

July 7, 1931.

J. KUBLER

1,813,857

TRANSFORMER

Filed Aug. 19, 1930

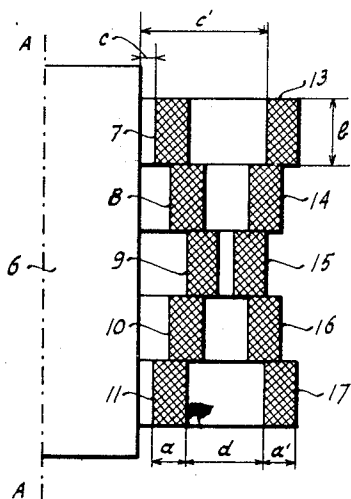


Fig. 1.

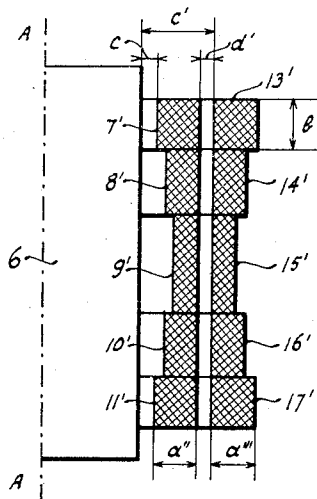


Fig. 2.

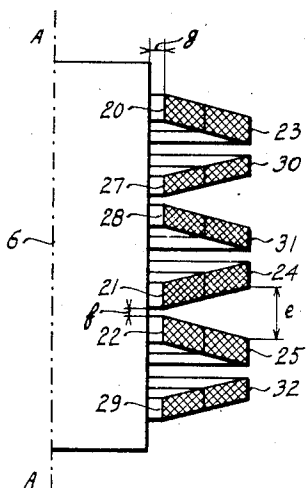


Fig. 3.

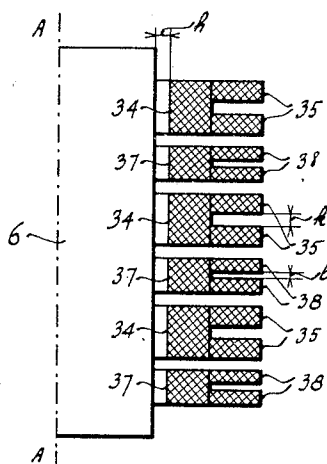


Fig. 4.

Inventor
Johannes Kubler
By *Alfred H. Dyson*
Attorney

UNITED STATES PATENT OFFICE

JOHANNES KUBLER, OF BADEN, SWITZERLAND

TRANSFORMER

Application filed August 19, 1930, Serial No. 476,295, and in Germany August 9, 1929.

This invention relates to improvements in electrical transformers and particularly to the arrangement and shape of the windings forming the electrically active portions of the structure.

As is well-known, it is advantageous to have uniform distribution of current throughout a transformer to the end that all of the coils connected in parallel circuits may be equally loaded particularly in transformers such as are used to supply multi-anode rectifiers of the metallic vapor type. Such equal division of current throughout all of the transformer windings not only makes the transformer cheaper to construct but also reduces the copper losses and generally increases the efficiency of operation of the entire structure.

It is, therefore, among the objects of the present invention to provide an electrical transformer structure in which the windings are connected in parallel and are so arranged and shaped as to avoid so-called equalizing or circulating currents in the windings.

Another object of the invention is to provide an electrical transformer structure in which the windings are connected in parallel and are so arranged and shaped as to obtain substantially equal inductances throughout the structure.

Another object of the invention is to provide an electrical transformer structure in which the windings are connected in parallel and the several portions of the windings are formed with the same numbers of turns and are differently spaced from the transformer core or from each other so as to secure equal distribution of current throughout the entire transformer.

Objects and advantages, other than those above set forth, will be apparent from the following description when read in connection with the accompanying drawings in which

Figure 1 is a vertical cross-sectional view of one embodiment of the invention showing a portion only of the core of a transformer taken on the central line therethrough about

which core portion the windings are arranged,

Figures 2, 3 and 4 are views similar to that shown in Figure 1 but differing therefrom in the shape and arrangement of the coils.

Referring more particularly to the drawings by characters of reference, the reference numeral 6 designates a portion of a core about which the several windings of a transformer are arranged. The coils forming the primary winding or the different primary winding sections are designated by similar reference numerals in Figures 1 and 2 and differing reference numerals in Figures 3 and 4 as is likewise the case with the secondary windings.

In the embodiment of the invention shown in Figure 1, the primary and secondary windings are arranged concentrically to the centerline A—A of the core portion 6 on which they are mounted and each of the primary winding sections 7, 8, 9, 10 and 11 have the width a or the same number of turns as is the case also with the secondary winding sections 13, 14, 15, 16 and 17 which have the same width a' . It is to be assumed that all of the winding sections are connected in parallel. The width a of the several coils or winding sections being the same it will be understood that the height b of the several coils must be identical as shown to obtain the same number of turns for each winding section. The several sections are however spaced from the core the distances c and c' and from each other the distances d . The several series of primary and secondary coils have spacings different from each other and the spacing of each series of coils differ from each other. By properly proportioning the several sections, the inductances of the several coils or sections of each winding may be made equal at all points which prevents the rise of circulating currents and facilitates calculation of the values for the structure in addition to the advantages previously set forth.

As shown in Figure 2, the primary and secondary windings are again arranged concentrically to the centerline of the core portion 6 but the widths a'' and a''' of the winding sections vary so that the height b of the several

coils or winding sections varies inversely as the widths over the entire height of both the primary and secondary windings for the purpose of forming each section with the same number of turns. The spacings c of the several primary winding sections from the core are different in each of the coils of different sizes. It will be seen that the spacing of the primary from the secondary winding is the same throughout the entire length of the structure. When the several coil sections are properly proportioned, the above arrangement also prevents the occurrence of equalizing or circulating currents in the windings.

The structure shown in Figure 3 differs materially from that shown in the preceding figures as may be readily seen. In Figure 3, the primary windings are designated by reference numerals 20, 21, 22, 23, 24 and 25 which windings are arranged in pairs as shown at 20-23, etc. and have the same dimensions for the purpose of obtaining the same number of turns in each coil. Each pair of primary winding coils being connected in parallel and having the same number of turns, the pairs of coils are inclined at an angle to the centerline A-A of the core portion 6 for the purpose of producing an equal inductance in both coils of each pair. The coils 27 to 32 inclusive of the secondary windings are uniform in size and shape and are also arranged in parallel connected pairs. Being of the same size and having the same number of turns, the secondary coils must be inclined to the centerline A-A to secure an equal inductance in the several secondary coils. The coils of each pair of both the primary and secondary windings are equally spaced from each other by the amounts e at the outer edges and the smaller amounts f at the inner edges. The primary and secondary windings are both spaced from the core 6 by the distance g .

Figure 4 illustrates a modification of the invention in which the primary windings are arranged in groups of two coils of the same cross-section area as at 34 and 35, of which coil 35 is supported upon coil 34 and so constructed that the two half sections are spaced from each other by the amount k . The secondary winding is also arranged in groups of two coils of the same cross section area as at 37 and 38. Coil 38 is supported on coil 37 and is constructed as two half sections spaced from each other by the distance l . All of the coils of both windings are spaced from the core 6 by the distance h .

It is of course not necessary that both the primary and the secondary winding coil sections be connected in parallel but it is sufficient if any one of the two windings i. e. the secondary winding be connected in parallel. It will be readily understood that any of the modifications may be combined with any other modification for the purpose of produc-

ing a uniform distribution of current throughout the windings so long as the dimensions of the coils of the several windings are uniform and have the same number of turns to obtain a substantially uniform inductance throughout the entire transformer for each of the coil portions. It is to be noted that the present invention is not to be confused with structures in which the several windings are connected in series and are spaced differently with respect to each other or to the core for purposes of insulation etc., for the reason that such transformers do not have parallel connected winding sections which are so arranged as to remain free from the equalizing or circulating current avoided by the present invention.

Although but a few embodiments of the present invention have been illustrated and described, it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

Claims—

1. An electric transformer comprising a core, a primary winding, and a secondary winding, said windings being divided into parallel connected winding sections, said sections being so spaced relative to said core and so proportioned as to obtain substantially equal inductances at all points throughout parallel connected sections.

2. An electric transformer comprising a core, a primary winding, and a secondary winding, said windings being divided into parallel connected winding sections, the corresponding sections of said windings being similarly spaced from each other and being so spaced relative to said core and so proportioned as to obtain substantially equal inductances at all points throughout the parallel connected sections.

3. In an electric transformer comprising a core, a primary winding, and a secondary winding, said windings being divided into parallel connected winding sections, the different sections of said windings being differently spaced from each other and from said core to obtain substantially equal inductances at all points throughout the parallel connected sections.

4. An electric transformer comprising a core, a primary winding, and a secondary winding, said windings being divided into parallel connected winding sections, the differently located sections of said windings being different in size, the difference in size being so proportioned as to obtain substantially equal inductances at all points throughout the parallel connected sections.

5. An electric transformer comprising a core, a primary winding, and a secondary winding, said windings being divided into parallel connected winding sections, said sec-

tions being uniformly spaced from each other and being formed with varying cross-sections to obtain substantially equal inductances throughout the parallel connected sections.

6. An electric transformer comprising a core, a primary winding, and a secondary winding, said windings being divided into parallel connected winding sections, the sections of each winding being uniform in dimensions and being arranged at varying spacings from each other and from the sections of the other windings to obtain substantially equal inductances through the parallel connected sections.

15 In testimony whereof I have hereunto subscribed my name this 6th day of August, A. D. 1930.

JOHANNES KUBLER.

20

25

30

35

40

45

50

55

60

65