No. 886,049. PATENTED APR. 28, 1908.

B. FRANKENFIELD.

MULTIPLE VOLTAGE SYSTEM OF DISTRIBUTION.

APPLICATION FILED NOV. 30, 1906.

2 SHEETS—SHEET 1.

Fig. 1

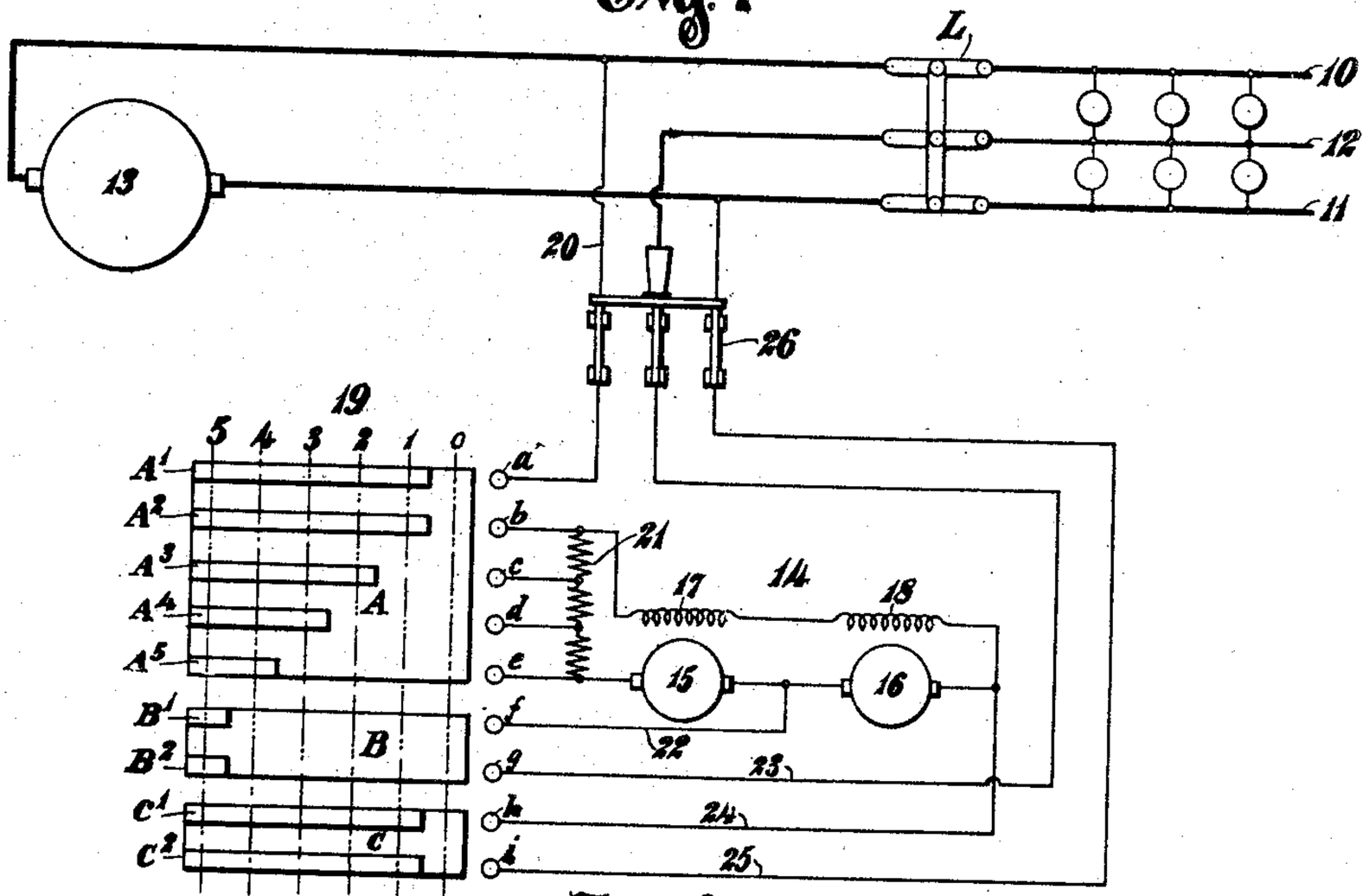
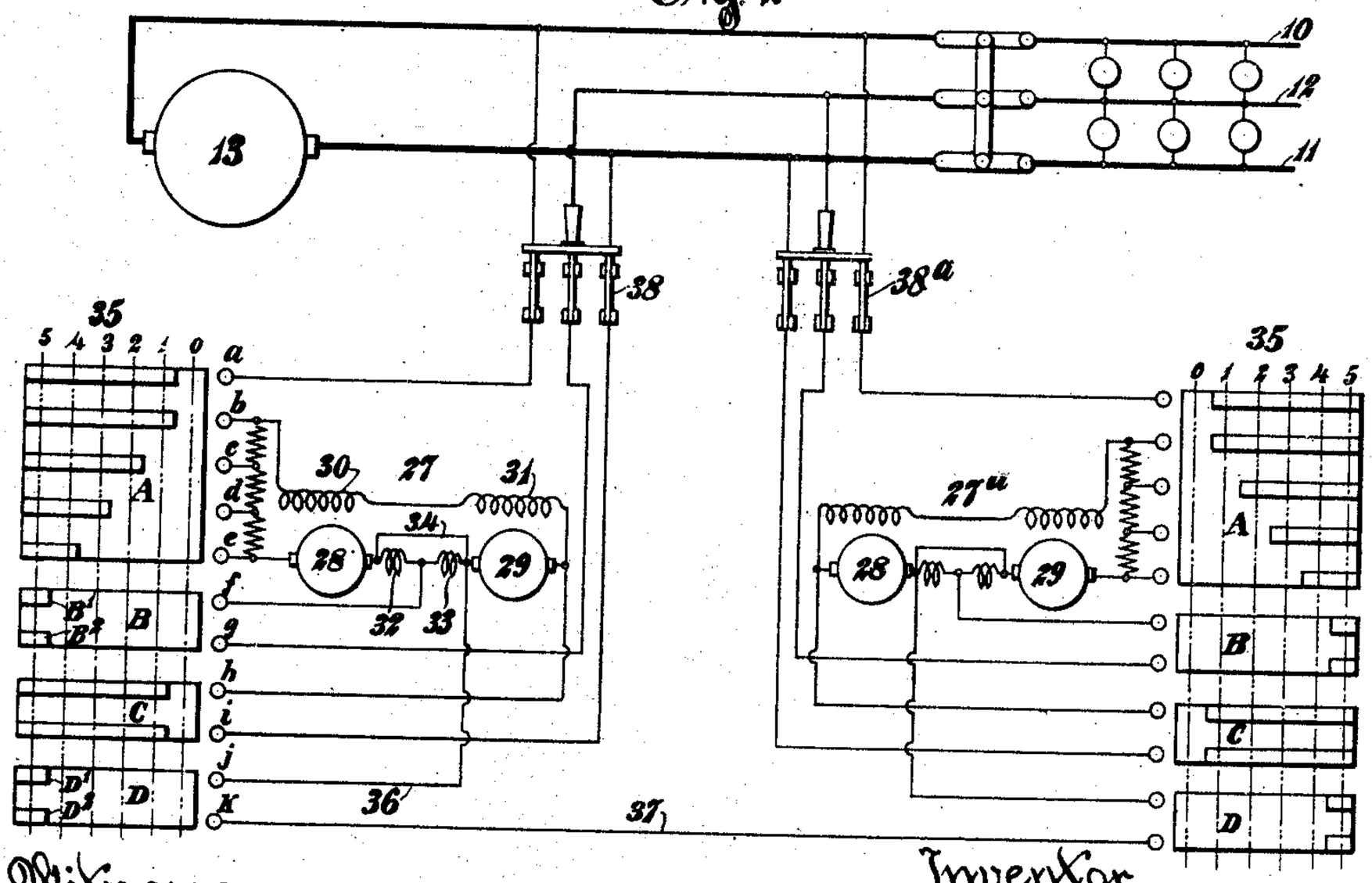


Fig. 2



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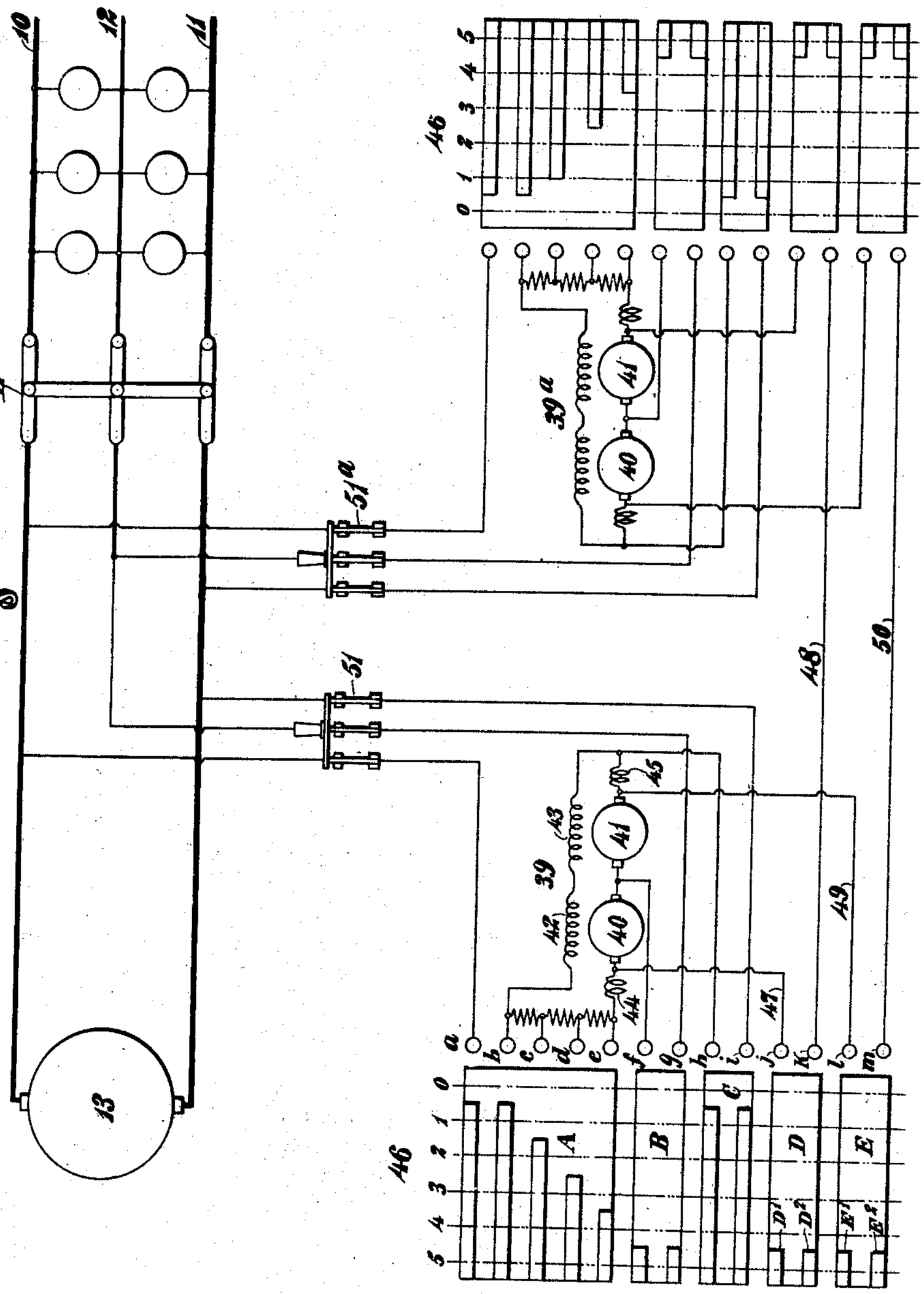
2 SHEETS—SHEET 2.

Fig 3



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UNITED STATES PATENT OFFICE.

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

MULTIPLE-VOLTAGE SYSTEM OF DISTRIBUTION.

No. 886,049. Specification of Letters Patent. Patented April 28, 1908.

Application filed November 30, 1906. Serial No. 345,591.

To all whom it may concern:

Be it known that I, BUDD FRANKENFIELD, 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 Multiple-Voltage Systems of Distribution, of which the following is a full, clear, and exact specification.

My invention relates to balancers employed in multiple voltage systems of distribution.

Each balancer is usually equipped with a starting rheostat and at least two switches for connecting it to, or disconnecting it from, the main source of current supply and the conductors of the multiple voltage system. When it is desired to start a balancer the latter is first connected by a double-pole switch to the outside main conductors of the system and is brought up to speed by cutting out sections of resistance of the starting rheostat. After the machine is up to speed, it is connected by a switch to the neutral or compensating conductor so that it will "take load". It is sometimes economical to employ two or more balancers of the same or different capacities in a system, particularly if the unbalanced current varies greatly at different times. When the current is only slightly unbalanced a single balancer may be sufficient to supply the unbalanced current. Should the unbalanced current become too great for that balancer, a larger balancer may be connected to the system, or two may be employed at the same time. On account of the good inherent regulating qualities of compound wound machines, it is sometimes desirable to employ them in balancers. When two compound wound balancers are connected in parallel to the same system, the balancers must be connected together by one or more equalizers. Accordingly one or more additional equalizer switches must be employed for each balancer. The equalizer switch is usually closed after the balancer is up to speed and before the latter is connected to the neutral or compensating conductor, or before it takes load. Thus it is seen that to connect a balancer to a system and place it in running condition, several different steps or operations are required.

When there is only a single balancer employed in a system, there is little danger of the balancer and translating devices being injured in case the switches above referred to are not closed in the proper order, for the reason that the translating devices are usually disconnected from the source of current supply and the balancer by a load switch until the balancer is up to speed. However, when two or more balancers are employed in the same system and it is desired to connect an additional balancer in parallel with a balancer already in operation, there is danger of violent short circuit occurring through one of the armatures of one or both of the balancers, particularly through an armature of the balancer being started, in case the switches are not closed in the proper order. Such short circuit will result in case the operator should close the switch connecting the balancer to the neutral or compensating conductor before the balancer is up to speed, or from the failure of the operator to open the switch in the neutral or compensating conductor when the balancer was shut down at the close of a preceding run. A short circuit may also occur through an equalizing conductor if the equalizing switch is closed at the wrong time, as will appear later.

The switches and starting rheostat are usually mounted on a switch board. The switch board occupies considerable space, and is expensive, particularly in view of the large number of switch and rheostat connections and the length and weight of the connecting conductors, the switch board usually being located at a distance from the balancer.

One of the objects of my invention is to simplify the steps or operations necessary for an operator to take in order to connect and start a balancer and to place it in running condition.

A further object is to avoid the danger of a short circuit occurring when a balancer is being started.

A still further object is to reduce the length and weight of the conductors and connections of a balancer, and to reduce in general the cost of installation.

With these ends in view, I provide a unitary device or controller for performing all the steps or operations heretofore accomplished by several switches and a starting rheostat for connecting the balancer to the system and for placing it in running condition.

My invention consists of certain novel combinations and arrangements of parts described in the specification and set forth in the appended claims.

For a more complete 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 including a shunt wound balancer equipped with my invention; Fig. 2 shows a multiple voltage system including two compound wound balancers also equipped with my invention; and Fig. 3 is a similar view of a multiple-voltage system including two balancers compounded in a slightly different manner and equipped with my invention.

Referring now to the figures of the drawings, 10 and 11 represent the outside main conductors and 12 a neutral or compensating conductor of a three-wire multiple voltage system of distribution connected to a main source of current 13. While I have shown a three-wire system, it is to be understood that my invention may be applied to a system having more than three wires or conductors. Current is supplied to translating devices, in this case lamps, which may be connected to the source of current supply by a load switch L.

At 14 is shown a balancer, consisting in this case of two shunt wound dynamo-electric machines. The armatures of the balancers are shown at 15 and 16 respectively, and the shunt field windings at 17 and 18.

At 19 is shown in development a controller which is so constructed and connected to the system and balancer that by simply moving the controller handle from one extreme position to another, the balancer is brought from rest to the full running condition. The controller, in this case, is of a drum type, the movable member being provided with three contact drums A, B and C, and a plurality of contact fingers *a* to *i* inclusive. Drum A is provided with five contact segments designated A^1, A^2, A^3, A^4, and A^5, which are adapted to be engaged by contact fingers *a*, *b*, *c*, *d* and *e;* drum B is provided with two contact segments B^1 and B^2 which are adapted to be engaged by contact fingers *f* and *g;* and drum C is provided with two contact segments C^1 and C^2 adapted to be engaged by contact fingers *h* and *i*. The controller has in this case six different positions indicated by vertical dot and dash lines which are designated 0, 1, 2, 3, 4 and 5 respectively. Contact finger *a* is connected by conductor 20 to main conductor 10; contact finger *b* is connected to the shunt field circuit and to one side of a sectional resistance 21, the opposite side of which is connected to the armature circuit; contact fingers *c*, *d* and *e* are also connected to sections of the resistance 21; contact fingers *f* and *g* are connected respectively by conductor 22 to a point in the armature circuit intermediate the armatures 15 and 16, and by conductor 23 to the neutral or compensating conductor 12; contact fingers *h* and *i* are connected by conductors 24 and 25 respectively to the armature and shunt field circuit and to main conductor 11. It will be seen that the balancer is connected to the main conductors 10 and 11 of the system and brought up to speed on drums A and C and is connected to the neutral or compensating conductor on drum B.

The contact segments of the drums A and C and the contact fingers are so arranged that when the controller is in the zero or off position, both sides of the balancer are disconnected from the main conductors of the system. When the controller is in the first running position, the balancer is connected to both the outside or main conductors. The circuit is then as follows: main conductor 10, conductor 20, contact finger *a*, contact segments A^1 and A^2 of drum A, contact finger *b*, shunt fields 17 and 18 in parallel with starting resistance sections 21 and armatures 15 and 16, then conductor 24, contact finger *h*, contact segments C^1 and C^2 of drum C, contact finger *i*, conductor 25 and finally main conductor 11 of the system. When the controller is in the second running position, contact segment A^3 of drum A engages contact finger *c*, resulting in one section of the starting resistance 21 being cut out of the armature circuit, the circuits otherwise remaining the same as in the first running position. In a similar manner when the controller is placed in the third and fourth running positions, the second and third sections of the starting resistance are cut out of the armature circuit. Thus it is seen that drums A and C serve to connect the balancer to the outside main conductor of the system and to cause the balancer to be brought up to speed. When the controller is moved to the fifth running position, contact segments B^1 and B^2 engage contact fingers *f* and *g* and the balancer is thus connected to the neutral or compensating conductor of the system so as to take load. I have in this case shown at 26 a three-pole switch in the conductors 22, 23 and 24 connecting the balancer to all three main conductors of the system. This switch may be omitted if desired, but is preferably employed for the reason that when it is open all the conductors of the balancers are rendered dead and therefore any repairs or changes can be made to balancer or controller connections with absolute safety. The controller in this and in each of the following cases is preferably arranged close to the balancer so that short connecting conductors only are necessary.

Referring now to Fig. 2 of the drawing, I have shown a multiple voltage system to which two compound balancers 27 and 27^a are adapted to be connected in parallel.

Each balancer comprises in this case armatures 28 and 29, shunt field windings 30 and 31 and series field windings 32 and 33. In this particular case the series field windings are connected together between the two armatures 28 and 29. These series fields are normally shunted by a low resistance conductor 34 as is shown and described in application of L. L. Tatum Serial No. 301,819 filed Feb. 19, 1906. Each balancer is provided with a controller 35 by means of which all the necessary operations for connecting it to the system can be accomplished. Each controller consists of four drums A, B, C and D and a series of contact fingers *a* to *k* inclusive. The controllers 35 are exactly similar to controller 19 before described except that each of the former has an additional contact drum D with two contact segments D^1 and D^2, and two additional contact fingers *j* and *k*. Contact fingers *a* to *i* inclusive are connected to the balancer and system as are the contact fingers of controller 19 of Fig. 1. Contact finger *j* of each controller 35 is connected by conductor 36 to the low resistance shunting conductor 34 around the two series field windings of the corresponding balancer, and the two contact fingers *k* of the two controllers are connected together by a conductor 37. This arrangement of series field windings and low resistance conductors 34 permits the use of a single equalizer between the two balancers, the equalizer consisting of conductors 36 and 37.

Assume that one of the balancers is in operation and it is desired to connect the other balancer to the system in parallel to the operating balancer. When the controller of the balancer to be connected is in the zero or "off" position the balancer is entirely disconnected from the system. When such controller is moved to the first running position the balancer is connected to the two outside main conductors of the system, the starting resistance being in series with the armature. As the controller is moved from the first to the fourth running positions, the sections of the starting resistance are successively cut out, and the balancer is brought up to speed. When the controller is moved to the fifth position, contact segments B^1 and B^2 of the drum B are engaged by contact fingers *g* and *f* and contact segments D^1 and D^2 are engaged by contact fingers *j* and *k*, thus connecting the balancer to the neutral or compensating conductor and connecting the two balancers by the single equalizer. The contact segments D^1 and D^2 are preferably slightly longer than contact segments B^1 and B^2 so that the equalizer connection is made before the balancer takes load. If desired, however, the controller may be provided with another notch or running position, in which case the equalizer connection will be made in the fifth position and the connection to the neutral or compensating conductor in the sixth position. I have also in this case shown at 38 and 38^a two three-pole disconnecting switches.

Since the equalizer is connected to the balancers between the armatures 28 and 29, there is a considerable difference of voltage between the equalizer and either outside main conductor of the system. Consequently with the usual method of connecting, starting, and paralleling there is danger of a short-circuit through the equalizer and one of the armatures of the balancer being started in case the equalizer switch is closed before the balancer is up to speed, in exactly the same manner as through the neutral or compensating conductor. However, with the unitary device for performing all the operations or for making all the connections necessary to place the balancer in condition to take load, the equalizing and the neutral or compensating conductor connections can not be made until after the starting resistance has been cut out of the armature circuit step-by-step, and the balancer has in consequence been brought up to speed.

In Fig. 3 I have shown my invention applied to compound wound balancers having series field windings arranged in a different manner, so that two equalizers instead of one are necessary. The balancers are shown at 39 and 39^a and each comprises two armatures 40 and 41, shunt field windings 42 and 43, and series field windings 44 and 45. In this case the series windings are arranged between the outside main conductors and the armatures respectively instead of between the armatures as in the preceding case. Each balancer is provided with a controller 46 for performing all the steps or operations necessary to place the balancer in running condition in parallel with the other balancer. Each controller in this case is provided with five contact drums A, B, C, D and E and with stationary contact fingers designated *a* to *m* inclusive. It is seen that drums A, B and C are exactly similar to drums A, B and C of the controllers 19 and 35 shown in Figs. 1 and 2 respectively and that drum D is similar to drum D of the controller 35. The controllers in this case are each provided with an additional drum E having two contact segments E^1 and E^2 and with two additional stationary contact fingers *l* and *m*. Contact fingers *a* to *i* are connected to the balancer and to the system as are the corresponding contact fingers in controllers 19 and 35 of Figs. 1 and 2. Accordingly drums A and C serve to connect the balancer to the main conductors of the system and to cause the balancer to be brought up to speed and drum B serves to connect the balancer to the neutral or compensating conductor, as in the preceding cases. Contact finger *j* of each controller is connected by conductor 47 to a point be-

tween the series field 44 and armature 40, and contact fingers *k* of both controllers are connected together by conductor 48. Thus conductors 47 and 48 form one of the equalizers. Contact finger *l* is connected by conductor 49 to a point between the series field 45 and armature 41 and the two contact fingers *m* of each controller are connected by conductor 50, the conductors 49 and 50 forming a second equalizer. The contact segments of drums D and E are of the same length and are preferably slightly longer than contact segments of drum B so that the balancers will be connected by the equalizers before being connected to the neutral or compensating conductor. If desired, each controller may be provided with another notch or running position so that the equalizer and neutral or compensating conductor connections can be made at successive notches or positions. I have in this case also shown three-pole switches 51 and 51[a] located between the balancers and the conductors of the distributing system so that the balancers can be entirely disconnected from the system if desired. These switches, as in the preceding case, may be omitted if desired.

It is to be understood that the construction, particularly the arrangement and number of the controller contacts, may be widely varied. For example, the number of contact segments in the starting drum and hence the number of sections of the starting resistance may be different from what is here shown. Many other obvious modifications may also be made without departing from the spirit and scope of my invention. All such I aim to cover broadly in the following claims.

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

1. In a multiple voltage system of distribution, main and compensating conductors, a balancer, and a controller for first connecting the balancer to the main conductors and then, after the balancer is up to speed, to a compensating conductor.

2. In a multiple voltage system of distribution, main and compensating conductors, a balancer, and a single controller for connecting said balancer first to the main conductors, then causing the balancer to be gradually brought up to speed, and then connecting the balancer to a compensating conductor.

3. In a multiple-voltage system of distribution, main and compensating conductors, a balancer, a starting resistance therefor, and a single controlling device for connecting the balancer to the main conductors and to the starting resistance, gradually cutting out the starting resistance to bring the balancer up to speed, and finally connecting the balancer to a compensating conductor.

4. In a multiple-voltage system of distribution, main and compensating conductors, a compound wound balancer arranged for connection to said conductors, and a unitary controller for first connecting the balancer to the main conductors, for then regulating the speed of the balancer, and for then connecting the latter to an equalizer.

5. In a multiple-voltage system of distribution, a plurality of main and compensating conductors, two or more compound-wound balancers, each having series and shunt field windings, a starting resistance for each balancer, one or more equalizers for connecting the balancers together, and a controller for connecting each balancer to the main conductors, for regulating the speed of the balancers, and for connecting the balancer to the equalizer or equalizers and to a compensating conductor of the system.

6. In a multiple-voltage system of distribution, main and compensating conductors, a plurality of balancers, and a unitary controller for each balancer, each controller being arranged and connected sequentially to connect its corresponding balancer to the main conductors, to bring said balancer up to speed, and to connect said balancer to a compensating conductor.

7. In a multiple-voltage system of distribution, main and compensating conductors, a plurality of compound-wound balancers, an equalizer, and a unitary controller for each balancer, said controller being arranged and connected sequentially to connect its corresponding balancer to the main conductors, to bring said balancer up to speed, and to connect said balancer to a compensating conductor, and a point between an armature and a series field winding of said balancer to said equalizer.

8. In a multiple-voltage system of distribution, main and compensating conductors, a balancer, a starting resistance, and a drum controller for sequentially connecting the balancer to a main conductor with said starting resistance in circuit, cutting out said resistance, and connecting the balancer to a compensating conductor.

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

BUDD FRANKENFIELD.

Witnesses:
GEO. B. SCHLEY,
FRED J. KINSEY.