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K. KUHLMANN.

PROTECTIVE DEVICE FOR ELECTRICAL SYSTEMS.

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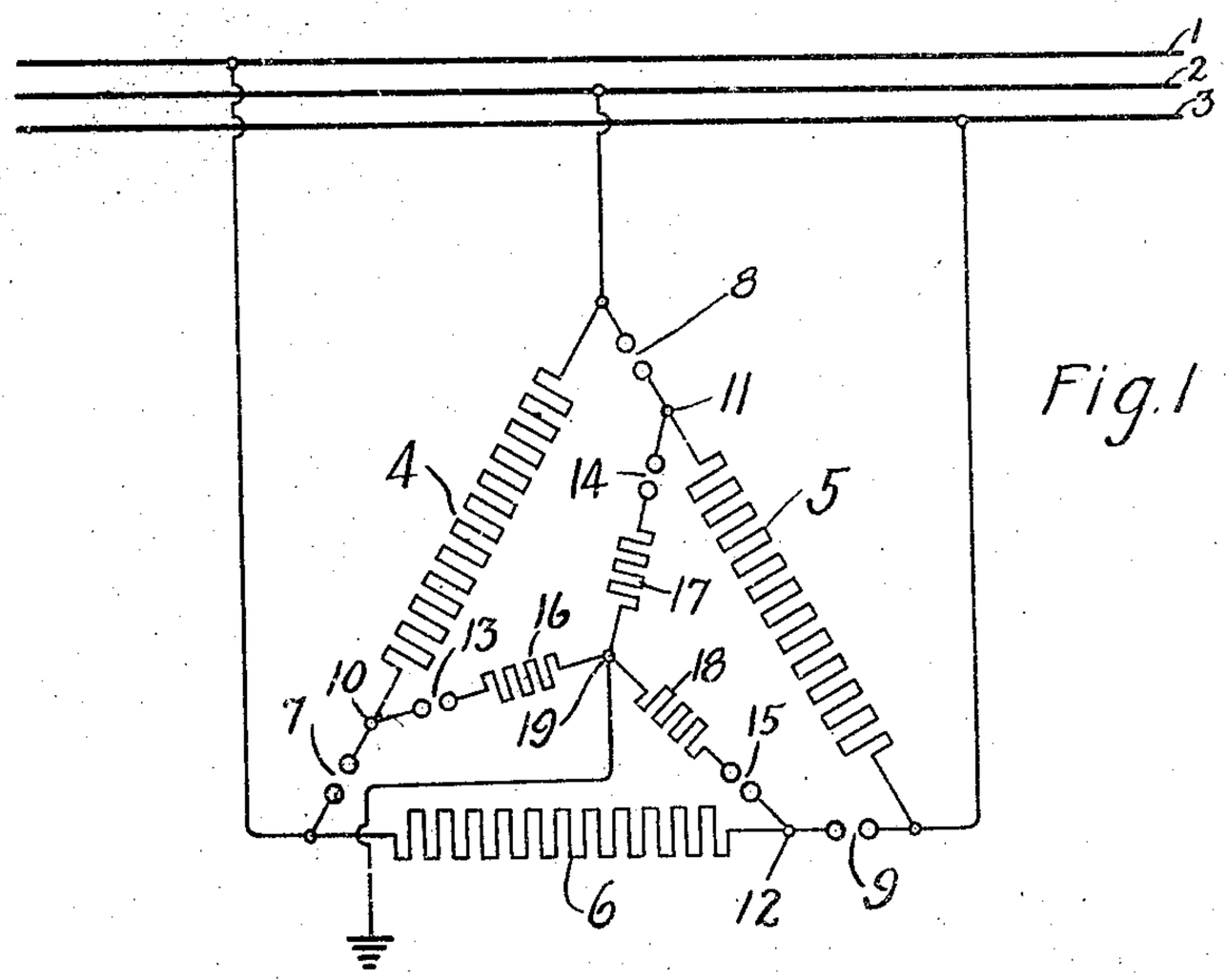

Fig. 1

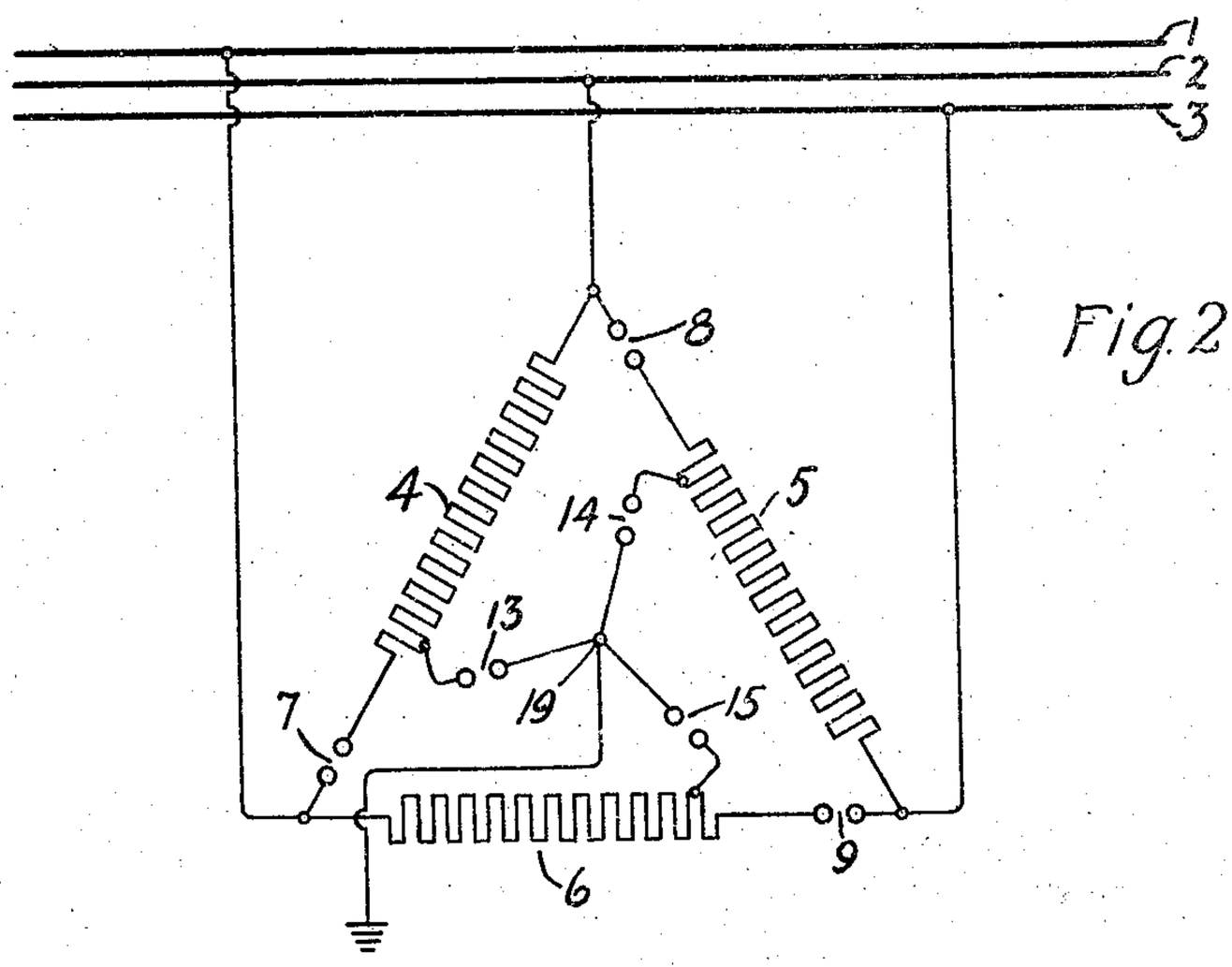

Fig. 2

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UNITED STATES PATENT OFFICE.

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PROTECTIVE DEVICE FOR ELECTRICAL SYSTEMS.

No. 897,211. Specification of Letters Patent. Patented Aug. 25, 1908.

Application filed March 15, 1907. Serial No. 362,479.

To all whom it may concern:

Be it known that I, KARL KUHLMANN, a subject of the Emperor of Germany, residing at Berlin, Pankow, Germany, have invented certain new and useful Improvements in Protective Devices for Electrical Systems, of which the following is a specification.

In electrical supply systems, spark gaps or condensers are generally employed as a protection against excessive potentials. They are usually connected in series with resistances, and arranged partially between the leads themselves and partially between their respective leads and ground. Attempt has heretofore been made to reduce the number of resistances, but too little attention has heretofore been paid to the point of creating excess potential paths according to the frequency of the excess potentials. The number of oscillations is of essential influence on the path selected by a quantity of electricity for its discharge. Thus, for example, it is known that high frequency discharges choose the path through spark gaps or condensers in preference to that through ohmic resistance, since the latter cannot be so formed as to offer an entirely inductionless path to very rapidly alternating currents.

The arrangement described below embodies the principles above set forth.

One novelty of the new arrangement consists in the special provision of paths for the rapidly oscillating pulsations.

In the accompanying drawing, Figure 1 is a diagrammatic illustration of my invention as applied to a three phase system,—Fig. 2 is a modification omitting certain of the resistances.

In Fig. 1 the three conductors 1, 2 and 3 of a three phase system to be protected, are connected to each other through resistances 4, 5 and 6, each connected in series with a safety device such as the spark gaps 7, 8, and 9. Each conductor of the three phase system is separated from every other conductor by a resistance and a safety device or spark gap, and the spark gaps and resistances are so disposed that each conductor is connected directly to the spark gap of one path and the resistance of another path. At the junction points 10, 11 and 12, between the safety devices and their respective resistances, auxiliary paths are connected which lead through spark gaps 13, 14 and 15 and resistances 16, 17 and 18 to a junction point 19 connected directly to ground. The resistances 16, 17 and 18 are comparatively small and may, under some circumstances, be omitted. With this arrangement of the resistances and spark gaps, excessive potentials of comparatively small frequency which may be produced between any lead and earth, find a path of discharge through a resistance and its spark gap, for example, from conductor 2 through resistance 4, spark gap 13, and resistance 16, to earth; the high frequency discharges choose on the contrary, the path through spark gap 8, spark gap 14, and resistance 17 for the reason that this path contains only small resistance. In the latter case, however, the first mentioned path is also partly utilized. The arrangement has the great advantage that lightning discharges, generally large, are not merely carried off through a single spark gap but are carried to earth on two parallel paths; disturbances of the safety device by reason of too great heating is therefore avoided. Excessive potentials between two conductors, for example, between conductors 2 and 1, select, according to the number of oscillations, the path through 4 and 7, or through 8, 14, 17, 16, 13 and 7. In the latter case they pass harmlessly notwithstanding the small resistance, since in this path four spark gaps are traversed in series. For the same reason, after the simultaneous operation of all the lightning arresters, no excessive passage of current can take place between the leads.

Instead of the auxiliary paths to ground being branched off directly at the points of junction of the spark gaps with the resistance; it is also possible, as shown in Fig. 2, to branch them off from intermediate points of the resistances, points located near the junction of each spark gap and its resistance. According to this arrangement the small resistances 16, 17 and 18 may be entirely dispensed with. This arrangement, like that of Fig. 1, furnishes for rapidly oscillating discharges a path which contains only small resistances in series with the safety device. This is the essential condition for rapid carrying off of such discharges, while, of course, resistances which might be arranged in parallel to the excessive potential safety devices, would not prejudice the method of operation.

The arrangement described might be employed, if desired, in a supply system with

other number of phases, or direct current systems.

What I claim as new and desire to secure by Letters Patent of the United States, is,—

1. The combination with the conductors of a polyphase electrical system, of a resistance and a safety device connecting each conductor with each other conductor of the system, and a low reactance path to ground from the junction of each safety device and its corresponding resistance.

2. The combination with a plurality of line conductors, of a discharge path therebetween including resistance, a second discharge path therebetween of low reactance to include part of said first named path, and a ground connection for an intermediate point in said second path.

3. The combination with a plurality of line conductors, a resistance path therebetween including a spark gap, a second path of low reactance also including said spark gap, and a connection to ground from an intermediate point on said second path.

4. The combination with the three conductors of a three phase system, resistance paths arranged in delta between said conductors for the discharge of abnormal potential of relatively low frequency, a spark gap in each of said resistance paths, and a path to ground through each of said spark gaps but offering less reactance to high frequency discharges than do the resistance paths between line conductors

5. The combination of a ground connection, a plurality of paths of low reactance leading therefrom, and a connection from each of said paths to a line conductor of an electrical system through a resistance, and a connection from each of said paths to a second line conductor through a path of lower reactance.

6. In a lightning arrester, the combination of a ground connection, a plurality of spark gap paths leading therefrom, a plurality of line conductors of a polyphase system, a connection from each of said paths to a line conductor through a resistance, and a second connection to another line conductor through a path including a spark gap but having lower reactance.

7. The combination with a plurality of line conductors of an electric system, of a discharge path from one line conductor to another, said path including a high resistance and also a safety device, and a path to ground for each of said line conductors, said last named path including a safety device and a resistance much lower in value than that of said high resistance in the path between line conductors.

In witness whereof, I have hereunto set my hand this 23rd day of February, 1907.

KARL KUHLMANN.

Witnesses:
JULIUS RUMLAND,
KARL MICKELSEN.