

A. F. BERRY.
 APPARATUS FOR USE IN THE DISTRIBUTION OF ELECTRIC CURRENTS.
 APPLICATION FILED MAR. 14, 1910.

1,010,409

Patented Dec. 5, 1911.

4 SHEETS-SHEET 1.

Fig. 1.

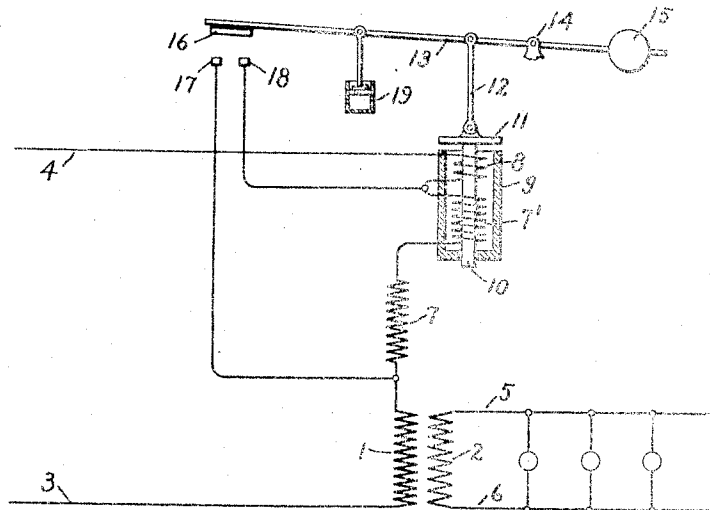
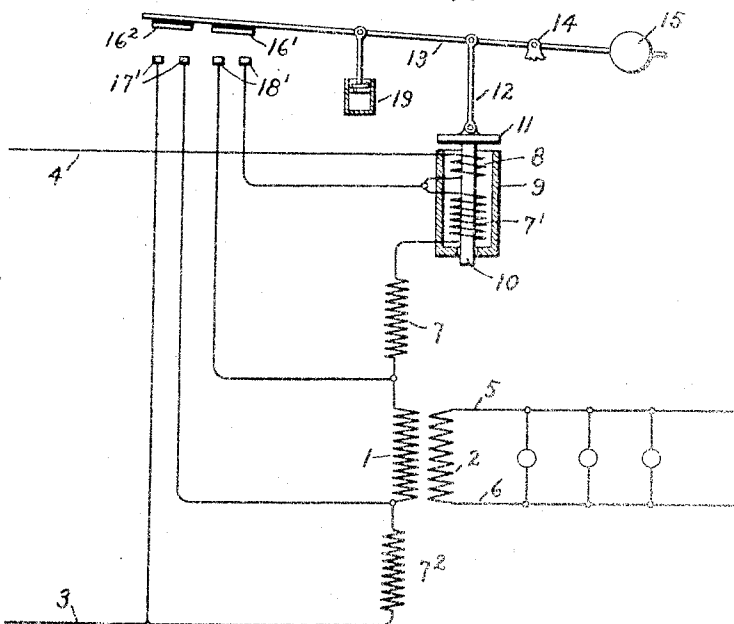


Fig. 2.



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4 SHEETS—SHEET 2.

Fig. 3.

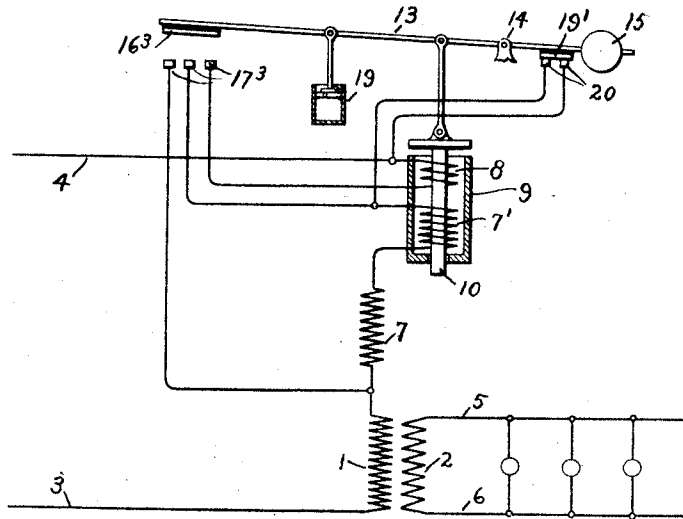
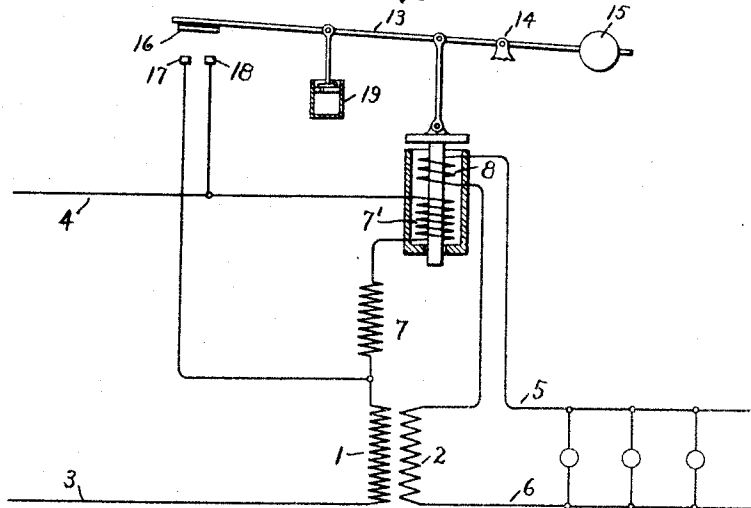


Fig. 4.



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4 SHEETS—SHEET 3.

Fig. 5.

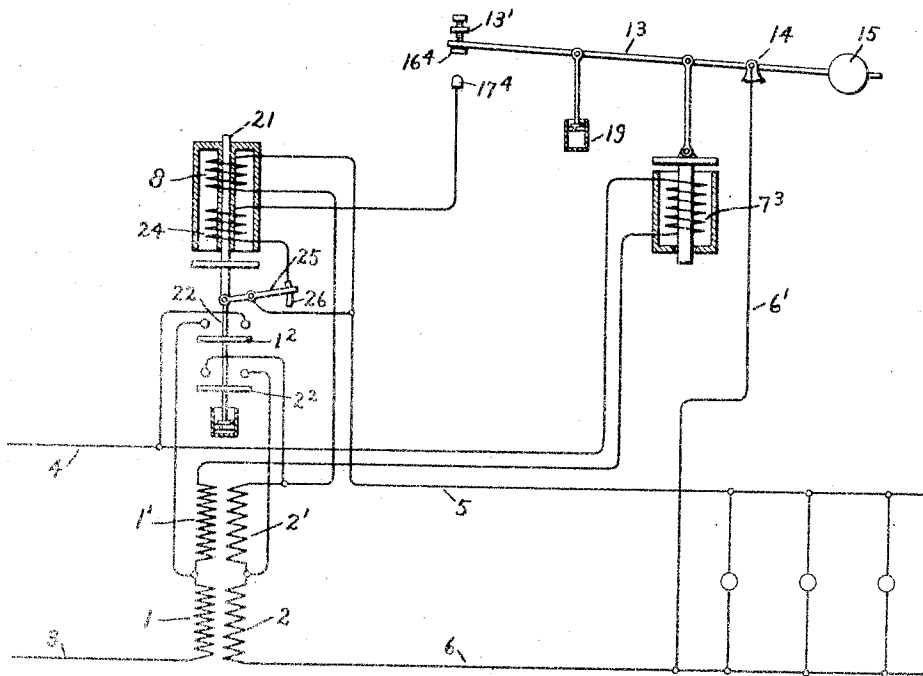
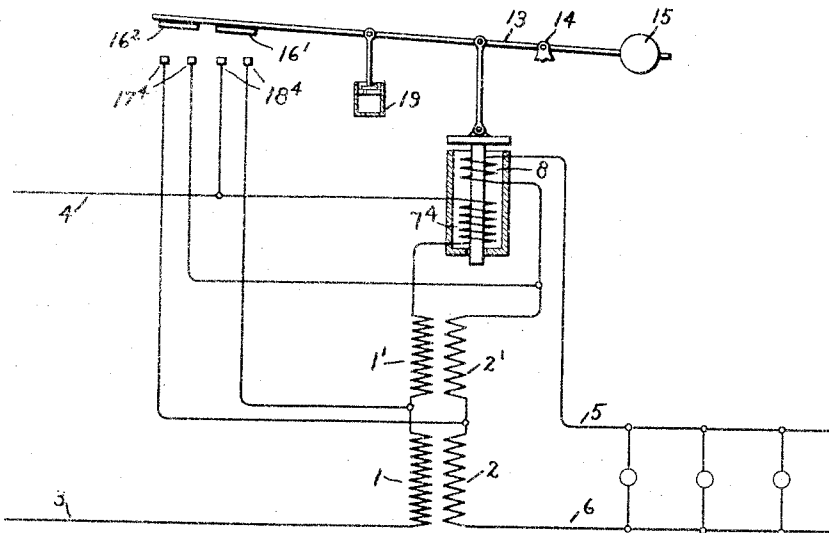


Fig. 6.



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4 SHEETS-SHEET 4.

Fig. 7.

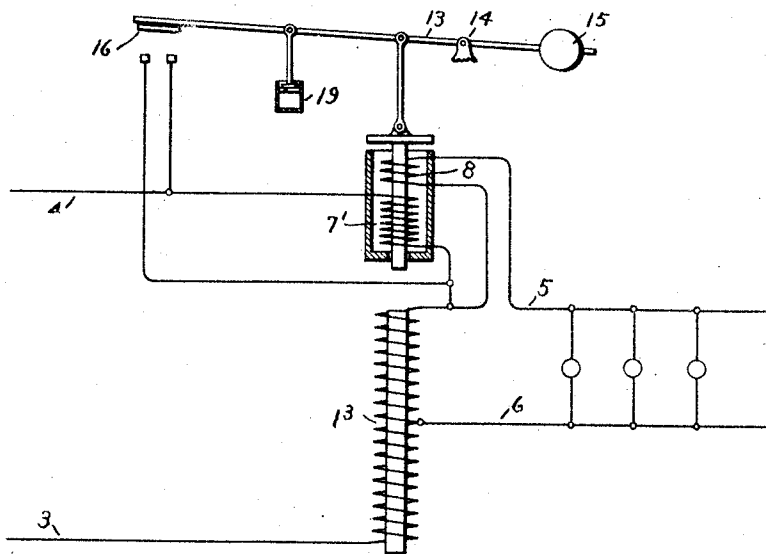
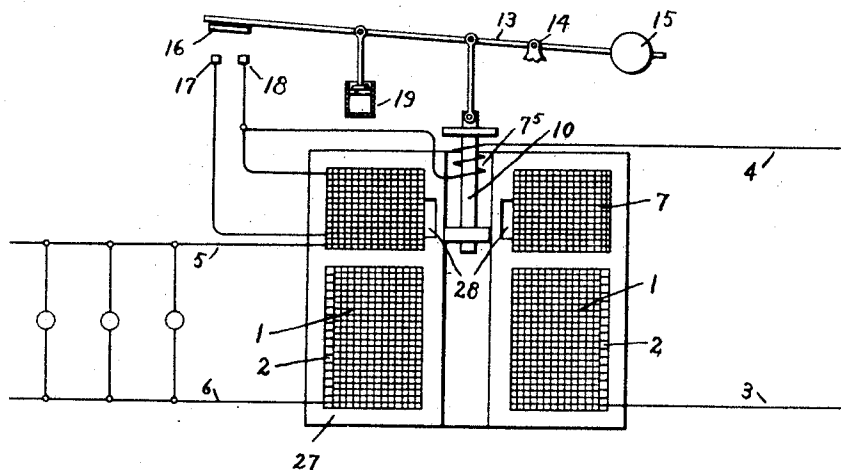


Fig. 8.



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UNITED STATES PATENT OFFICE.

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APPARATUS FOR USE IN THE DISTRIBUTION OF ELECTRIC CURRENTS.

1,010,409.

Specification of Letters Patent.

Patented Dec. 5, 1911.

Application filed March 14, 1910. Serial No. 549,132.

To all whom it may concern:

Be it known that I, ARTHUR F. BERRY, a subject of the King of Great Britain, residing at Ealing, Middlesex, England, have invented certain new and useful Improvements in Apparatus for Use in the Distribution of Electric Currents.

My invention relates to improvements in apparatus for use in the distribution of alternating electric currents comprising a transformer arranged to be automatically put into or out of effective use, in accordance with the load on the secondary circuit, and the object of my invention is to limit the losses in the transformer when it has no load or a very small load in the secondary circuit.

More specifically, my invention relates in general to improvements in the apparatus which I have described in my former Patents Nos. 796,555 and 800,538; and my present invention has for its object to simplify the construction and improve the working of apparatus of the kind referred to and to provide apparatus and connections which are adapted not only for station use but also for use on a consumer's premises.

I accomplish the object of my invention by connecting to the primary of the transformer or transformers a reactive or controlling winding which is adapted to exercise a choking effect on the transformer circuit when little or no current is flowing through the secondary circuit. This reactive winding increases the impedance of the transformer circuit and acts to put the transformer out of effective use without disconnecting it from the circuit, and is arranged to be short-circuited by short-circuiting mechanism when current flows in the secondary circuit or increases beyond a predetermined amount. The short-circuiting mechanism may be arranged to be actuated wholly or in part by this reactive winding, and it may be held in the short-circuiting position by a second winding which I shall call a retaining winding. When the current falls so as to be equal to or below the predetermined amount for which the short-circuiting mechanism is arranged to operate, this mechanism is automatically released and the reactive winding again placed in series with the transformer.

The further novelties of my invention are pointed out with more particularity in the

claims annexed to and forming a part of the specification.

For a further understanding of my invention, reference may be had to the accompanying drawings which show diagrammatically the arrangement of circuits and apparatus which I may use; Figures 1 to 4, both inclusive, showing various arrangements of apparatus for use with a single transformer; Figs. 5 and 6 showing arrangements of apparatus for use with two transformers, that is, a main and supplementary transformer, as shown in my previous patents; Fig. 7 showing an arrangement for a compensator or auto-transformer; and Fig. 8 showing a modified form of construction.

Referring first to Fig. 1, I have shown a transformer which has a primary winding 1 and a secondary winding 2. The primary winding is connected to supply conductors 3, 4 which are connected to a suitable source of supply, which is not shown. The secondary winding 2 is connected to conductors 5 and 6 which supply suitable translating devices. In series with the primary 1 are reactive windings 7, 7'. The winding 7' is shown as connected in series with another winding 8 which I shall call the retaining winding, for convenience. Winding 7' is called, also for convenience, the controlling winding but it is to be understood that it may be considered as forming part of the reactive winding. Windings 7 and 8 are shown as forming a portion of an electromagnetic mechanism which also comprises a cylindrical iron core 9 which may be laminated, if desired, inclosing windings 8 and 7' and the armature 10 which is inclosed by these windings. The upper end of armature 10 is provided with a collar 11 arranged to be held magnetically against the upper end of magnet core 9 after it has been attracted thereto. Connected to the armature 10 by means of link 12 is the short-circuiting mechanism which consists of a switch lever 13 pivoted at 14 and having one end loaded with a weight 15 and a contact 16 at the other end. In operative relation with contact 16 are contacts 17 and 18 which are connected to conductors at either end of windings 7, 7', so that closing these contacts short-circuits windings 7, 7'. The arm 13 is counterbalanced by weight 15 so that it is normally biased for an open-circuit position

as shown in the drawing. When the windings of the electromagnetic mechanism in operative relation with the short-circuiting mechanism are energized with greater than
 5 a predetermined amount of current, they will pull down the switch lever and thus short-circuit windings 7, 7'. The dash pot 19 is connected to the lever so that the circuit may be closed rapidly, but will be
 10 opened somewhat slowly.

The manner in which this device operates is as follows: Normally the reactive and controlling windings 7, 7' are in series with the primary of the transformer. When the
 15 current flows in the secondary or increases beyond a predetermined amount, the current flowing through the retaining winding 8 and the controlling winding 7' will be so great as to cause the armature 10 to be
 20 pulled down, thus closing the circuit between the contacts 17 and 18 and short-circuiting the reactive and controlling windings. The retaining winding 8, however, will still be in the circuit and will hold the switching
 25 mechanism in its short-circuiting position until such time as the secondary current falls below the predetermined amount for which the electromagnetic mechanism is set, in which case the weight 15 will cause the
 30 switching lever to slowly change its position, and the reactive winding will again be placed in series with the primary of the transformer. As will be seen, when there is no current or a very small current in the
 35 secondary circuit, the reactive winding, in which, as stated above, I may also include what I call the controlling winding, will exert its full choking effect on the primary winding so as to, in effect, put the trans-
 40 former out of action without disconnecting it from the primary supply conductors 3 and 4, thereby preventing waste of electric energy in the transformer. When the current in the secondary circuit rises above the
 45 predetermined value or when it recommences to flow, supposing it to have been cut off, the impedance of the primary winding 1 will be reduced to such an extent as to allow sufficient current to flow through the re-
 50 active and controlling winding 7' so as to enable it to attract the armature 10, and thus close the switch, thereby short-circuiting itself in the manner already described and enabling a larger current to flow through
 55 the primary winding 1 and also through the retaining winding 8 which will then act to hold the armature 10 in its attracted position, and keep the switch lever in its short-circuited position.

It will be obvious, while I have illustrated the controlling winding 7' and the reactive winding 7 as two windings, for the purposes of clearness, and have so described them, that the entire reactive winding may be
 65 placed in operative relation with the arma-

ture 10 in a similar manner to the winding 7', as shown; that is, winding 7' would be increased and winding 7 omitted, and various other constructions, which would be simple in character and obvious to those skilled in
 70 the art and which I have not deemed it necessary therefore to illustrate, may be adopted.

It will also be obvious, that, while I have shown a particular form of short-circuiting
 75 switch embracing the contacts 17 and 18 and the movable member 16, any form of switch such as desired may be used, and I do not limit myself to this particular form, which is diagrammatically shown for clearness of
 80 illustration.

Referring now to Fig. 2, I have shown a modification of the connections shown in Fig. 1. This modification consists in ar-
 85 ranging a reactive winding in series with both sides of the primary winding of the transformer. In this case the switch lever 13 must be provided with two sets of short-circuiting switches, as shown in the diagram, these switches short-circuiting both
 90 the reactive and controlling windings.

Fig. 3 shows a further modification of my invention, wherein the retaining winding is not normally connected in series with the
 95 controlling winding but is normally disconnected from the circuit, and the controlling and reactive windings are connected in series with primary and supply conductors 3 and 4. When the current in the trans-
 100 former exceeds the predetermined amount, the switch mechanism is actuated in the manner previously described and the controlling or reactive windings are short-circuited while the retaining winding is put
 105 directly in series with the primary winding of the transformer. This result is accomplished by providing the switch lever with an additional short-circuiting device 19', 20, which, as will be seen from an inspection
 110 of the figure connects the controlling winding 7' directly to the conductor 4. After the current has reached a predetermined amount so that winding 7' pulls down arma-
 115 ture 10 in a manner similar to that already described in reference to Fig. 1, the contact 16^s and contacts 17^s short-circuit the reactive and controlling windings and connect retaining winding 8 directly in series with
 120 primary winding 1.

In Fig. 4 I have shown a still further
 125 modification of the connections which I may use. This modification consists in connecting the retaining winding directly in series with the secondary circuit. It will be obvious, however, that modifications of the
 130 connections which I have illustrated will suggest themselves to those skilled in the art and I have not considered it necessary to illustrate such. The connections of the apparatus shown in Fig. 4 cause the apparatus
 135

to operate in the same manner as has been previously described.

Fig. 5 shows a still further modification of my invention. This modification consists in the employment of a main and supplementary transformer having their windings connected in series in a manner previously described in my patents already referred to. The reactive and controlling windings, here shown as being combined into one winding, are connected normally in series to the primary windings of these two transformers. The short-circuiting mechanism in this case short-circuits both the primary and secondary windings of the supplementary transformer, and also the controlling winding. In the arrangement which I have shown in Fig. 5, the supplementary transformer has primary and secondary windings 1' and 2', which are respectively connected in series with the windings of the main transformer 1 and 2. The primary supply conductor 4 is shown as connected in series with the controlling winding 7^a which is connected in series with the primary windings of the transformers. The controlling winding is shown as arranged to pull down the switch lever 13 which, in general, is similar to the lever as already described, but, instead of the short-circuiting member 16, has a simple contact member 16^a which for the lower position of the lever comes in contact with the stationary contact 17^a. The lever 13 is connected by conductor 6' to conductor 6. The short-circuiting mechanism in this case consists of a mechanism shown on the left of the figure, comprising a retaining winding 8 and an auxiliary winding 24. The armature 21 is connected to a rod 22 which has contacts 1², 2² which are arranged so that in the upper position these contacts will short-circuit respectively the primary and secondary windings of the supplementary transformer together with the controlling winding. Connected also to rod 22 is the lever 25 which makes contact with the stationary member 26. For this connection the controlling winding acts as a relay and when the load on the two transformers in series reaches a predetermined amount controlling winding 7^a will pull down the switch lever and thus cause the winding 24 to be energized, pulling armature 21 upward in a vertical direction in the figure shown. This will cause the movable contacts 1², 2² to short-circuit the controlling winding and the primary windings of the transformer and the secondary windings thereof, and the armature will be retained in its position by the retaining winding 8. When the current falls below the predetermined amount, armature 21 will fall by the action of gravity and connect the supplementary transformer in series with the main transformer. The

retaining winding with its armature may be arranged to control mechanical means for holding the short-circuited mechanism in the closed position.

In Fig. 6 I have shown a somewhat simplified arrangement of the connections shown in Fig. 5. In this case the two transformers are shown as connected in series and with the controlling winding 7^a, connected in series with the primary windings of the transformers, and the switching lever is arranged to short-circuit both the primary winding of the supplementary transformer and the controlling winding and the secondary winding of the supplementary transformer. This figure is similar to the connections shown in Fig. 2, with the exception of the fact that the short-circuiting switches 16' and 16² short-circuit the windings of the supplementary transformer and the controlling winding, instead of short-circuiting the two reactive windings and the controlling winding.

Fig. 7 shows another arrangement which I may adopt when using a compensator or auto-transformer. In this case it will be seen from the diagram, the controlling winding is connected between one end of the winding 1² of the compensator and the primary supply conductor 4, and the retaining winding is connected in series with the conductor 5. The arrangement is such that, when the secondary circuit is loaded above a predetermined amount, the electromagnetic mechanism and the short-circuiting mechanism will operate in a manner similar to that already described, short-circuiting the controlling winding.

In Fig. 8 I have shown a modification of the arrangement of the windings and core, as previously described. In this case the magnetic core 27 may be arranged to completely inclose the controlling winding, as shown. With such a construction, by furnishing a completely closed magnetic circuit for the winding, the choking effect of the same will be increased. The retaining winding 7^a may either be used alone to operate the switching device or may have its action assisted by the construction which I have shown. When a load is put on the secondary winding of the transformer the impedance of the latter is reduced and hence the voltage across the controlling winding 7 will be increased. Such increase in voltage will produce a greater flux in the portion of the core surrounding this winding, and this increase in flux may be used to assist the action of the retaining winding by reducing the section of the core 27 as shown, at 28, so as to cause a considerable magnetic leakage to the armature 10 before the controlling winding is short circuited. It will be obvious that such magnetic leakage will operate to actuate the switching device and will

thus assist the action of the retaining winding. In the construction, which I have shown also, the transformer, with its primary and secondary windings, and the controlling and retaining windings, with the switching device, are shown as combined into one unit.

While I have shown and described my invention as embodied in certain particular forms and construction of apparatus, I do not limit myself to such forms and construction but seek in the appended claims to cover all forms and construction which shall be within the scope of my invention and be obvious to those skilled in the art.

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

1. In combination, a transformer, a reactive winding normally in series therewith, and means for short circuiting said winding when the transformer load is greater than a predetermined amount, said means comprising a short circuiting mechanism and an electro-magnetic mechanism in operative relation therewith, embracing a controlling winding short circuited substantially simultaneously with the reactive winding, and a retaining winding both windings normally energized by a current substantially proportional to the transformer load.

2. In combination, a transformer, a reactive winding normally in series therewith, and means for short circuiting said winding when the transformer load is greater than a predetermined amount, said means comprising a short circuiting mechanism and an electro-magnetic mechanism in operative relation therewith, embracing controlling and retaining windings, the controlling winding forming a portion of the reactive winding and being short circuited substantially simultaneously with the reactive winding, the controlling and retaining windings being

normally energized by a current substantially proportional to the transformer load. 45

3. In combination, a main transformer, a supplementary transformer having its windings in series therewith, a reactive winding normally in series therewith, and means for short circuiting the windings of the supplementary transformer, and the reactive winding, when the transformer load is greater than a predetermined amount, said means comprising a short circuiting mechanism and an electro-magnetic mechanism in operative relation therewith, embracing a controlling winding short circuited substantially simultaneously with the reactive winding, and a retaining winding both windings normally energized by a current substantially proportional to the transformer load. 50 55 60

4. In combination, a main transformer, a supplementary transformer having its windings in series therewith, a reactive winding normally in series therewith, and means for short circuiting the windings of the supplementary transformer, and the reactive winding, when the transformer load is greater than a predetermined amount, said means comprising a short circuiting mechanism and an electro-magnetic mechanism in operative relation therewith, embracing controlling and retaining windings, the controlling winding forming a portion of the reactive winding and being short circuited simultaneously with the reactive winding, the controlling and retaining windings being normally energized by a current substantially proportional to the transformer load. 65 70 75

In witness whereof, I have hereunto set my hand this first day of March, 1910. 80

ARTHUR F. BERRY.

Witnesses:

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J. C. WREST.