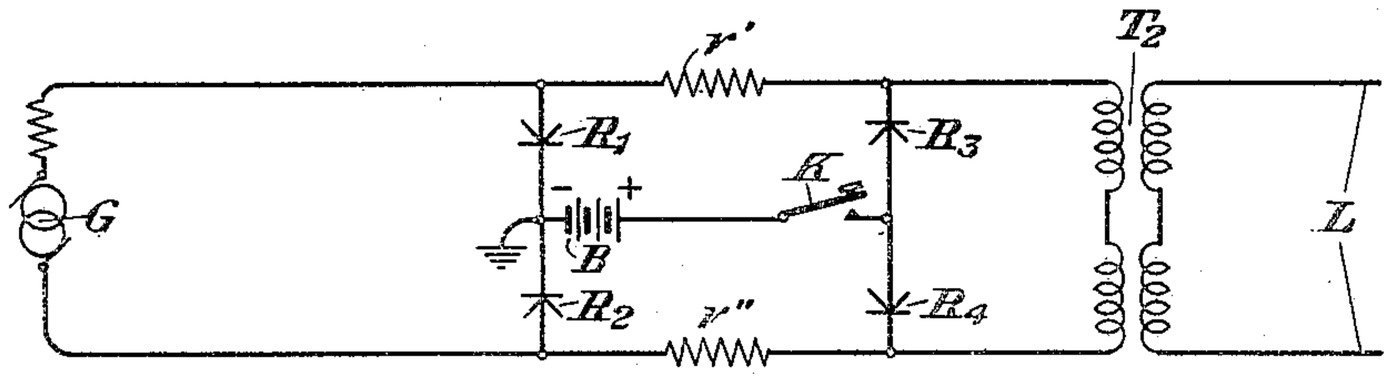

Fig. 2

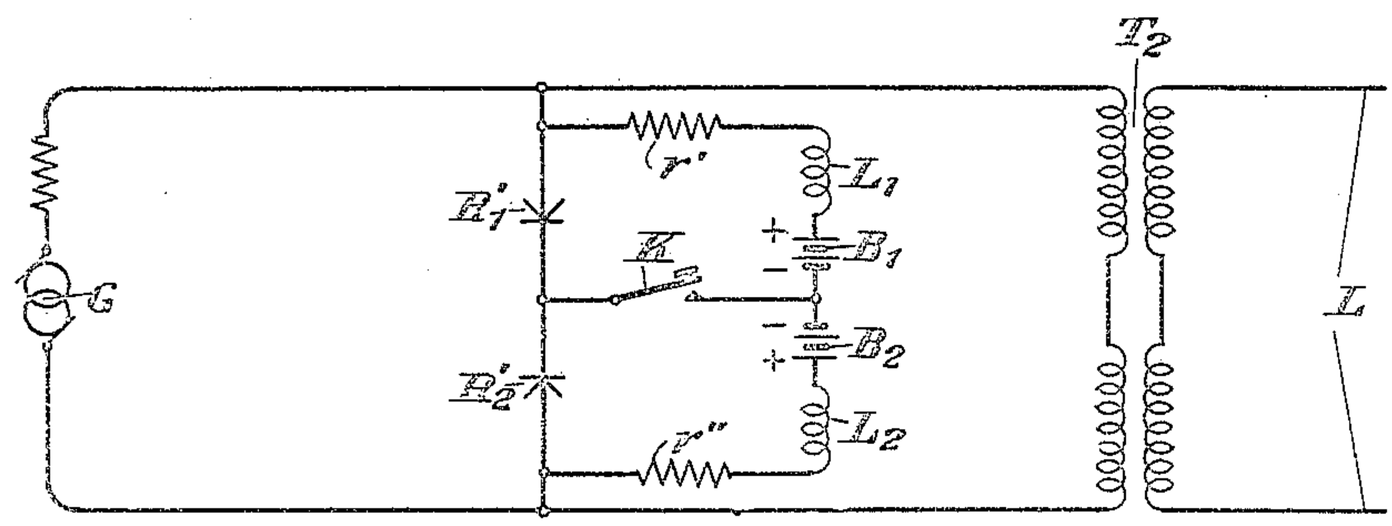

Fig. 3

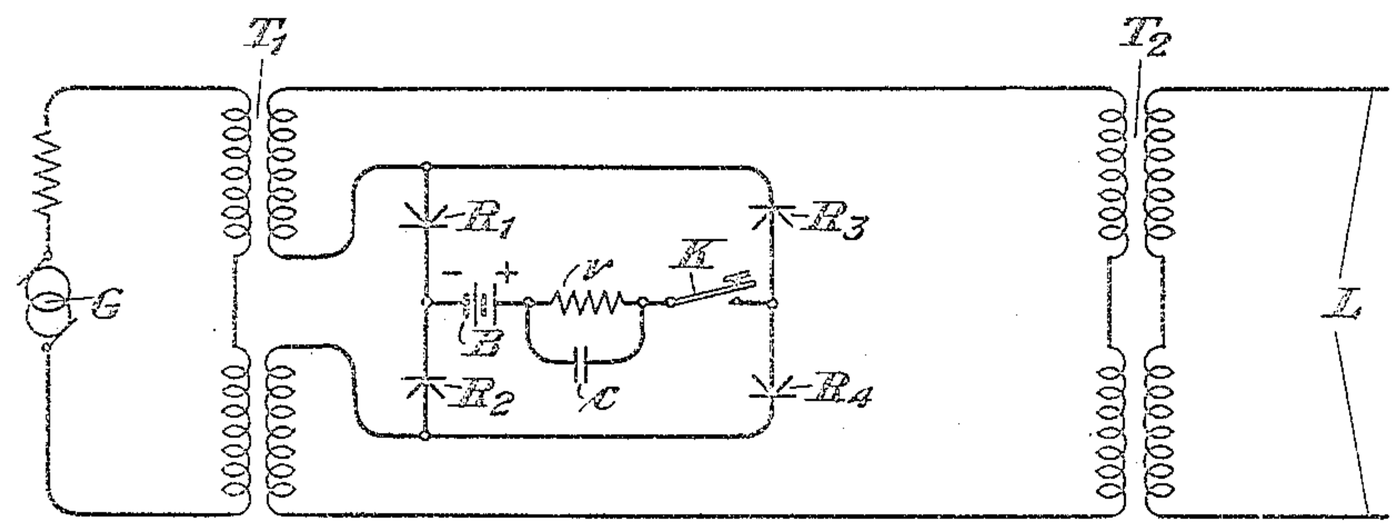

Fig. 4

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MEANS FOR IMPROVING CONTACT OPERATION

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7 Claims. (Cl. 178—66)

This invention relates to electrical transmission systems, and more particularly to means for improving the transmission of currents over such systems, when such currents are transmitted over the contacts of relays, switches or similar devices, in such systems.

In transmission systems trouble has been experienced in transmission of currents due to the existence of high resistance at so-called "dry" contacts of switching devices therein. These "dry" contacts are usually those carrying comparatively small currents and voltages. Instances wherein such "dry" contacts would have an undesired effect on transmission might, for example, arise in carrier telegraph systems and in echo suppressor devices for short circuiting lines carrying small currents. The arrangements of the invention provide means for applying a comparatively high voltage across the contact points of the switching device, in order to break down the high contact resistance, in such a way that through transmission is not affected. Further objects and features of the invention will appear more fully from the detailed description thereof hereinafter given.

The invention may be more fully understood from the following description together with the accompanying drawing, in the Figures 1, 2, 3 and 4 of which the invention is illustrated. Fig. 1 is a circuit diagram illustarting the arrangements of the invention applied to a set of contacts connected in shunt across a transmission line. Figs. 2 and 3 are modifications of the arrangements of Fig. 1. Fig. 4 is a circuit diagram illustrating the arrangements of the invention applied to a set of contacts connected in series in a transmission line. Similar reference characters have been utilized to denote like parts in all of the figures.

In Fig. 1 is shown a transmission line L connected to a source of current, such as the generator G. Bridged across the line L would be a circuit arrangement including the switch K. When the contacts of switch K are open, current from G will flow out over the line L. When switch K is closed, a shunt will be closed across the line L and substantially no current will flow out thereover, as will be pointed out hereinafter. An arrangement having the above characteristics might be utilized for the transmission of signals in a carrier telegraph system. For example, the arrangements of the invention might be applied to a carrier telegraph system of the type shown in U. S. Patent 1,773,789, issued August 26, 1930 to W. T. Rea. This patent shows a carrier telegraph sending circuits 4 which might correspond to line L. An oscillator 5, which might correspond to oscillator G, is connected to line 4 and adapted to be short-circuited by the contacts of relay 2. The arrangements of this invention might be utilized to short-circuit line 4 in place of the relay contacts shown in the above mentioned patent. If comparatively small currents and voltages were carried by the contacts of switch K trouble in the transmission of currents might be experienced due to the existence at such "dry" contacts of a high resistance. Accordingly, the switch K is connected across line L by a balanced rectifier circuit as shown. This circuit would include the rectifiers R_1, R_2, R_3 and R_4, poled as shown. The requirement for perfect balance is that the impedances of R_1 and R_2 be equal and the impedance of R_3 equal that of R_4. A battery B poles as shown and a current-limiting resistance r shunted by a condenser C are connected as shown to one of the contacts of key K. It will be seen that with the switch K open, current will flow freely from the generator G to the line L, the rectifiers being so poled that no path is offered through the bridged circuits. When the key K is closed, current will flow from the generator G through rectifiers R_1 and R_4 for one half of the alternating current wave and through rectifiers R_2 and R_3 during the other half, so that substantially no current will flow to the line L. The condenser C is shown connected so as to effectively short circuit the current-limiting resistance r for alternating currents, but with a comparatively low value of r this might not be necessary. In accordance with the arrangements of the invention the battery B provides a voltage across the contacts of switch K which will be effective in breaking down the resistance of a film or particles of dirt which may be upon the contacts. There is, however, no tendency for current from B to enter the line L or the generator G other than longitudinally due to the fact that the rectifiers are balanced. It might be desirable to isolate the rectifier arrangement by means of the transformer T_2 to prevent the flow of current from the battery longitudinally through admittance to ground. A transformer T_1 is also desirable between the generator and the rectifier circuit because it is common practice to ground one terminal of the generator. The battery may also be grounded as shown and be common to a number of circuits.

In Fig. 2 is shown a modification of the arrangements of Fig. 1. In Fig. 2 the current limiting resistance is divided into two equal parts

r' and r'', which are connected serially in the line. No condenser is needed in this case and the transformer T_1 is omitted. In other respects the operation is similar to that heretofore described.

In Fig. 3 is shown a further modification of the arrangements of the invention. In this arrangement only two rectifiers, R'_1 and R'_2, are needed, but it is required that they be of a type, the impedance of which for small superposed alternating currents becomes small when the rectified current becomes large. These rectifiers are poled to oppose each other so as to offer no path for the current from the generator when the switch K is open. Bridged around these rectifiers, or across the line, is a circuit including the current limiting resistances r' and r'', the batteries B_1 and B_2, and the inductances L_1 and L_2. This circuit arrangement will offer substantially no path for the current from generator G, when switch K is open, because of the impedance offered by inductances L_1 and L_2. Accordingly, when switch K is open, current from generator G will be transmitted out over the line L. When switch K is closed current will flow from G for either half of the alternating current wave over the following path; from the tip side of the line through R'_1 and R'_2 to the ring side of the line. This is because the rectifiers, as heretofore pointed out, are of the type in which the impedance for small superposed alternating currents decreases rapidly when the rectified current becomes large. When switch K is closed the voltages of the two batteries B_1 and B_2 are effective breaking down resistance existing across the contact points of switch K.

In Fig. 4 the arrangements of the invention are shown applied to the contacts of a switching device connected in series in a line rather than in shunt across a line as in the previously described arrangements. In this arrangement a balanced rectifier circuit is provided including rectifiers R_1, R_2, R_3 and R_4. The requirements for perfect balance is that the impedances of R_1 and R_2 be equal and the impedance of R_3 equal that of R_4. Rectifiers R_1 and R_2 are oppositely poled and are connected serially in the line. Rectifiers R_3 and R_4 are poled oppositely to each other and with respect to R_1 and R_2, and connected serially in the line. The two sets of rectifiers are in parallel with each other. Connected between the rectifiers of each set is the battery B, the current-limiting resistance r shunted by condenser C, and the switch K. The operation of the arrangements of Fig. 4 is the reverse of the previously described arrangements in that current flows over the line L when the switch K is closed and not when it is open. When the switch K is open the poling of the rectifiers will in effect open the line. When switch K is closed a path for one half of the alternating current wave will be presented as follows; from the tip side of the line through R_1, battery B, condenser C, switch K, rectifier R_4, to the ring side of the line. A path for the other half of the alternating current wave will be as follows; from the ring side of the line, through R_2, battery B, condenser C, switch K, rectifier R_3, to the tip side of the line. Due to the balanced condition of the rectifiers current from battery B will not enter the circuit of generator G. The rectifier circuit may be isolated by the transformers T_1 and T_2.

It is pointed out that a desirable type of rectifier for use in the arrangements of the invention would be those of the copper-oxide variety. However, other types of rectifiers may also be used. Furthermore, while the generator G has been shown as of the alternating current variety, neverthless the arrangments of the invention are applicable to circuits utilizing sources of potential of other types, such for example as a battery.

While the arrangements of the invention have been disclosed as embodied in certain specific forms which are deemed desirable, it is understood that they are capable of embodiment in many and other widely varied forms without departing from the spirit of the invention as defined by the appended claims.

What is claimed is:

1. An electrical circuit, a source of voltage connected thereto, a switching device having a set of contacts connected to said circuit for controlling the flow of current over said circuit from said source of voltage, and auxiliary means for applying a voltage across the contacts of said switching device to break down the contact resistance thereof.

2. An electrical circuit, a source of voltage connected thereto, and a switching device connected to said circuit for controlling the flow of current over said circuit from said source of voltage, said switching device comprising a circuit arrangement comprising two sets of rectifiers connected across said circuit, the rectifiers of each set being oppositely poled, and a circuit connected between the two sets of rectifiers and including the contacts of a switch and means for applying a voltage across said contacts.

3. An electrical circuit, a source of voltage connected thereto, and a switching device connected to said circuit for controlling the flow of current over said circuit from said source of voltage, said switching device comprising a circuit arrangement comprising two sets of rectifiers, each set being connected to said electrical circuit and in parallel with the other set, the rectifiers of each set being oppositely poled with respect to each other and with the corresponding rectifiers in the other set, and a circuit connected from a point between the rectifiers of one set to a point between the rectifiers of the other set, said circuit including the contacts of a switch and a source of voltage.

4. A transmission line, a source of voltage connected thereto, and a switching device connected to said line for controlling the flow of current over said line from said source of voltage, said switching device comprising a circuit arrangement comprising two sets of rectifiers, each set being connected to the line and in parallel with the other set, the rectifiers of each set being oppositely poled with respect to each other and with the corresponding rectifiers in the other set, the impedances of the rectifiers in each set being equal to each other, and a circuit connected from a point between the rectifiers of one set to a point between the rectifiers of the other set, said circuit including the contacts of a switch, a current limiting resistance shunted by a condenser, and a source of voltage.

5. An electrical circuit, a source of voltage connected thereto, and a switching device connected to said circuit for controlling the flow of current over said circuit from said source of voltage, said switching device comprising a circuit arrangement comprising two paths connected to said electrical circuit and arranged for transmission in opposite directions, each of said paths having a portion thereof in common with the other, said common portion including the contacts of a switch and a source of voltage.

6. An electrical circuit, a source of voltage connected thereto, and a switching device connected to said circuit for controlling the flow of current over said circuit from said source of voltage, said switching device comprising a circuit connected across said electrical circuit including two oppositely poled rectifiers, a second circuit connected across said electrical circuit inluding two inductances and two oppositely poled sources of voltage, and a circuit including the contacts of a switch connected from a point between said rectifiers to a point between said oppositely poled sources of voltage.

7. In an electrical system in which currents are transmitted over the contacts of a switching device therein the method of reducing the resistance existing at said contacts which comprises applying across such contacts a voltage distinct from the voltage of the transmitted currents.

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