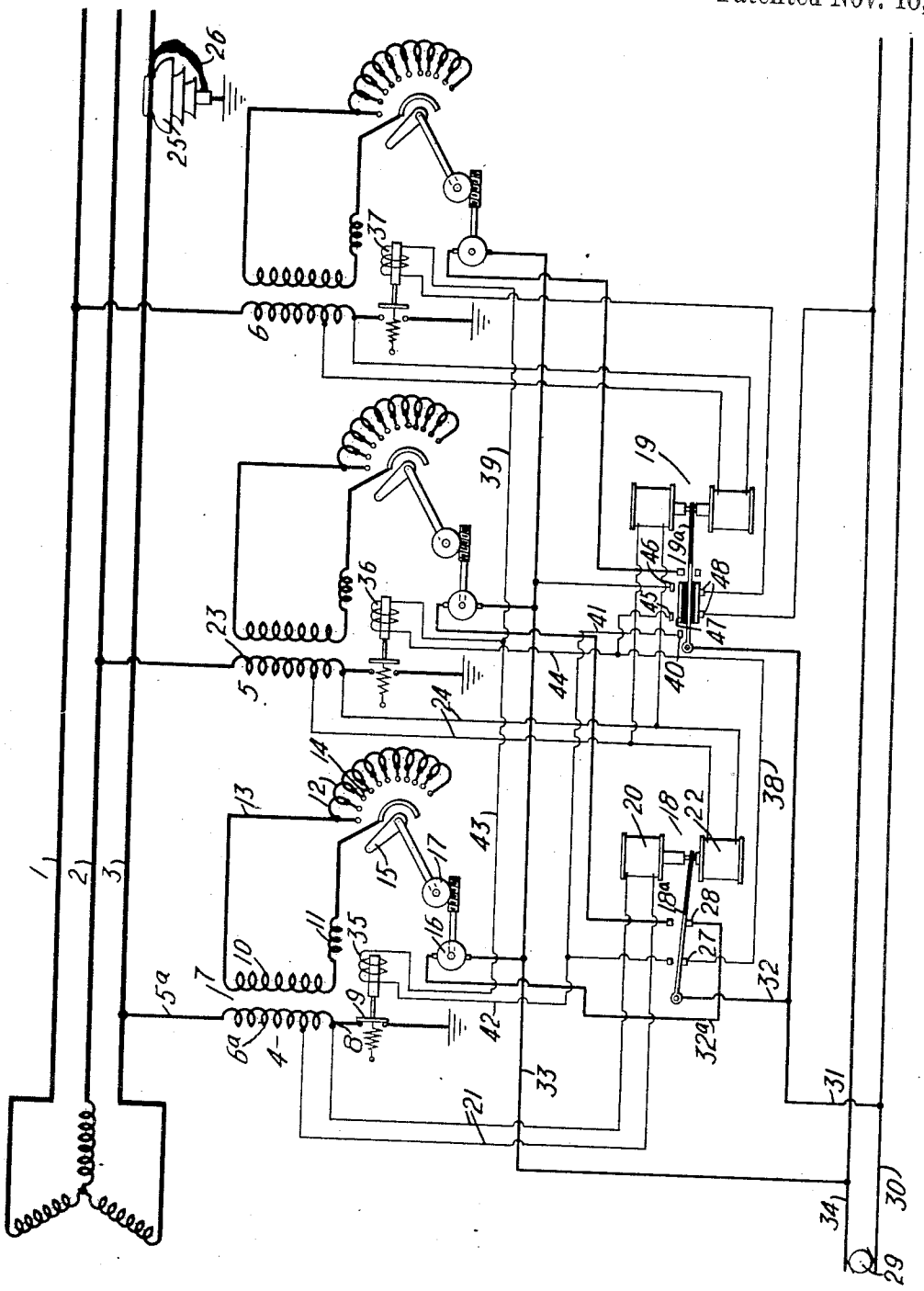
A. CHERNYSHOFF.

ARCING GROUND SUPPRESSOR.

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1,160,844.

Patented Nov. 16, 1915.



WITNESSES:

Fred. A. Lind

Geo. W. Hansen.

INVENTOR

Alexander C. Chernyshoff

BY

Marley & Carr

ATTORNEY

UNITED STATES PATENT OFFICE.

ALEXANDER CHERNYSHOFF, OF SWISSVALE, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA.

ARCING-GROUND SUPPRESSOR.

1,160,844. Specification of Letters Patent. Patented Nov. 16, 1915.

Application filed October 3, 1914. Serial No. 864,707.

To all whom it may concern:

Be it known that I, ALEXANDER CHERNYSHOFF, a subject of the Czar of Russia, and a resident of Swissvale, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Arcing-Ground Suppressors, of which the following is a specification.

My invention relates to protective devices, and it has special reference to arcing-ground suppressors which are adapted to protect electrical conductors and their line insulators from the abnormal stresses occasioned by electric arcs discharging to ground.

Lightning arresters, such as aluminum electrolytic cells, usually afford ample protection to electrical apparatus against lightning disturbances in medium and high-tension transmission lines to which such apparatus is connected. However, such arresters do not protect the line insulators from arcs that follow lightning discharges, which insulators, under all conditions, should be kept intact.

When an arcing ground occurs upon an insulator that supports a high-tension line, it is important that the arc thus occasioned be suppressed quickly because the rapid make-and-break of the arc may create high-frequency disturbances which are very dangerous to the system and the electrical apparatus associated therewith. Also, if arcs over insulators are allowed to continue, they may crack the insulators or burn off the line conductors, thereby causing interruptions of service. To this end, arcing-ground suppressors have been provided which remove or minimize arcing grounds over insulators, but, heretofore, such suppressors have been unsatisfactory because of the abrupt changes in electrical conditions to which the high-tension lines are subjected when these suppressors operate.

It frequently happens that dangerous high-frequency surges are impressed upon a transmission line when an arcing-ground suppressor of the usual type is actuated to remove instantaneously and directly the ground upon the affected conductor. Although the arc across the insulator may be extinguished or suppressed, the abruptness of removing the ground from the affected conductor may create high-frequency surges of considerable energy which may be disastrous to the system.

One object of my invention is to provide an arcing-ground suppressor which will gradually restore normal electrical conditions upon the affected conductor after the arcing ground has been suppressed.

Another object of my invention is to provide an arcing-ground suppressor which, after removing the ground from an affected conductor of a transmission line and gradually restoring normal electrical conditions thereupon, will automatically assume its initial state, thereby preparing itself for suppressing arcs that may subsequently be established on the transmission line.

A further object of my invention is to provide an automatic arcing-ground suppressor which will be simple in construction and reliable in operation, and which will not require an undue amount of attention on the part of the operator or inspector.

To understand more fully my invention, reference may be had to the following description and the accompanying drawing in which the diagrammatic figure shows a simple form of my invention applied to a polyphase transmission line.

It is usual to employ arcing-ground suppressors on ungrounded systems, because, if a neutral point of the system were grounded through no resistance or a relatively small resistance, the accidental grounding of one conductor would impose short-circuit conditions upon one phase of the system, thereby necessitating an interruption of service. In a three-phase system, if the neutral point is not grounded or is grounded through a relatively high resistance, the operating voltage between the phases of either a delta or a V-connection will not be affected to any appreciable extent when one phase is accidentally or purposely grounded. Again, arcing-ground suppressors are particularly adapted to protect lines supported on insulators, the pins or supports of which are grounded—a condition which obtains in the use of common steel towers. Therefore, I have shown my arcing-ground suppressor employed in conjunction with high-tension lines of an ungrounded system, it being presumed, for the purpose of illustration only, that the lines or conductors are supported by insulators secured to steel towers.

Referring to the drawing, the conductors 1, 2 and 3, comprising a three-phase transmission line, are afforded protection against

arcing grounds by means of arcing-ground suppressors 4, 5 and 6, respectively. Inasmuch as these arcing-ground suppressors are identical in operation, I will describe the arcing-ground suppressor 4 only, which is associated with the transmission line or conductor 3. A terminal 5^a of a primary winding 6^a of a transformer 7 is connected to the line conductor 3, another terminal 8 of said winding being connected to ground through a bridging member 9. A secondary winding 10, that is inductively related to the primary winding 6, comprises a circuit having an inductance device 11 and an impedance device or resistor 12 inserted therein. The impedance device 12 is connected, at one terminal, through a conductor 13, to the secondary winding 10 and is also provided with a plurality of taps 14 which may be engaged by a switching member 15 that completes the electrical connection to the other terminal of the secondary winding 10. The switch 15 is operated in a clockwise direction by means of a motor 16 and a wheel-and-ratchet device 17.

The arcing-ground suppressors 4, 5 and 6 are selected by means of selecting relays 18 and 19. The winding of an electromagnet 20 of the relay 18 is shunted, by means of conductors 21, across a portion of the high-tension winding 6^a. The winding of an electromagnet 22 of the relay 18 is shunted across a portion of the primary winding 23 of the transformer 5 by means of conductors 24, and generates a flux which opposes and normally balances that of the electromagnet 20. The primary windings of the transformers 4, 5 and 6 are so designed that they are normally of high impedance, and, for this reason, the normal currents flowing therethrough are of small value, although full line potential is imposed upon each of the said primary windings. Also, the relays 18 and 19 are so designed that, when the conductors 1, 2 and 3 are maintained at their normal operating potential, their armatures 18^a and 19^a, respectively, are disposed midway between the electromagnets.

To understand more fully the operation of my device, I have shown an insulator 25 supporting the conductor 3. When an arc 26 extends from the conductor 3 over the insulator 25 to ground, the voltage impressed upon the high-tension winding 6^a is reduced to that of the effective potential drop along the arc 26. This decrease of potential across the winding 6^a will decrease the current flow through the winding of the electromagnet 20, and, consequently, the armature 18^a will move to the position shown and bridge contact members 27 and 28. In this event, current will flow from a source 29 along conductors 30, 31 and 32, over the armature 18^a and the contact 28, along a conductor 32^a through the motor 16 and along conductors 33 and 34 to the source of supply 29. The motor 16, being actuated, will rotate the switch 15 in a clockwise direction and will substantially instantaneously short circuit the secondary winding 10 of the transformer 7. This instantaneous short circuiting of the secondary winding 10 reduces the impedance of the primary winding 6^a to a relatively low value, thereby connecting the affected conductor 3 to ground through the substantially low impedance now offered by the primary winding 6^a. As a consequence thereof, the arc 26 around the insulators 25 will be extinguished because of insufficient potential to maintain it. The insulator reassumes its normal condition of insulation as soon as the arc vapors are cooled below the temperature of conduction, which requires but a small fraction of a second of time.

If the primary winding 6^a is now abruptly restored to its normal condition, high-frequency electrical surges may be imposed upon the line conductor 3 which may be dangerous to the electrical apparatus connected to the transmission line. To eliminate the possibility of establishing these high-frequency surges, the primary winding 6^a is gradually restored to its initial electrical condition by gradually opening the short circuit imposed upon the secondary winding 10. As the switch 15 successively engages the taps 14 of the energy-consuming device 12, increasing amounts of impedance are inserted in circuit with the secondary winding 10. After a sufficiently high impedance is thus connected in circuit with the secondary winding 10 to preclude the development of high-frequency surges upon the conductor 3, the switch 15 opens the circuit and thereby reëstablishes normal conditions in the primary winding itself and in the conductor 3 and, at the same time, the circuit assumes again its normal condition of equality of potential on each phase above ground. The transmission line is thus clear of an arcing ground without interrupting the service.

It is important that, when the arcing-ground suppressor 4 operates, the arcing-ground suppressors 5 and 6 be precluded from operating, in order to prevent establishing a short circuit across any phase of the transmission line. To this end, switches 35, 36 and 37 are provided which operate the bridging members 9 inserted between one terminal of each of the primary windings and ground of the transformers 4, 5 and 6, respectively. When the armature 18^a of the selective relay 18 is in the position shown, current flows over the contact 27 and a conductor 38, through the winding of the switch 36, over a conductor 39 and through the winding of the switch 37. As current flows through the winding of the switches 36 and 37, they are actuated to withdraw the

bridging members 9, thus disconnecting the primary windings of the transformers 5 and 6 from ground. Normal conditions will be again restored upon the switches 36 and 37 when the relay 18 assumes its normal position after having extinguished the arcing ground on the conductor 3.

When an arcing ground occurs upon the conductor 1, the armature 19ª of the selective relay 19 is pulled upwardly. The switches 35 and 36 are actuated to remove the grounds from the primary windings of the transformers 5 and 6 by reason of current flow across a contact 40, over conductors 41 and 42, through the winding of the switch 35, over a conductor 43, through the winding of the switch 36, over a conductor 44 and across contact terminals 45 and 46, which are bridged by an insulated member 47 mounted upon the armature 19ª. At the same time, contact members 48 are disconnected, thereby opening the circuit of the winding of the switch 37. This precludes the switch 37 from operating and thereby maintains the ground upon the primary winding of the transformer 6.

While I have shown an inductance 11 and a device 12 as being inserted in circuit with each of the secondary windings of the transformers 4, 5 and 6, it will be understood that, under certain conditions, resistors may be desirable. Therefore, it is not essential that the secondary winding of each of the said transformers be connected in circuit with inductance devices, inasmuch as non-inductive resistors may suffice. Again, I have shown a particular form of interrelating means whereby the arc suppressors associated with unaffected conductors of the transmission line may be rendered inoperative, but it is obvious that many combinations and arrangements may be made to perform the same function.

While I have shown and described in detail one embodiment of my invention, it will be understood that various modifications may be made without departing from the spirit and scope of the appended claims.

I claim as my invention:

1. An arcing-ground suppressor comprising a transformer having a primary winding, one terminal being normally grounded and the other being connected to a line conductor, and a secondary winding which is normally open-circuited, an impedance device provided with a plurality of taps, and means actuated by a change of potential on said primary winding to connect gradually varying amounts of said impedance device in circuit with the secondary winding.

2. An arcing-ground suppressor comprising a transformer having a primary winding, one terminal being normally grounded and another terminal being adapted for connection to a line conductor and a secondary winding normally open-circuited, an impedance device provided with a plurality of taps, and means actuated by a decrease of potential on said primary winding to connect gradually varying amounts of said impedance device in circuit with the secondary winding.

3. An arcing-ground suppressor comprising a transformer having a primary winding, one terminal being normally grounded and another terminal being adapted for connection to a line conductor and a secondary winding normally open-circuited, an impedance device provided with a plurality of taps, and means actuated by a decrease of potential on said primary winding to connect gradually increasing amounts of said impedance device in circuit with the secondary winding.

4. An arcing-ground suppressor comprising a transformer having a primary winding, one terminal being normally grounded and another terminal being adapted for connection to a line conductor and a secondary winding normally open-circuited, an impedance device provided with a plurality of taps, means actuated by a decrease of potential on said primary winding to connect gradually increasing amounts of said impedance device in circuit with the secondary winding, and means to restore the secondary winding to its initial state.

5. An arcing-ground suppressor comprising a transformer having a primary winding and a secondary winding, one terminal of the primary winding being adapted for a ground connection and another terminal for connection to a line conductor and the secondary winding being normally open-circuited, an energy-consuming device, and means actuated by a decrease of potential on said primary winding to insert gradually varying amounts of said energy-consuming device in circuit with the secondary winding.

6. An arcing ground suppressor comprising a transformer having a primary winding and a secondary winding, one terminal of the primary winding being adapted for ground connection and another terminal thereof being adapted for connection to a line conductor and the secondary winding being normally open-circuited, an energy-consuming device, and means actuated by a decrease of potential on said primary winding to insert gradually varying amounts of said energy-consuming device in circuit with the secondary winding to effect a gradual decrease of the current flow therethrough.

7. The combination with a line conductor to be protected from the effects of arcing grounds, of an arcing-ground suppressor comprising a primary winding, one terminal being connected to said conductor and another terminal being grounded, a secondary winding in inductive relation with the said

primary winding, and means associated with the primary winding to short circuit said secondary winding on the occurrence of an arcing ground upon said conductor.

8. The combination with an electrical conductor, of an arcing-ground suppressor comprising a primary winding, one terminal being grounded and another terminal being connected to said conductor, a secondary winding, and means for short-circuiting substantially instantaneously said secondary winding on the occurrence of an arcing ground upon said conductor.

9. The combination with an electrical conductor, of an arcing-ground suppressor comprising a primary winding, one terminal being grounded and another terminal being connected to said conductor, a secondary winding, and means for short-circuiting substantially instantaneously said secondary winding on the occurrence of an arcing ground upon said conductor and to then restore gradually said secondary winding to its normal open-circuit condition.

10. The combination with an electrical conductor, of an arcing-ground suppressor comprising a transformer having a primary winding of normally high impedance, one terminal of which may be connected to ground and another terminal of which may be connected to said conductor and a secondary winding which is normally open-circuited, and means associated with said secondary winding to reduce the impedance of said primary winding to a relatively low value on the occurrence of an arcing ground on said conductor.

11. The combination with an electrical conductor, of an arcing-ground suppressor comprising a transformer having a primary winding of normally high impedance, one terminal of which may be connected to ground and another terminal of which may be connected to said conductor and a secondary winding which is normally open-circuited, means associated with said secondary winding to reduce the impedance of said primary winding to a relatively low value on the occurrence of an arcing-ground on said conductor, and means to restore gradually said primary winding to its initial condition of high impedance.

12. The combination with an electrical conductor, an arcing-ground suppressor comprising a transformer having a primary winding of normally high impedance, one terminal of which may be connected to ground and another terminal of which may be connected to said conductor and a secondary winding which is normally open-circuited, and means associated with the secondary winding and actuated by a change of potential on said primary winding to reduce the impedance of said primary winding to a relatively low value on the occurrence of an arcing-ground on said conductor.

13. The combination with an electrical conductor, of an arcing-ground suppressor comprising a transformer having a primary winding of normally high impedance, one terminal of which may be connected to ground and another terminal of which may be connected to said conductor and a secondary winding which is normally open-circuited, and means actuated by a change of potential on said primary winding to short-circuit said secondary winding and thereby reduce the impedance of said primary winding to a relatively small value on the occurrence of an arcing-ground on said conductor.

14. The combination with an electrical conductor, of an arcing-ground suppressor comprising a transformer having a primary winding of normally high impedance, one terminal of which may be connected to ground and a secondary winding which is normally open-circuited, means actuated by a change of potential on said primary winding to short-circuit said secondary winding and thereby reduce the impedance of said primary winding to a relatively small value on the occurrence of an arcing-ground on said conductor, and means to restore gradually the primary and secondary windings to their initial electrical conditions.

15. The combination with a plurality of electrical conductors, of arcing-ground suppressors therefor, each suppressor comprising a normally high impedance winding, one terminal of which may be connected to its associated electrical conductor and another terminal of which may be grounded, means to decrease the impedance of said winding to a relatively low value, and relays to select the arc suppressor associated with the affected conductor and to actuate the means whereby the impedance of said winding may be reduced to a relatively low value.

16. The combination with a plurality of electrical conductors, of arcing-ground suppressors therefor, each suppressor comprising a winding of normally high impedance, one terminal of which may be connected to its associated electrical conductor and another terminal of which may be grounded, means whereby the impedance of said winding may be reduced to a relatively low value, devices to select the arc suppressor associated with the affected conductor and to actuate said means whereby the impedance of said selected winding may be reduced to a relatively low value, and means to gradually restore the said winding to its initial state of high impedance.

17. The combination with a plurality of electrical conductors, of arcing-ground sup-

pressors therefor, each suppressor comprising a winding of normally high impedance, one terminal of which may be connected to its associated electrical conductor and another terminal of which may be grounded, means whereby the impedance of said winding may be reduced to a relatively low value, devices to select the arc suppressor associated with the affected conductor and to actuate said means whereby the impedance of said selected winding is reduced to a relatively low value, means to gradually restore the said winding to its initial state of high impedance, and means to preclude the operation of the arc suppressors associated with the unaffected conductors.

In testimony whereof, I have hereunto subscribed by name this 24th day of Sept., 1914.

ALEXANDER CHERNYSHOFF.

Witnesses:
J. W. BROWN,
B. B. HINES.

Corrections in Letters Patent No. 1,160,844.

It is hereby certified that in Letters Patent No. 1,160,844, granted November 16, 1915, upon the application of Alexander Chernyshoff, of Swissvale, Pennsylvania, for an improvement in "Arcing-Ground Suppressors," errors appear in the printed specification requiring correction as follows: Page 2, line 13, for the reference-numeral "6" read *6ª;* same page, line 79, for the word "insulators" read *insulator;* and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 18th day of January, A. D., 1916.

[SEAL.]

J. T. NEWTON,

Acting Commissioner of Patents.

Cl. 175—294.