No. 885,106. PATENTED APR. 21, 1908.

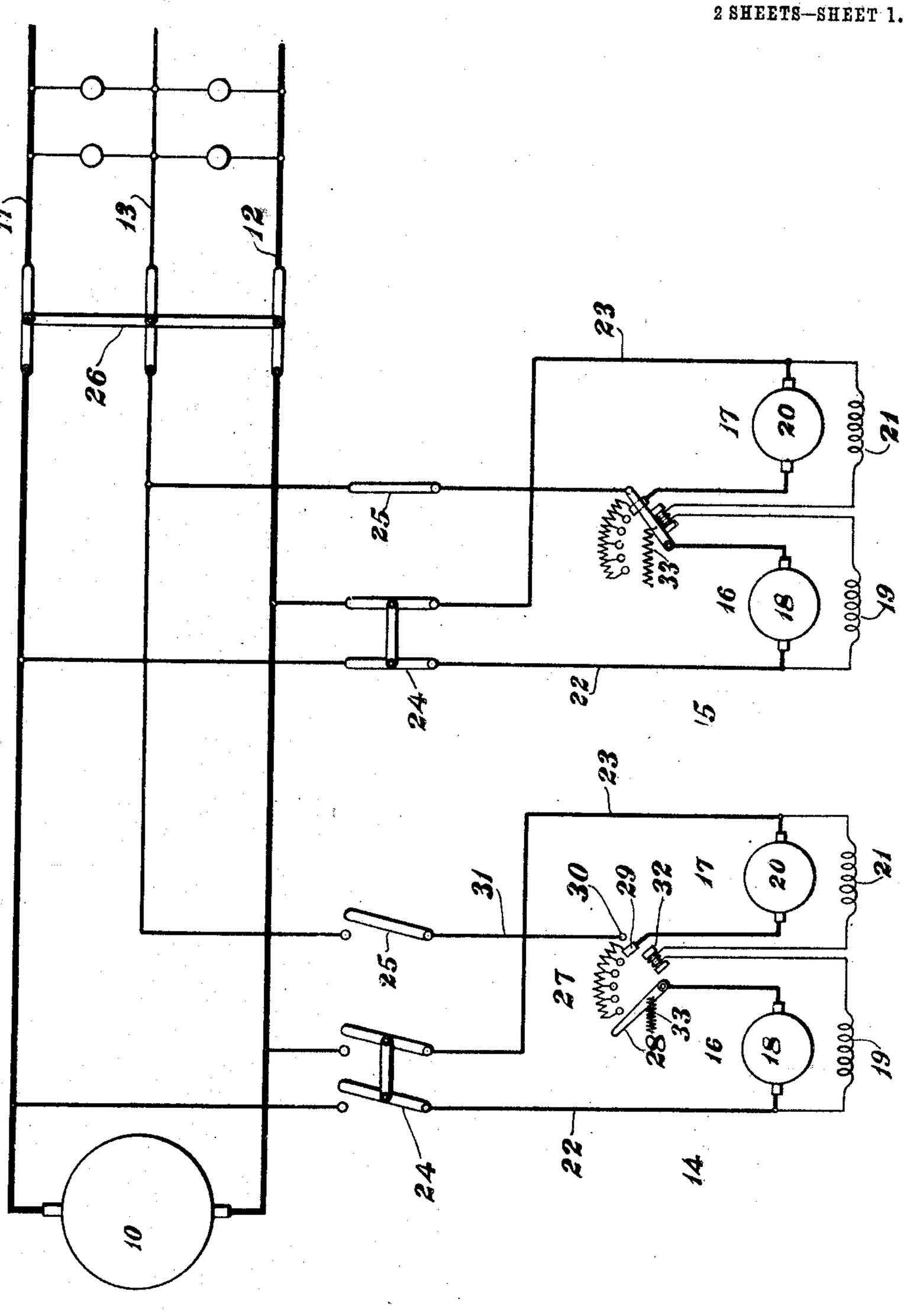
L. L. TATUM.

SYSTEM OF DISTRIBUTION.

APPLICATION FILED APR. 16, 1906.

2 SHEETS—SHEET 1.

Fig. 1.



WITNESSES

Oliver W. Sharman

Fred J. Kinsey

INVENTOR

Lewis L. Tatum

BY

Chas. E. Lord

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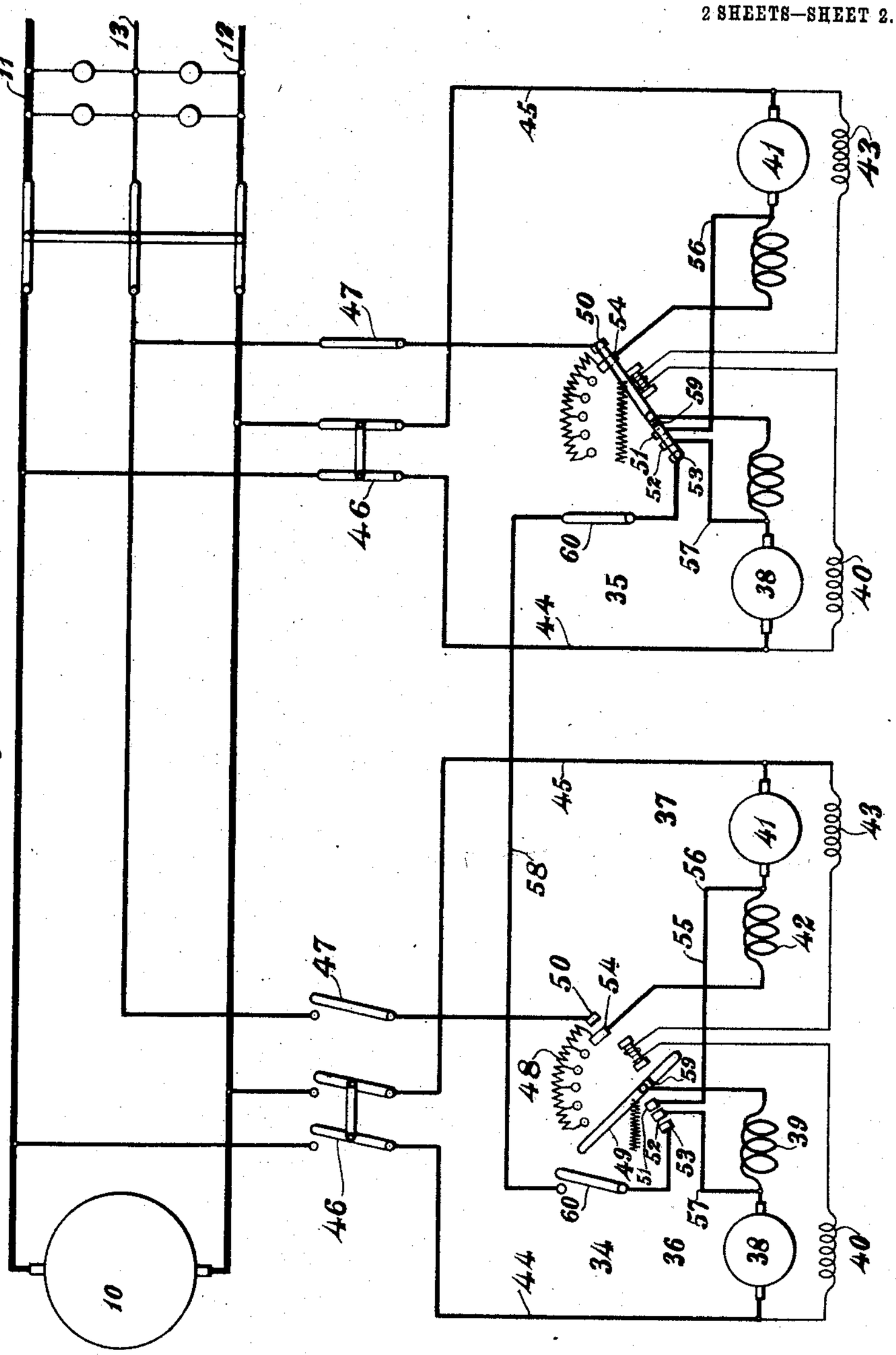

Fig. 2

WITNESSES

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UNITED STATES PATENT OFFICE.

LEWIS L. TATUM, OF NORWOOD, OHIO, ASSIGNOR TO ALLIS-CHALMERS COMPANY, A CORPORATION OF NEW JERSEY, AND THE BULLOCK ELECTRIC MANUFACTURING COMPANY, A CORPORATION OF OHIO.

SYSTEM OF DISTRIBUTION.

No. 885,106. Specification of Letters Patent. Patented April 21, 1908.

Application filed April 16, 1906. Serial No. 311,842.

To all whom it may concern:

Be it known that I, LEWIS L. TATUM, citizen of the United States, residing at Norwood, in the county of Hamilton and State of Ohio, have invented certain new and useful Improvements in Systems of Distribution, of which the following is a full, clear, and exact specification.

My invention relates to multiple-voltage systems of distribution in which balancers, as they are commonly called in the art, are employed for maintaining the differences in voltage between the several conductors at their predetermined values, when the currents in the various branches of the system are unbalanced or are unequal.

The size and number of balancers which may be employed economically in a system depends upon the degree or extent of unbalancing and the duration of the unbalanced condition. If at all times the currents are only slightly unbalanced, or if though the degree of unbalancing is considerable it does not vary greatly at different times, a single balancer can usually be employed, with sufficient economy, to supply the necessary balancing current. If, however, the degree of unbalancing is excessive, or if the unbalancing varies greatly at different times, it may be necessary or at least more economical to employ two or more balancers of the same size or of different sizes in the same system. In the case where the unbalancing varies greatly at different times, when the currents are only slightly unbalanced, a single balancer is connected to the system, the other balancer or balancers remaining idle. When, however, the unbalancing becomes so great that such single balancer cannot with economy supply sufficient current to maintain the difference in voltages of the conductors at their proper values, a large balancer or two or more balancers in parallel are connected to the system.

Each balancer is usually equipped with at least two switches for connecting it to, or disconnecting it from, the main source of power and the multiple-voltage system. One of the switches, usually a double-pole switch, is located in the conductors connecting the balancer to the two outer or main conductors or legs of the system, while the other switch is in that or those connecting it to the neutral or compensating conductor or conductors. The balancer is also provided in the armature circuit with a rheostat or starting-box for bringing the balancer to the proper speed before it is connected to the neutral or compensating conductor or conductors or before it is ready to "take load". To start a balancer the double-pole switch connecting it to the outer or main conductors is first closed and the balancer is brought up to speed by gradually cutting out the resistance of the starting box. When the balancer is up to speed the switch connecting it to the neutral or compensating conductor or conductors is closed. A multipole switch or circuit breaker (the number of poles depending on the number of conductors of the multiple-voltage system) is provided for connecting the lamps or other translating devices constituting the load to the main source of current and to the balancer or balancers.

When there is only a single balancer employed in the system no damage can result to the balancer or translating devices in case the switch in the neutral or compensating conductor is closed before the balancer is brought up to speed, providing the multipole load-switch is not closed until the balancer is up to speed. In case two or more balancers are adapted to be employed in the same system, if it is desired to connect an idle balancer in parallel with a balancer in operation, with the apparatus formerly employed and as balancers have heretofore been connected, there is danger of a violent short circuit through one or more of the machines of the idle balancer in case the balancer is connected to the neutral or compensating conductor or conductors before it is up to speed. This usually results from the carelessness of the operator in closing the switch which connects the balancer to the neutral or compensating conductor before closing the switch which connects the balancer to the main conductors of the source of current, or before the balancer is up to speed, or in having neglected when the balancer was shut down at the close of a preceding run or operation to open the switch which connects the balancer to the neutral or compensating conductor.

On account of the good regulating qualities of compound-wound dynamo-electric machines, it is desirable to employ them in balancers. In a copending application Serial No. 301,819, filed Feb. 19, 1906, I have

shown and described balancers adapted to be connected in parallel, each balancer consisting of two compound-wound dynamo-electric machines having series field windings which are between the armature windings and have their adjacent ends connected to the neutral conductor and their remote ends joined by a low resistance conductor, the low resistance conductors of the two balancers being connected by a single equalizer. With compound-wound dynamo-electric machines having windings so arranged and connected that the equalizer is between the armatures, there is considerable difference of potential between the equalizer and each main conductor of the system, and therefore if the equalizer is connected to the balancer before the latter is up to speed there is danger of a short-circuit through the equalizer and one or more of the machines of the balancer, in the same manner as through the neutral or compensating conductor and such machine. Therefore, in compound-wound dynamo-electric machines so arranged and connected there is a danger of a short-circuit through either the neutral or compensating conductors or through the equalizer.

One of the objects of my invention is to provide means for avoiding the danger of short-circuit through one of the armature windings of a balancer and the consequent injury to that machine and to the translating devices when the balancer is started from rest and connected to a multiple-voltage system, especially when it is connected to the system in parallel to the one or more other balancers.

A further object of my invention is to provide means whereby the steps or operations necessary to start and connect a balancer are lessened.

In carrying out my invention I connect the starting-box or starting-rheostat between the armature windings of a balancer and to the neutral or compensating conductor in such a manner that there is no direct connection between said conductor and either armature winding until the rheostat-arm is in its final or running position.

In another aspect, my invention consists in a multiple-voltage system of distribution to which two or more compound-wound balancers are adapted to be connected in parallel, each of which balancers has a starting device to which a neutral or compensating conductor of the system and an equalizer conductor are so connected that said conductors are directly connected to either machine of the balancer only when the arm of the starting device is in its running position.

In still another aspect my invention consists in providing for each balancer a controller or a starting and connecting device which first serves to bring the balancer up to speed and then to connect the balancer to a compensating conductor, or to an equalizer, or to both.

More specifically considered my invention consists in a multiple-voltage system of distribution, to which one or more balancers are adapted to be connected, a starting rheostat between the armatures of each balancer, the rheostat of each balancer having one or more normally isolated contacts, one of which is connected to a neutral or compensating conductor and another of which may be connected to an equalizer conductor, the said contacts being so arranged that they will only be engaged by the rheostat arm and connected to the balancer when said rheostat arm is in its final or running position.

My invention still further consists in the details of construction, and combinations and arrangements of parts described in the specification and set forth in the appended claims.

For a better understanding of my invention, reference is had to the accompanying drawings in which

Figure 1 is a diagrammatic representation of a multiple-voltage system of distribution in which two shunt-wound balancers equipped with my invention are employed; and Fig. 2 is a diagrammatic representation of a multiple-voltage system in which two compound-wound balancers equipped with my invention are employed.

Referring now to Fig. 1 of the drawing, I have shown at 10 a main source of current connected to the multiple-voltage system which consists, in this case, of two main conductors 11 and 12 and the neutral or compensating conductor 13. It may be stated at this point that my invention is applicable to the multiple-voltage systems of distribution in which the differences in voltage between the neutral or compensating conductor and the main conductors are equal, called the symmetrical voltage systems, or the systems in which the differences in voltage between the compensating conductor and the main conductors are unequal, called the unsymmetrical voltage systems. My invention can also be applied to multiple-voltage systems having more than three conductors. At 14 and 15 are shown, respectively, two shunt-wound balancers adapted to be connected to said multiple-voltage system to maintain the voltages at their normal values in the well known manner when the currents in the two sides of the system are unbalanced or are unequal. Each balancer consists of two dynamo-electric machines 16 and 17, machine 16 consisting of an armature 18 and shunt field winding 19, and machine 17 consisting of an armature 20 and shunt field winding 21. The armatures 18 and 28 are connected respectively to conductors 22 and 23 which in turn are adapted

to be connected by a double-pole switch 24 to the main conductors 11 and 12 of the system. Each balancer is adapted to be connected to the neutral or compensating conductor 13 by a single-pole switch 25. At 26 is shown the three-pole switch or circuit-breaker adapted to connect the translating devices to, or disconnect them from, the balancers and source of current supply.

Between the armature windings of each balancer is a controlling device adapted to connect the armature windings of that balancer together and to the neutral or compensating conductor. In the preferred form of my invention the controlling device consists of a special rheostat 27 having an arm 28 connected, in this case, directly to one side of the winding of armature 18, and having the last or final contact 29 connected directly to one side of the winding of armature 20. At 30 is shown an isolated contact connected by conductor 31 to the single pole switch 25 in the conductor leading to the neutral or compensating conductor. This contact is located adjacent the final or last contact 29 and is adapted to be engaged by the rheostat arm 28 when the latter rests upon said contact 29. The rheostats are each provided with a no-voltage release, the rheostat arm being held in the running position by the magnet 32 having a coil in the shunt field circuit, and being adapted to be returned to the "off" position when the magnet is de-energized, by some means as a spring 33.

Heretofore, the neutral or compensating conductors have been connected directly to the armature circuits of the balancers, and each starting box or rheostat is usually between one of the armatures and an outside conductor. With the balancer so connected, as was stated above, there is danger of a short-circuit through one of the machines of a balancer, in case the switches are improperly manipulated, as will now be more fully described. Suppose, for example, the operator desires to connect to the system, in parallel with a balancer which is already running, a balancer having the ordinary neutral or compensating conductor connections. Ordinarily he would first close the double-pole switch 24 and then bring the balancer up to speed by moving the rheostat arm to its running position, and when the balancer is up to speed and is developing sufficient counter-electromotive-force he would close switch 25. In case, however, the operator should close switch 25 before he closed switch 24, or in case at the end of the preceding run he had neglected to open switch 25 after opening switch 24, and would attempt to start the balancer by closing switch 24, there would be a violent short-circuit through one of the machines. Assume that balancer 15 is in operation and that the rheostat 27 is between armature 18 and conductor 22 of balancer 14, and that conductor 31 is permanently connected between the armatures 18 and 20 in the usual manner. If switch 25 is closed and balancer 14 is at rest, and the operator should close switch 24 of balancer 14, there would be a direct short-circuit from the neutral or compensating conductor 13 to the main 12, which short-circuit would result in a rush of current through the armature 20, in the bringing of the potential of the neutral or compensating conductor to that of the main conductor 12, and in conductors 11 and 13 being subjected to the entire voltage of the system. The result would be that the armature 20 and the translating devices between the conductors 11 and 13 would be injured or burned out. The same disastrous result would occur if there were only a single balancer in the system and the operator should close the load switch 36 and the single-pole switch 25 before the balancer is brought up to speed. But when the balancers are connected according to my invention, it is seen that a short-circuit from the neutral or compensating conductor through one of the machines is practically impossible. In case switch 25 should be in its closed position when switch 24 is closed, no damage could result for the reason that the neutral or compensating conductor is nevertheless disconnected from the armatures until the rheostat arm is in its running position. When the rheostat arm is in this position, the balancer is practically up to speed, and is developing a sufficient counter-electromotive-force to prevent a short-circuit. I have shown shunt-wound balancers each consisting of two shunt-wound dynamo-electric machines. My invention, so far described, could, however, be applied to balancers consisting of dynamotors in which the motor and generator armature windings are arranged on a single armature core.

Referring now to Fig. 2 of the drawing I have shown at 34 and 35 two compound-wound balancers equipped with my invention. Each balancer consists in this case of two dynamo-electric machines 36 and 37, machine 36 of each balancer having an armature 38, series field winding 39 and shunt field winding 40, and machine 37 of each balancer having an armature 41, series field winding 42 and a shunt field winding 43. The armatures 38 and 41 at one side are connected respectively to conductors 44 and 45, which in turn are adapted to be connected to the main conductors 11 and 12 by a double-pole switch 46. Each balancer is adapted to be connected to the neutral or compensating conductor by a single-pole switch 47. The series field windings 39 and 42 of each balancer are arranged between the armatures thereof and are adapted to be connected together as will be described. Each balancer is provided with a rheostat 48 having in

this case a rheostat-arm 49 and four normally isolated contacts 50, 51, 52 and 53, the latter being adapted to be engaged by the rheostat-arm 49 only when it is in its running position and in engagement with the last rheostat-contact 54. The series windings 39 and 42 are shunted, as will be described, by a low resistance conductor or equalizer connection 55. The starting-rheostat of each balancer may be located either in the low resistance conductor 55 shunting the series winding, or may be connected directly between the two series windings. Since the low resistance conductor and the series windings form parallel paths between the two armatures of the balancer, in order that the rheostat located in one conductor or path may not be short-circuited by the other conductor, means must be provided for maintaining the conductor which does not contain the rheostat, open until the balancer is up to speed. If the starting-rheostat is between the series windings and the low resistance conductor is maintained open until the balancer is up to speed, the balancer will start with the machines acting as differential motors. The differential field action will, however, be very slight. If on the other hand the rheostat is in the low resistance conductor and the path through the series winding is maintained open until the balancer is up to speed, the balancer will start with the machines acting as shunt motors. The former arrangement is shown in the drawings, but it will be understood that the latter arrangement may be employed if desired.

As was stated above, the rheostats are located between the series field windings, series field winding 39 of each balancer being connected to the rheostat-arm 49, and series field 42 being connected to the last or final contact 54. The neutral or compensating conductor 13 is connected to contact 50 of the rheostat of each balancer, as in the case of the shunt-wound balancers first described. In order that the rheostat of a balancer may not be short-circuited by the low resistance conductor 55 I divide the latter into two portions 56 and 57, the former being connected to normally isolated contact 51 and the latter to normally isolated contact 52. At 58 is shown an equalizer connected at each end to an isolated contact 53. One of the advantages of the low resistance conductors or equalizer-connections 55, is that a single equalizer only is necessary for two balancers. If desired, however, more than one equalizer may be employed and the low resistance conductor can then be dispensed with. The lower part of each rheostat arm 49, which engages the contacts 51, 52 and 53, is insulated from the remaining portion as at 59, so that the rheostat arm and conductor 55 will not short-circuit the series fields when the system is unbalanced. Two equalizer switches 60 are shown in the equalizer.

If the operator desires to start one of the balancers and connect the latter to the system in parallel with a balancer already in operation, he will close the main switch 46 and move the rheostat-arm 49 to the right, gradually cutting sections of the resistance out of the armature circuit. When the rheostat arm is moved to its running position, the arm engages contacts 50, 51, 52, 53 and 54. With the arm in this position the neutral or compensating conductor is connected to a point between the series field windings which are now directly connected together, and one end of the equalizer is connected to the low resistance conductor 55, the parts of which are now connected together. Thus it is seen that the machines are brought up to speed in the proper manner and that there is no danger of a short-circuit through one of the machines and through either the equalizer or the neutral or compensating conductor. As in the preceding case, each rheostat is provided with a no-voltage release.

It is seen that the balancers can be brought up to speed and connected to the system or disconnected therefrom without danger of a short-circuit, by simply manipulating the handle of the starting-rheostat. In fact the load, neutral and equalizer switches, although preferably employed, can, if desired, be dispensed with. The starting-rheostat therefore serves as a controller or unitary starting and connecting device by means of which the operator can by a single operation or step accomplish what has heretofore required several successive operations.

I have shown one specific embodiment of my invention but it is evident that many changes can be made without departing from the broad spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent is:—

1. In a multiple-voltage system of distribution, a plurality of main and compensating conductors, a balancer comprising two armature windings connected to the main conductors, and a starting device connected to the armature windings and to a neutral or compensating conductor.

2. In a multiple-voltage system of distribution, a plurality of main and compensating conductors, a balancer comprising two armature windings connected to the main conductors, and a starting-device between the two armature windings of the balancer and connected to a neutral or compensating conductor.

3. In a multiple-voltage system of distribution, a plurality of main and compensating conductors, a balancer comprising two

armature windings, one side of the armature winding of each machine being connected to a main conductor, and a starting-rheostat for connecting two armature windings together and to the neutral or compensating conductor.

4. In a multiple-voltage system of distribution, a plurality of conductors, comprising main conductors and a neutral or compensating conductor, a balancer comprising two dynamo-electric machines having their armatures connected respectively to the main conductors, and a starting-rheostat adapted to connect the armatures to each other and to the neutral or compensating conductor.

5. In a multiple-voltage system of distribution, a plurality of conductors, comprising main conductors and a neutral or compensating conductor, a balancer comprising two dynamo-electric machines adapted to be connected to the conductors of said system, and a starting-rheostat connected between the armatures of said machines and adapted to connect said armatures to the compensating conductor when the arm of the rheostat is in one position only.

6. In a system of distribution, a plurality of conductors including two main conductors and a neutral or compensating conductor, one or more balancers, each comprising two dynamo-electric machines adapted to be connected to said conductors, and a starting-rheostat between the armatures of each balancer and adapted to connect said neutral or compensating conductor to said armatures only when the rheostat-arm is in its final or running position.

7. In a system of distribution, a plurality of conductors comprising two main conductors and a neutral or compensating conductor, one or more balancers each comprising two dynamo-electric machines adapted to be connected to said conductors, and a starting-rheostat for each balancer adapted to connect the armatures of the machines thereof together and to the compensating conductor, said compensating conductor being connected to a contact of each rheostat which contact is isolated except when the rheostat-arm is in its running position.

8. In a system of distribution, a plurality of main and compensating conductors, a balancer comprising two dynamo-electric machines adapted to be connected to said conductors, and a starting-rheostat between the armatures of each balancer and adapted to connect said armatures together and to a conductor having a potential between the potentials of the main conductors.

9. In a system of distribution, a plurality of main and compensating conductors, a plurality of balancers adapted to be connected to said system in parallel, and a starting-rheostat for each balancer adapted to connect the armature windings thereof to each other and to the neutral or compensating conductor.

10. In a system of distribution, a plurality of main and compensating conductors, a plurality of balancers adapted to be connected to said system in parallel, and a starting-rheostat between the armatures of each balancer and adapted to connect said armatures together and to a conductor having a potential between the potentials of the main conductors.

11. In a multiple-voltage system of distribution, a plurality of main and compensating conductors, a plurality of balancers adapted to be connected in parallel to the system, an equalizer connected between two balancers, and a starting-rheostat for each balancer, each rheostat being between two armatures and adapted to connect said armatures together and to said equalizer.

12. In a multiple-voltage system of distribution, a plurality of main and compensating conductors, a plurality of compound-wound balancers adapted to be connected in parallel to the system, an equalizer adapted to connect said balancers together, and a starting-rheostat between the armatures of each balancer, each rheostat being adapted to connect the compensating conductor and the equalizer to a balancer when the arm or handle of said rheostat is in its final or running position.

13. In a multiple-voltage system of distribution, a plurality of main and compensating conductors, a compound-wound balancer having armature windings connected directly to the main conductors and having series field windings between the armature windings, and a starting-rheostat between the armature windings and connected to the neutral or compensating conductor.

14. In a multiple-voltage system of distribution, a plurality of conductors comprising two main conductors and a neutral or compensating conductor, a compound-wound balancer having armatures connected directly to the main conductors and series-field windings between said armatures, and a starting-rheostat between the armature windings and adapted to connect the neutral or compensating conductor thereto when the rheostat-arm is in its final or running position only.

15. In a multiple-voltage system of distribution, a plurality of conductors comprising two main conductors and a neutral or compensating conductor, a compound-wound balancer having armature windings connected to the main conductors and series

field windings between the armature windings, a low-resistance conductor adapted to be connected around the series field windings, and a starting-rheostat between the armature windings and adapted to connect the low resistance conductor to said series field windings and to connect the neutral or compensating conductor to the balancer when the rheostat-arm is in its final or running position only.

16. In a multiple-voltage system of distribution, a plurality of conductors including two main conductors and a neutral or compensating conductor, a plurality of balancers, each consisting of compound-wound dynamo-electric machines having armatures connected to the main conductors and series field windings between the armature windings, a shunt around the series field windings of each balancer, an equalizer for two of said balancers, and a starting-rheostat between the armature windings of each balancer and adapted to connect the equalizer and neutral or compensating conductor to the balancer when said rheostat-handle or arm is in one position only.

17. In a multiple-voltage system of distribution, a plurality of main and compensating conductors, a plurality of balancers adapted to be connected thereto in parallel, each balancer comprising two compound-wound dynamo-electric machines, the armature windings of each balancer being connected respectively to two main conductors and the series windings being between the armature windings, a low resistance shunt adapted to be connected around the series windings of each balancer, an equalizer adapted to be connected between the low resistance shunts of the balancers, and a starting-rheostat between the armature windings of each balancer to connect said windings together, and to connect the equalizer to the shunt around said field windings and the neutral or compensating conductor to a point between the armature windings when said rheostat arm is in its running position only.

18. A multiple-voltage system of distribution, a balancer therefor, and a controller for the balancer, said controller being constructed and arranged first to bring the balancer up to speed and then to connect the latter to one of the conductors of the system.

19. In a multiple-voltage system of distribution, a plurality of conductors including two main conductors and a neutral or compensating conductor, one or more balancers, and a controller for connecting two armature windings of each balancer to each other and to a neutral or compensating conductor.

20. In a multiple-voltage system of disbution, main and compensating conductors, one or more balancers adapted to be connected thereto, and a controller for each balancer, each controller having means for connecting two armature windings of the balancer to each other and for connecting said windings to a compensating conductor when the balancer is up to speed.

21. In a system of distribution, main and compensating conductors, one or more balancers adapted to be connected thereto, each balancer consisting of two dynamo-electric machines, and a controller connected between two armature windings of each balancer, said controller having resistance contacts and a normally isolated final contact connected to a compensating conductor.

22. In a multiple-voltage system of distribution, main and compensating conductors, a plurality of balancers adapted to be connected thereto, an equalizer for adjacent balancers, and a controller for each balancer serving to bring the balancer up to speed and to connect the latter to the neutral or compensating conductor and to the equalizer.

23. In a multiple-voltage system of distribution, a plurality of main and compensating conductors, a plurality of balancers each consisting of dynamo-electric machines, and a controller for each balancer, each controller having resistance contacts and normally isolated contacts adapted to be engaged by the handle in its running position, a compensating conductor and an equalizer being connected to said isolated contacts.

24. In a multiple-voltage system of distribution, a plurality of conductors comprising two main conductors and a neutral or compensating conductor, a plurality of balancers adapted to be connected thereto, each balancer comprising two dynamo-electric machines, an equalizer, and a controller between the armature windings of each balancer, each controller having resistance contacts and normally isolated contacts adapted to be engaged by the rheostat arm in its final or running position, said contacts being connected respectively to a compensating conductor and to the equalizer.

25. A system of distribution comprising main and compensating conductors, a balancer, and unitary means for bringing said balancer up to speed and for connecting the latter to one or more conductors having a potential or potentials between the potentials of the main conductors of the system.

26. In a system of distribution, a plurality of conductors comprising main and compensating conductors, a balancer, and a controlling and connecting device for bringing said balancer up to speed and for connecting the latter to one or more conductors.

27. A multiple-voltage system of distribution, a balancer, and a unitary controlling and connecting device for bringing said balancer up to speed and for connecting the latter to the conductors of the system comprising a movable contact member, and a

plurality of stationary contact members to one of which a neutral or compensating conductor is connected.

28. In a system of distribution, one or more balancers, and a unitary controlling and starting device for each balancer comprising a movable contact member, resistance contacts, and one or more normally isolated contacts adapted to be engaged by the movable contact member when the latter is approximately in its running or final position, and one or more conductors connected to said isolated contact or contacts.

29. In a system of distribution, main conductors, a compensating conductor, a plurality of compound-wound balancers adapted to be connected thereto in parallel, an equalizer, and a starting and connecting device for each balancer, each of said starting and connecting devices comprising a movable contact member, a plurality of resistance contact members adapted to be engaged by said movable member when the latter is in its running or final position, said neutral or compensating conductor and equalizer being connected to the said isolated contacts.

30. In a multiple-voltage system of distribution, main conductors, a neutral or compensating conductor, a balancer including two armature windings connected in series across the main conductors, and a starting device connected to the armature windings and when in running position connecting the compensating conductor to a point between the two armature windings.

31. In a multiple-voltage system of distribution, main and compensating conductors, a balancer winding, a plurality of dynamo-electric machine armatures in series, and a starting rheostat the movable member of which is arranged to connect said armatures across the main conductors and to a compensating conductor.

32. In a multiple-voltage system of distribution, main conductors, a compensating or neutral conductor, a balancer including two armatures in series across the main conductors, a resistance for the circuit including said armatures, and a single movable member for cutting out said resistance and for connecting said neutral conductor to a point between said two armatures.

33. In a multiple-voltage system of distribution, main and compensating conductors, a plurality of balancers each including a plurality of dynamo-electric machines having series field windings, and a starting rheostat for each balancer, the movable member of said rheostat being arranged when in running position to connect its associated balancer to the compensating conductor and to connect points between the series field and armature of each machine of said balancer to corresponding points on any other balancer which is operating.

34. In a multiple-voltage system of distribution, main and compensating conductors, a plurality of balancers each including a plurality of dynamo-electric machines, and a starting rheostat for each balancer, the movable member of said rheostat being arranged in its running position to connect its associated balancer to the compensating conductor.

35. In a multiple-voltage system of distribution, main and compensating conductors, a plurality of balancers each including a plurality of dynamo-electric machines having series field windings, and a starting rheostat for each balancer, the movable member of said rheostat being arranged when in running position to connect its associated balancer to the compensating conductor and to connect points between the series field and armature of the machines of said balancer together and to corresponding points on any other balancer which is operating.

In testimony whereof I affix my signature, in the presence of two witnesses.

LEWIS L. TATUM.

Witnesses:
ARTHUR F. KWIS,
FRED J. KINSEY.