Sept. 6, 1927. 1,641,659

F. F. BRAND

AUTO TRANSFORMER

Filed Feb. 19, 1926

Fig. 1.

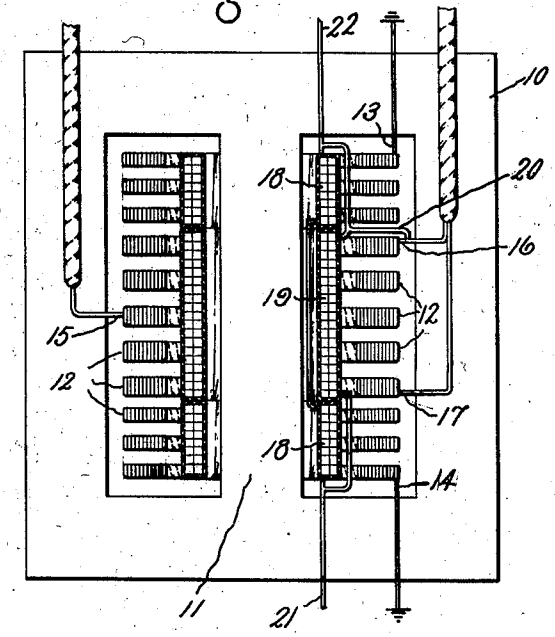


Fig. 2.

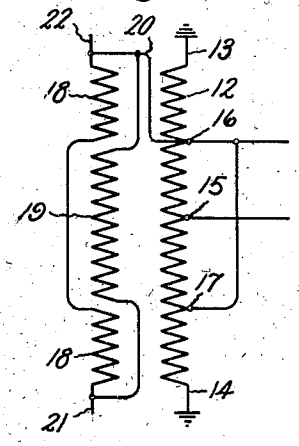
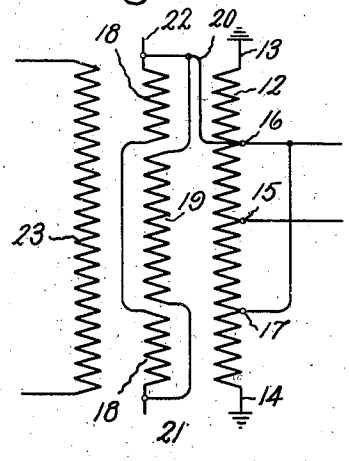


Fig. 3.



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UNITED STATES PATENT OFFICE.

FREDERICK F. BRAND, OF PITTSFIELD, MASSACHUSETTS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

AUTOTRANSFORMER.

Application filed February 19, 1926. Serial No. 89,504.

My invention relates to autotransformers. An autotransformer has a single main winding which may be used to connect two circuits if it is not necessary that the circuits be insulated from each other. The connected circuits are usually of different voltage, of course, and connected across correspondingly different numbers of turns of the winding so that the winding includes two groups of turns. One of these groups of turns is a common winding section between the terminals of each of the connected circuits and carries a current which is the algebraic sum of the currents in the two circuits. The other group of turns is a series winding section which carries a current which flows in series with both circuits but which does not flow through the common winding section. While the transformer is in operation, the voltage increases through the turns or coils forming the winding from the low voltage end, which may be grounded, to the high voltage end and it is desirable that the turns or coils be distributed along the core in approximately the order of increasing voltage so that the voltage and therefore the amount of insulation between adjacent turns or coils may be a minimum. This arrangement of the winding turns and coils also permits the shortest and simplest coil connections to be used but it necessarily separates the common and series winding sections and it is usually desirable that these be closely coupled to avoid excessive reactance. The general object of the invention is to provide an autotransformer construction in which the common and series sections of its winding are closely coupled to avoid high reactance, the turns or coils of the winding being distributed along the core substantially in the order of increasing voltage so that the voltage and therefore the insulation necessary between adjacent turns or coils is a minimum.

Other objects and advantages will appear from the following description taken in connection with the accompanying drawing in which Fig. 1 shows an autotransformer, partly in section, constructed in accordance with the invention; Fig. 2 is a diagram of the windings and their connections; and Fig. 3 is a winding diagram similar to that shown in Fig. 2 but with an additional winding which may be provided if desired.

Like reference characters indicate similar parts in the different figures of the drawing.

The particular form of autotransformer which has been selected to illustrate the invention includes a shell type core 10 having a winding leg 11 surrounded by a main winding 12. This winding 12 is provided with terminals and taps for connection to the conductors of two circuits of different voltage between which the transformer is to transmit power. The two ends 13 and 14 of the winding 12 are connected together, preferably by grounding them, to form one terminal and the center 15 of the winding is provided with a tap to form the other terminal for the two sides of the circuit having the higher potential. This form of winding having two parallel connected sections is often used in high voltage transformers as both ends of the winding are at low or ground potential and may therefore be insulated easily from the adjacent core yokes. The two connected and preferably grounded ends 13 and 14 of the winding 12 also form a terminal for one side of the circuit having the lower potential, two taps 16 and 17 being connected together to form the terminal for the other side of this circuit. The two taps 16 and 17 are equally spaced from the two ends 13 and 14 of the winding to give the proper voltage for the circuit having the lower potential. Each half of the winding 12 thus comprises a common section and a series section and its turns are arranged along the core substantially in the order of increasing voltage from the low voltage or grounded end to the central high voltage terminal 15. This arrangement avoids high voltage and the necessity of excessive insulation between adjacent turns and coils of the winding but results in a separation of the common and series sections.

To avoid high reactance between the common and series winding sections, an auxiliary winding is provided to bring the common and series sections into good inductive relation. This auxiliary winding comprises a section 18 in good inductive relation with the common winding sections and a section 19 in good inductive relation with the series winding sections. The sections 18 and 19 of the auxiliary winding have the same number of turns and are connected in series with their voltages opposed so that they tend to neutralize any leakage flux from the common and series sections of the main winding 12,

thus reducing the reactance between these sections of the main winding. When the opposed voltages in the sections 18 and 19 of the auxiliary winding are equal, there will be, of course, no circulating current in the local circuit which they form. If, however, the leakage flux from either the common or series section of the main winding induces a voltage in one of these sections 18 or 19 which is greater than the voltage in the other of these sections, then a circulating current will result which will serve to transfer part of the power between the two sections of the main winding, the remainder of the power being transmitted by direct induction through the common magnetic core surrounded by the two sections of the main winding. The power transmitted between the common and series sections of the main winding is thus transmitted partly by means of the direct magnetic coupling provided by the core and the remainder is transmitted by the auxiliary winding provided by the present invention. A connection 20 is desirable between the auxiliary winding and the main winding 12 to establish the potential of the auxiliary winding.

The auxiliary winding may be provided with terminals 21 and 22 if desired to supply a limited amount of current for lighting or other purposes. While the two sections 18 and 19 form a local circuit in which they are connected in series with their voltages opposed, the current which they may supply to any outside circuit connected to their terminals 21 and 22 will flow through them in parallel and their voltages will both be in the same direction in such an outside circuit. A second auxiliary winding 23 may also be provided if desired as shown in Fig. 3 and may be used to excite a synchronous condenser or otherwise.

The invention has been described as applied to an autotransformer having a main winding with a central high tension terminal and parallel connected sections at both sides of this terminal but it will be apparent that the invention may be used equally as well in connection with autotransformers having differently arranged windings.

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

1. An autotransformer comprising a winding having terminals adapted to connect two circuits of a different potential, said winding comprising a common section and a series section, and an auxiliary winding comprising two sections connected in series and with their voltages opposed, one of said auxiliary winding sections being in good inductive relation with said common winding section and the other of said auxiliary winding sections being in good inductive relation with said series winding section, whereby the reactance between said common and series winding sections is reduced.

2. An autotransformer comprising a core, a winding on said core having terminals adapted to connect two circuits of different potential, said winding comprising a common section and a series section, the turns of said winding being distributed along said core to avoid high potential between adjacent turns, and an auxiliary winding comprising two sections connected in series and with their voltages opposed, one of said auxiliary winding sections being in good inductive relation with said common winding section and the other of said auxiliary winding sections being in good inductive relation with said series winding section, whereby the reactance between said common and series winding sections is reduced.

3. An autotransformer comprising a core, a winding on said core having terminals adapted to connect two circuits of different potential, said winding comprising a common section and a series section, the turns of said winding being distributed along said core substantially in the order of increasing voltage to avoid high potential between adjacent turns, and an auxiliary winding comprising two sections connected in series and with their voltages opposed, one of said auxiliary winding sections being in good inductive relation with said common winding section and the other of said auxiliary winding sections being in good inductive relation with said series winding section, whereby the reactance between said common and series winding sections is reduced.

In witness whereof, I have hereunto set my hand this 16th day of February, 1926.

FREDERICK F. BRAND.