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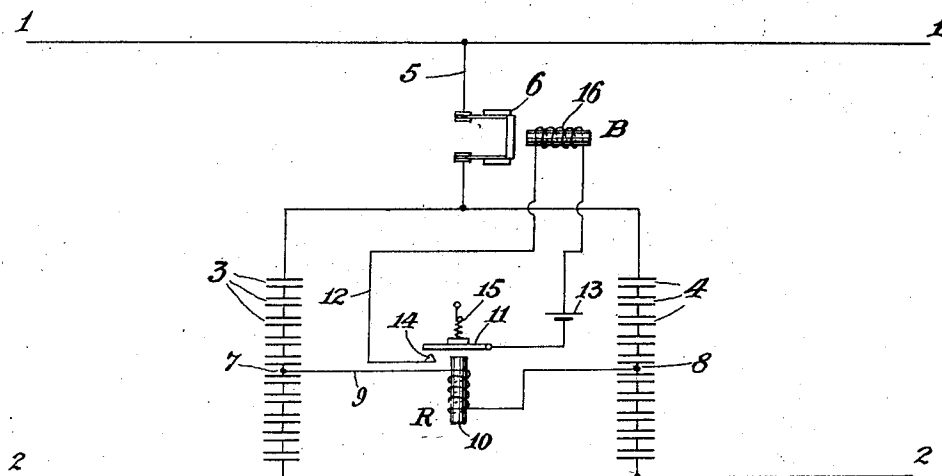
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PROTECTIVE MEANS FOR CONDENSER INSTALLATIONS

Filed Nov. 9, 1920

2 Sheets-Sheet 1

Fig. 1.



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Fig. 2.

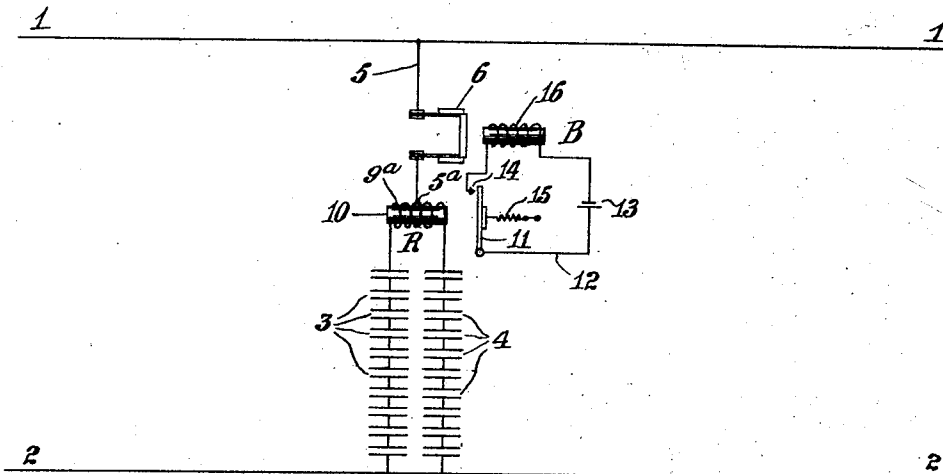
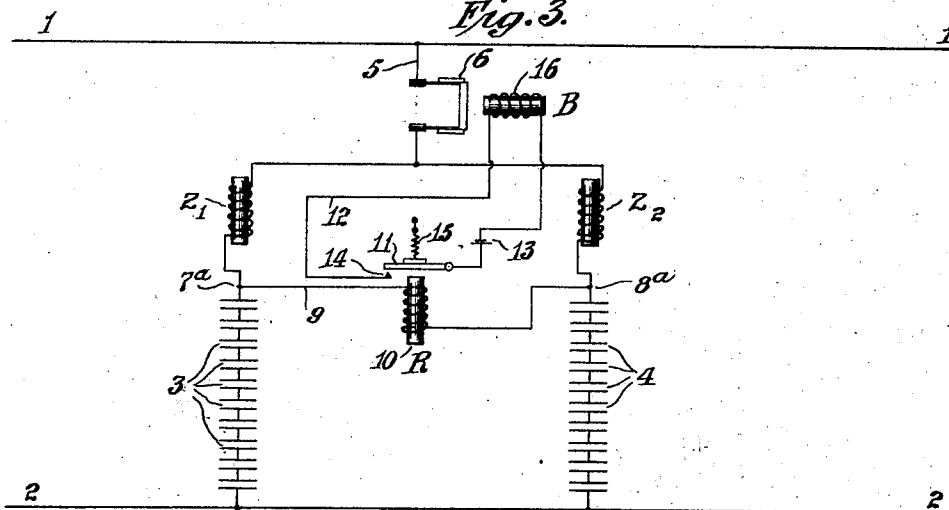


Fig. 3.



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UNITED STATES PATENT OFFICE.

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PROTECTIVE MEANS FOR CONDENSER INSTALLATIONS.

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To all whom it may concern:

Be it known that I, GREENLEAF WHITTIER PICKARD, a citizen of the United States of America, and a resident, of Newton Center, State of Massachusetts, have invented certain new and useful Protective Means for Condenser Installations, the principles of which are set forth in the following specification and accompanying drawings, which disclose the form of the invention which I now consider to be the best of the various forms in which the principles of the invention may be embodied.

This invention relates to protective means for condenser installations.

In commercial installations of condensers, as, for example, for the purpose of improving the power factor of transmission lines, a number of condensers or sections are placed in a series multiple arrangement or in multiple across the line. The failure of any one condenser or section, as by breakdown or other short-circuiting, will, of course, place an additional load on the remaining sections or condensers in series, and these sections will also be in peril. The use of such condensers for the purpose of improving the power factor of transmission lines has not been general for the principal reason that no adequate means has been provided for protecting the condenser installations against breakdown and final destruction.

Heretofore each group or string of condensers has been protected by a line fuse, which, of course, does not blow when a single section or condenser is shorted, but only when the whole string is distressed, that is to say, when half or more of the condensers have been ruined.

Other means have been suggested for protecting such condenser installations, such as cut-outs or warning signals directly controlled by the variation in current thru any string of condensers due to the breaking down of condensers in series. If, for example, there are ten condensers in series across the line, the failure of one condenser will increase the current thru the string by about eleven per cent and also increase by the same amount the potential across the remaining condensers. This increase of current or potential, however, is not sufficient in itself to positively operate any cut-out

or warning signal, and the result is that after a certain time the remaining condensers or sections break down and the entire string is destroyed. This may involve the destruction of hundreds or thousands of dollars worth of condensers, and obviously this prevention is of great importance.

The use of line fuses or circuit breakers operated directly by variation in current in the condenser circuit due to the breakdown of any condenser in the string, which variation in current may amount to eleven per cent in the example above given, is not sufficient for the purpose of direct operation of such fuses or circuit breakers. In practice, such devices would also operate on accidental disturbances, such as momentary increases of voltage on the line or surges or even because of mechanical vibration from adjacent machinery or generators in motion.

The object of the present invention is to remedy the above difficulties and provide means whereby the condenser installation may have the maximum protection.

In particular, the object of the invention is to provide means whereby the failure of any one condenser as by breakdown or other short-circuiting will automatically cut out the installation from the system in which it is installed.

The invention consists further in details of construction and combination of parts hereinafter more particularly described and claimed.

In the accompanying drawings, which form a part of the specification, Figure 1 is a diagrammatic view of one embodiment of the invention which is now considered the preferred one.

Figure 2 is a diagrammatic view of a modified form of the invention, and

Figure 3 is a diagrammatic view of a further modified form of the invention.

In order to illustrate an application of the invention, referring to Fig. 1, I have indicated a transmission line, including the conductors 1—1 and 2—2, across which a condenser installation comprising two strings or groups of condensers connected in series, (although the invention covers the use of a single condenser in each group), is connected for the purpose of improving the power factor of the transmission line. The

condensers of one group are indicated at 3 and the condensers of the other group are indicated at 4, the two groups being connected in parallel or multiple across the line preferably through a common lead 5 having a cut-out switch 6. Connecting points 7 and 8 of equal potential on the two strings of condensers 3 and 4, (and as shown in Fig. 1 the mid-points of the two strings of condensers, it being assumed that all the condensers are intact and of the same capacity,) is a bridge arrangement 9, including the relay R comprising an electromagnet 10 in the circuit of bridge 9 and a movable contact armature 11 acting as a switch controlling a battery circuit 12 provided with a suitable source of energy or battery 13. Inasmuch as during normal operation the points 7 and 8 are at the same potential, no current then flows thru the electromagnet 10. As soon as one section or one condenser of one string breaks down or fails by reason of some abnormal condition therein, the bridge 9 is unbalanced and current flows thru the relay R, closing the circuit 12 thru armature 11.

The armature 11, controlling the local battery circuit 12, is normally retained in open circuit position out of engagement with contact 14 by means of a spring 15 until the relay R is energized when armature 11 then closes circuit 12 by moving into engagement with contact 14. In the circuit 12 is included a circuit breaker B comprising an electromagnet 16 which, when energized by the closing of circuit 12, attracts the switch 6 cutting out the condensers from across the line. In a large system, there will be many strings of condensers or sections, and the above-described arrangement can be repeated for each pair.

In case any one section or any one condenser of either string of condensers 3 and 4 breaks down, there will be a difference of potential at the points 7 and 8, which causes the actuation of the relay R, closing the circuit 12 and automatically moving the switch 6 to open position. The two strings of condensers 3 and 4 are then cut out from across the line, and the circuit remains open until the defective section or condenser can be replaced or repaired.

Referring to Fig. 2, I have illustrated a modified form of bridge circuit employing a differential winding on the relay R. In the form here illustrated, the two groups of condensers 3 and 4 are connected to the common lead 5 thru the relay coil 9^a wound around the core 10, the lead 5 being tapped or electrically connected to the midpoint 5^a of coil 9^a, providing a coil having equal parts at opposite sides of point 5^a symmetrically arranged, providing a differential winding connecting condenser group 3 and condenser group 4 respectively and traversed by equal currents from conductor 5 to the two groups

of condensers. The magnetic effect of the currents in the two parts of the coil 9^a under normal conditions being equal and opposite, there will be no resultant magnetism in the core 10. When an abnormal condition exists in either group of condensers, as by reason of a breakdown of one of the condensers or other cause, the currents in the two parts of the coil 9^a will be unequal, thereby magnetizing the core 10, closing the circuit 12 thru armature 11 and contact 14, thus opening the circuits of the groups of condensers in the manner shown and described in connection with Fig. 1. Inasmuch as the coil 9^a is non-inductive, there is no appreciable reactance added to the condenser circuits. The coil 9^a should be composed of some material having a low ohmic resistance.

In Fig. 3 is illustrated the type of bridge disclosed in Fig. 1, but connected to equal potential points on the two condenser groups 3 and 4 at a slightly different location. In condenser installations as above described, it is sometimes customary to add a small reactance in series with each group of condensers for the purpose of protecting the system against high frequency surges and also for the purpose of preventing accentuation of harmonics in the line currents. Such reactances Z' and Z², which are equal impedances, are shown in Fig. 3 connected in series with the condenser group 3 and condenser group 4 respectively, each reactance being located between its group and conductor 5. In this embodiment, the bridge 9 containing relay R is shown connected to the groups 3 and 4 at points 7^a and 8^a of equal potential, each of which points is located for purposes of convenience between its group 3 or 4 and its reactance Z' or Z². As shown and described in referring to Fig. 1, the system of Fig. 3 operates normally with the currents flowing thru Z and condenser group 3, and Z² and condenser group 4, the points 7^a and 8^a being normally at equal potential. If a condenser or section of either group 3 or 4 breaks down, an increased current thru the defective group results, which raises the potential of either the point 7^a or 8^a above that of the other, thereby sending current across the bridge 9. The relay R then operates the local circuit 12 and electromagnet B for throwing open switch 6 of the condenser groups in the same manner as shown and described in connection with Fig. 1.

My invention accomplishes a protection that is impossible by either a line fuse or by a current-actuated circuit breaker above referred to, as it is not commercially practical to operate any fuse or circuit breaker on a margin of say eleven per cent. change of current as would be the case where one condenser out of a series of ten breaks down. Hence, in former constructions, such pro-

protective devices would not operate until a larger number of the sections had broken down.

By the present invention, any pair of groups of the condenser system is cut out as soon as any one section or condenser of that pair breaks down. Furthermore, the protective device herein described is not affected by accidental disturbances such as momentary increases of voltage on the line or surges, because such changes do not disturb the balance of the bridge 9 in any way, nor is it affected by vibration, because its operation results from a change from zero current thru the relay R to a strong current, and in consequence the spring 15 which normally holds the armature 11 back from the contact 14 can be made as strong as desired.

Of course, the broken-down or short-circuited condenser or condenser section is repaired or replaced after the installation has been saved by the automatic operation of main electromagnetic switch 6, whereupon the later is closed manually and the entire apparatus of the invention left in readiness to continue its protecting function.

It is to be understood that the invention is not limited to the embodiments and features specifically shown and described herein, but that such embodiments and features are subject to changes and modifications without any departure from the spirit of the invention.

I claim:—

1. In a condenser installation comprising parallel-connected condensers across a transmission line, the means for preventing breakdown of the entire condenser installation by a fault in any part of it, which comprises a main electromagnetic condenser-cut-out switch for the condensers across the line; a controlling electromagnetic

switch therefor having its coil connected to equipotential points of the condensers in the two branches of the condenser installation whereby said controlling switch is operated by current due to unbalancing of potential by a fault in any part of the condenser installation; and a circuit closed by said controlling switch and containing the coil of the main condenser-cut-out switch and a source of E. M. F.

2. In a condenser power-factor installation comprising parallel-connected condensers connected across the mains of an electric transmission system, the means for preventing breakdown of the entire condenser installation by a fault in any part of it, which comprises a main electromagnetic switch arranged to cut-out the entire condenser installation from the mains; a controlling electromagnetic switch therefor having its coil connected to the two branches of the condenser installation to cause the operation of said controlling switch by the current flow in the coil thereof resulting from a fault in any part of the condenser installation; and a circuit closed by said controlling switch and containing the coil of the main condenser-cut-out switch and a source of E. M. F.

3. In a condenser power-factor installation comprising parallel-connected condensers across the mains of an electric transmission system, the method of preventing breakdown of the entire condenser installation by a fault in any part of it, which consists in employing current flow resulting from a fault in any part of the condenser system to control the operation of a cut-out for the entire condenser system.

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Witnesses:

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CHAS H. KESLER.