Feb. 9, 1937. W. T. WINTRINGHAM 2,069,932

ELECTRICAL SYSTEM

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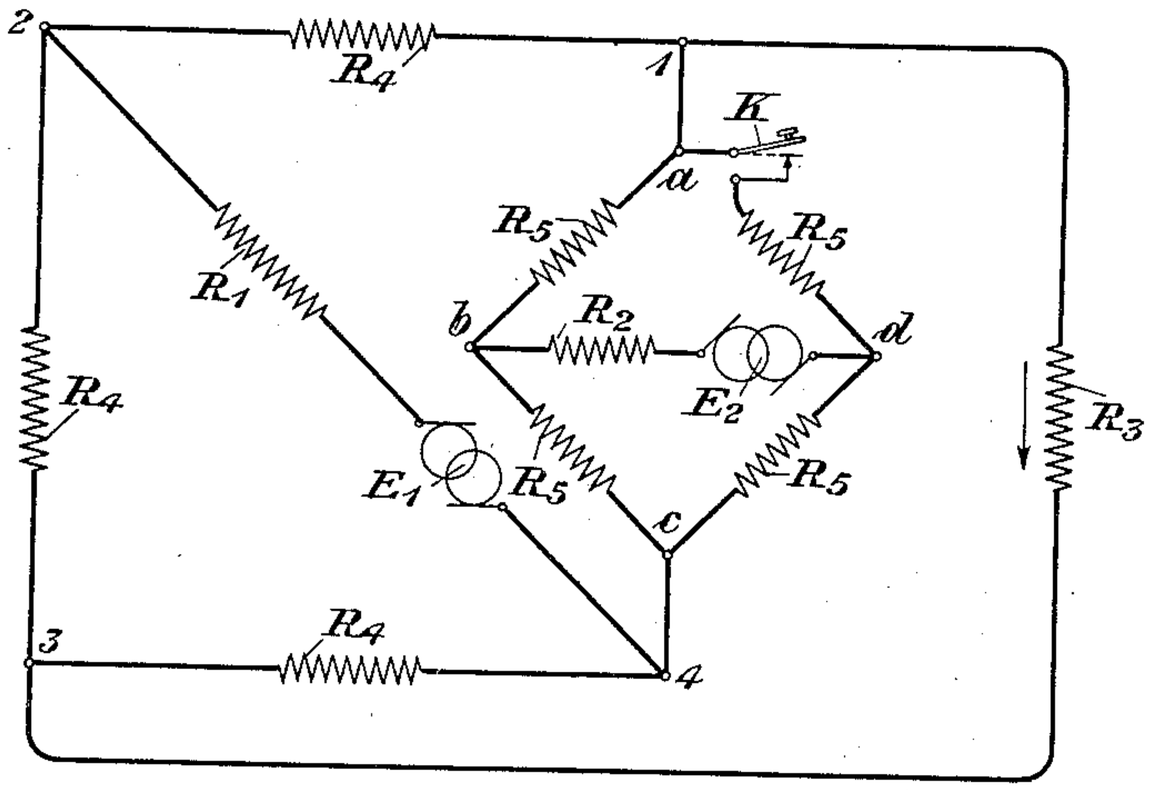
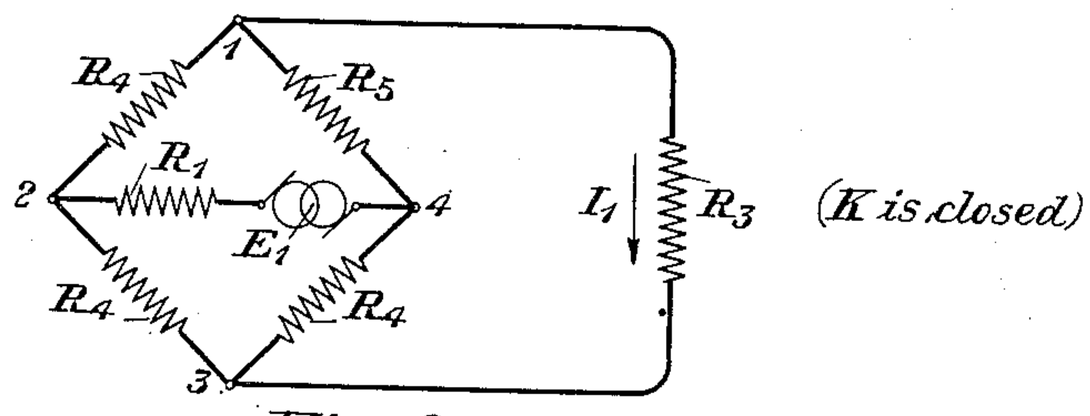
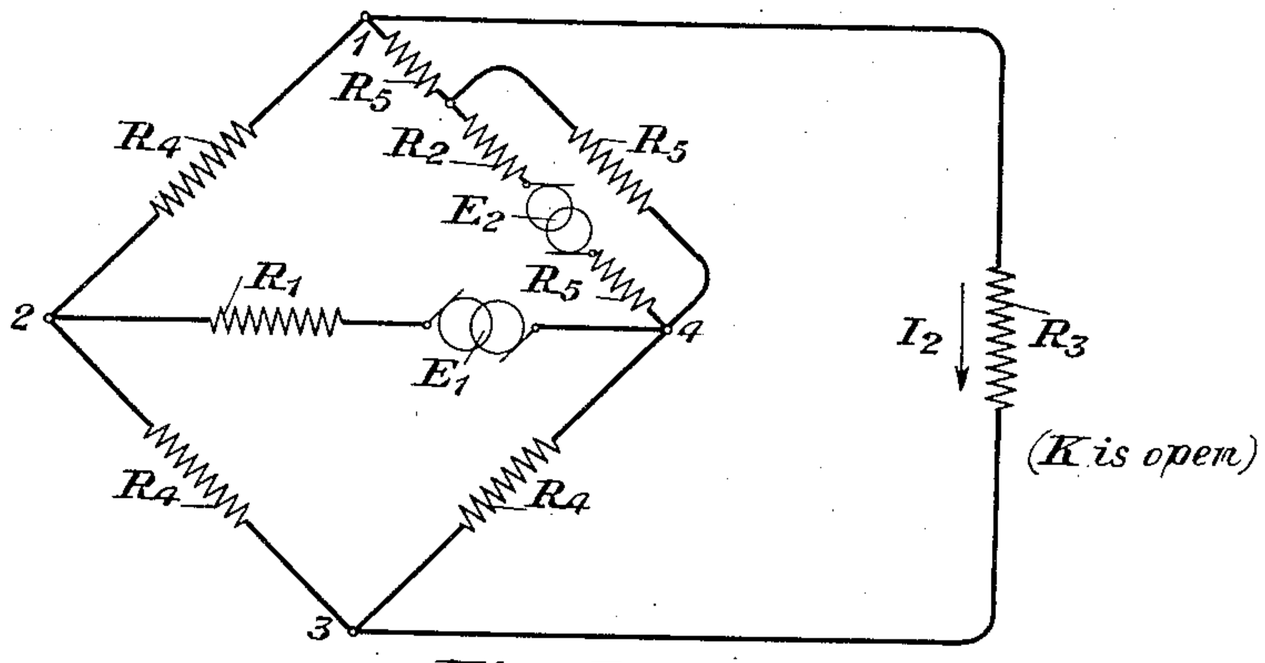


Fig. 1



(K is closed)

Fig. 2



(K is open)

Fig. 3

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ELECTRICAL SYSTEM

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2 Claims. (Cl. 178—68)

This invention relates to electrical systems, and more particularly to methods of and means for applying alternately to such a system two electric potentials.

The invention is applicable, for example, to polar telegraphy, and has the advantage over the arrangements of the prior art that energy can be applied to a work circuit alternately from two independent sources by the simple opening and closing of a single contact.

The methods used heretofore for the alternate application of two potentials involve the connection to the load or work circuit of the switch arm of a double-throw switch (or relay) and the connection of the two generators or other sources of electrical energy to two points of the switch so that when the switch is operated in one direction the first source is connected to the load, and when the switch is operated in the other direction the second source is connected to the load. This method of operation includes the disadvantages that an appreciable lapse of time is involved in the switching operation and that double-throw switching means are required.

It is the object of the present invention to overcome these disadvantages and to provide an arrangement whereby only a single contact is required for the switching operation, one source being effectively connected to the load when the contact is open and the second source when the contact is closed. Furthermore, it is the object of the invention to provide an arrangement whereby there is no appreciable lapse of time between the removal of the output of one source and the application of the output of the second source.

In general the applicant accomplishes the above stated objects by impressing the two electric potentials directly on an auxiliary circuit associated with the work circuit, switching the auxiliary circuit between two conditions and causing each circuit condition to balance out one of the potentials in the auxiliary circuit and impress the other on the work circuit.

The invention will be understood from the following description of one desirable embodiment thereof, which description is to be read with reference to the accompanying drawing.

Figure 1 of the drawing shows diagrammatically a suitable arrangement of the system of the invention including a work circuit, an auxiliary circuit and a key for controlling the latter;

Fig. 2 shows the effective arrangement of the system when the key of Fig. 1 is closed; and

Fig. 3 shows the effective arrangement of the system when the key of Fig. 1 is open.

Like characters of reference in the several figures of the drawing designate corresponding elements of the system.

With particular reference first to Fig. 1, there is disclosed what may be termed a double Wheatstone bridge. The inner bridge includes four equal resistance arms *a*—*b*, *b*—*c*, *c*—*d* and *d*—*a*, the resistance of each arm being represented by R_5. One arm of this bridge, *d*—*a*, is so arranged that it may be opened or closed by the operation of the key K. A generator of electromotive force E_2 and an internal resistance R_2 are connected across the bridge between points *b* and *d*. Through the connections *a*—**1** and *c*—**4** the conjugate terminals of this inner bridge are connected so that the bridge forms one arm of an outer Wheatstone bridge. The other arms of this outer bridge **1**—**2**, **2**—**3** and **3**—**4** are of equal resistance, represented by R_4. Across this outer bridge, between the points **2** and **4**, another generator of electromotive force E_1 and an internal resistance R_1 are connected. The work circuit, including the load represented by R_3, is connected across the conjugate terminals **1** and **3** of the outer bridge.

When the key K is closed, the inner bridge, made up of the four equal resistance arms, each having the value R_5, is balanced and the appearance of potential from the generator E_2 at any point in the system outside the inner bridge is prevented. Therefore, with respect to the effect on the remainder of the circuit, this inner bridge (as long as the key K is closed) might be replaced by a single resistance equal in value to the resistance across the terminals *a* and *c* through which it is connected to the remainder of the circuit. This substitution is indicated in the equivalent circuit shown in Fig. 2, in which the inner bridge making up the arm **1**—**4** of the outer bridge is replaced by its value R_5. It is clear that with the key K of Fig. 1 closed, the generator E_1 will produce a current I_1 through the load R_3 if the bridge as shown in Fig. 2 is unbalanced. Accordingly it will be understood that one requirement of the operation of the system of the invention is that the resistance value R_5 be unequal to the resistance value R_4. With this requirement met it is clear that with the key K closed the output of generator E_1 is impressed on the work circuit connected across the conjugate terminals **1** and **3** of the outer bridge, while the output of generator E_2 in the inner bridge is balanced out in the double Wheat-

stone bridge or auxiliary circuit and is accordingly not impressed on the work circuit.

If the key K of Fig. 1 is open the inner bridge is obviously unbalanced and the potential from the generator E_2 will affect the remainder of the circuit. The requirement is, of course, that energy shall be produced in the load R_3 while no energy from the generator E_1 shall be impressed on the work circuit. This requirement and the manner in which it is met will be understood from an examination of Fig. 3, which represents diagrammatically the condition of the system when key K is open. In order that the outer bridge may be balanced to prevent the flow of current in the load R_3 due to the generator E_1, the following condition must obtain:

$$R_4 = R_5 + R_5\frac{R_2+R_5}{R_2+2R_5}$$

This requirement, of course, is quite consistent with the requirement stated hereinabove that R_4 and R_5 must be unequal.

Accordingly it is seen that with the arrangement shown in Fig. 1, if the key K is closed we have the equivalent of the arrangement of Fig. 2 in which the output of generator E_2 is balanced out in the auxiliary circuit and the generator E_1 causes the flow of a current I_1 through the load R_3 in the work circuit; if, on the other hand, the key K of Fig. 1 is open, we have the equivalent of the arrangement shown in Fig. 3, in accordance with which the generator E_2 of the inner bridge causes the flow of current I_2 through the load R_3, while the output of generator E_1 is balanced out in the auxiliary circuit since the resistance of the outer bridge arm 1—4 is equal to the resistance of each of the other arms 1—2, 2—3 and 3—4.

It will be understood that a system such as that disclosed permits the transmission of polar telegraph signals, for example, from a single contact, no appreciable timing elapsing between the removal of one potential and the application of the second potential.

While the invention has been disclosed in one desirable form for the purpose of illustration, it is to be understood that the embodiment may take many other and different forms within the scope of the appended claims.

What is claimed is:

1. In combination in an electrical system, a work circuit, a first balance bridge, a second balance bridge including said first bridge as one of its arms, a single-contact switch for opening and closing one arm of said first bridge, and two sources of electrical energy connected one across each of said bridges, the resistance values of the arms of said bridges and the connection of said bridges to said work circuit being such that upon the opening of said switch the energy from the source connected across the first bridge alone is impressed on said work circuit and upon the closing of said switch the energy from the source connected across the second bridge alone is impressed on said work circuit.

2. In an electrical system, a double Wheatstone bridge comprising an outer bridge and an inner bridge forming one arm of the outer bridge, a first source of electrical energy connected across the outer bridge, a second source of electrical energy connected across the inner bridge, a switch for opening and closing one arm of the inner bridge, and a work circuit connected across the conjugate terminals of the outer bridge, the resistance values of the arms of the two bridges being such that when the switch is closed the energy from the first source alone is impressed on the work circuit and when the switch is open the energy from the second source alone is impressed thereon, whereby the outputs of the two sources may be applied alternately to the work circuit without substantial lapse of time between the removal of one and the application of the other.

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