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A. MEYERHANS

2,531,697

TRANSFORMER

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Fig. 1.

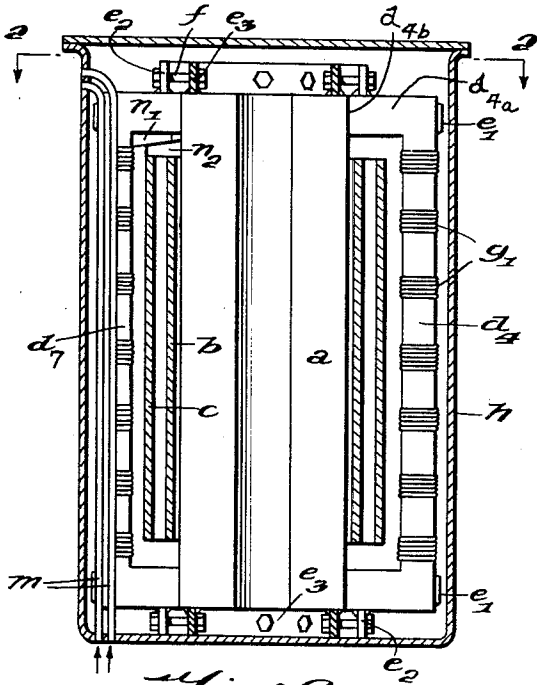


Fig. 3.

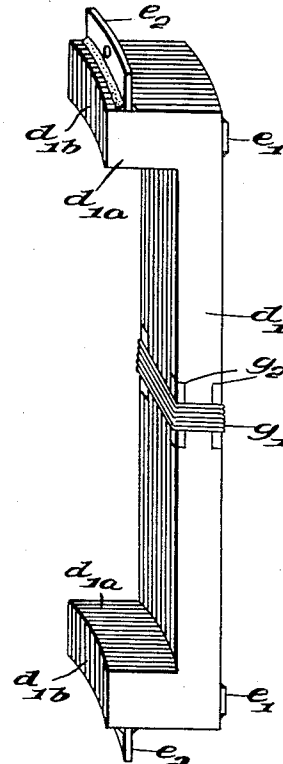


Fig. 2.

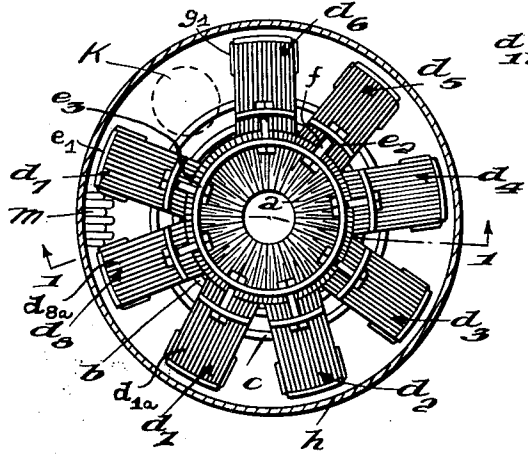
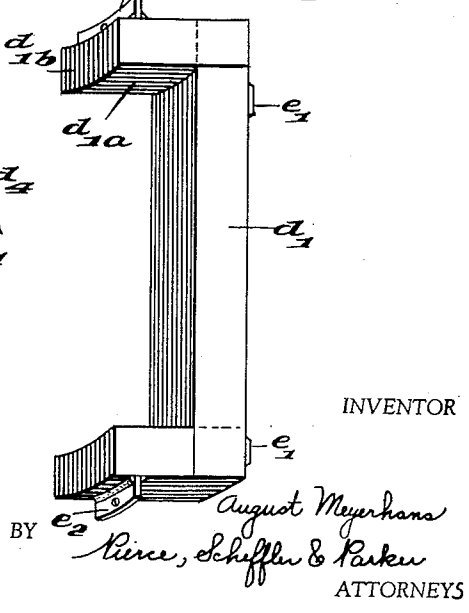


Fig. 4.



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TRANSFORMER

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3 Claims. (Cl. 175-356)

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When building transformers it has been usual up to the present to make the iron core composed of columns for the windings and yoke parts for the magnetic return flow out of sheet metal stampings of different length and width, which are superposed in parallel planes and may be interleaved. If in this arrangement the column form is adapted as closely as possible in cross-section to the circular form of the windings, the number of different sized stamping operations is increased and the work entailed in stamping and the waste of sheet metal also becomes greater. The building up of the columns and the putting together of the iron core entails much labor and is costly. The cost of building up the core is reduced by employing columns composed of metal sheets which are layered substantially radially and which are connected at their end surfaces by welding seams. This method of building up columns is not only simple and cheap as regards manufacture, it is also favorable from the magnetic and electric point of view. However, the usual way of building up the return flow is still unfavorable, as it entails a considerable amount of stamping work and a substantial waste of sheet metal and makes it necessary to employ arrangements for supporting the windings.

The object of the present invention is to provide a transformer having a column built up of radial metal sheets, in which the described disadvantages are eliminated through the magnetic return flow path being formed according to the invention of stampings which are built up in substantially U-shaped packets and are pressed with their flanges against the column.

In the accompanying drawing there is shown diagrammatically as a construction example of the above invention a single phase transformer. Figure 1 is a view in longitudinal section taken on line 1-1 of Fig. 2 and Figure 2 is a view in transverse cross-section taken on line 2-2 of Fig. 1. Figures 3 and 4 show constructional details.

In the figures *a* represents the column of the iron core with radially-stacked stampings and the concentric high and low voltage windings *b*, *c*. The magnetic return flow iron is formed of U-shaped yokes or packets of stampings *d*, *d*₁ to *d*₈, which are arranged radially around the periphery of the column and are pressed with their flanges *d*_{1a} to *d*_{8a} against the column, so that they surround the windings. The end faces *d*_{1b} to *d*_{8b} of the flanges of the U-shaped packets of stampings which confront the exterior surface of the column *a* have a concave curvature com-

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plementary to the convex curvature of the column, in order to facilitate the direct passage of the flux between the column and the return flow iron. The stampings of the U-shaped packets of the return flow iron can simply be stacked over a former corresponding to the circular periphery of the column. The stampings of the U-shaped yokes are held together by welding seams which are provided in places, preferably on the outwardly disposed surfaces of the webs and/or flanges. In the example shown, connecting strips *e*₁, *e*₂ are used for the welding connection. The strips *e*₂ which are welded to the flanges of the U-shaped packets are used with the aid of strips *e*₃ welded to the end surfaces of the column and of bolts *f* for producing the pressure between the column and the U-shaped packets of the return flow iron. The active part of the transformer is inserted in a circular tank *h*. At least one sector of the radially built up column is replaced by a sector of insulating material *i*, for instance wood. This increases the space for the leads. *k* represents a bushing insulator.

The packets of the magnetic return flow iron may be formed either of metal sheets stamped out in U-shape (Fig. 3) or of rectangular stamped sheets built together and interleaved in U-form (Fig. 4), whereupon they are welded in the manner described above. It is recommended to hold the stampings together at certain points by means of bandages *g*₁ (Figs. 1 and 3), which consist at least in part of insulating material. The bandages will suitably consist of cord windings which are placed over angle pieces *g*₂ of layered insulating material, and cover the corners of the packets of stampings.

Through the iron core being built up in accordance with the invention the magnetic return flow part will also have a shape in which the stamping work is reduced to a minimum. Metal sheets stamped out in rectangular form and put together in U-form are held together very simply; no insulated screw connections are required for the packets of stampings. The welding seams hold the metal sheets together rigidly. When the packets are composed of U-shaped stampings, it becomes possible to use the rectangular waste as column stampings for a smaller transformer. The special form of welded connections in the case of the column and the return flow part enables the two parts to be united under pressure in a very simple manner. The building up of the transformer is thus greatly facilitated. By means of wedge-shaped distance pieces *n*₁, *n*₂ (Fig. 1) pressure may be applied to the wind-

ings while the U-shaped packets are being pressed against the column. As the packets of the return flow part are individually pressed with sufficient force against the column, the induction of the joint may be as great as the induction of the column. With a filling factor of 70% in the column, referred to the full circular cross-section, and of 90% in the return connection yoke pieces, the height of the yoke pieces H will be

$$H \times D \times \pi \times 0.9 = D^2 \frac{\pi}{4} 0.7$$

D=core diameter

H=0.195D.

As the normal transformer has a yoke height of about D, for the transformer according to the invention the overall height will be reduced by $2D - 0.39D = 1.61D$.

The manner in which the iron core is built up in accordance with the invention provides a further advantage as regards cooling. Cooling tubes *m* may be disposed in the spaces between the ray-like or radially arranged stamping packets of the return flow part. The cooling tubes *m* may also be corrugated in the direction of the longitudinal axes of the transformer.

The space occupied by the transformer is in this way considerably reduced; its weight is also reduced, to which the round form of the casing also contributes, whereby reinforcement becomes unnecessary.

For building up a three-phase transformer the possibility is provided of mounting three single-phase transformers of the construction above described axially one behind the other in one vessel.

The construction according to the invention is particularly suitable for enabling transformers of considerable output to be housed in a recumbent position on a vehicle frame, so as to enable the railway loading gauge to be utilized to the best possible advantage. The bushing insulators can be arranged so as to be distributed over the two ends of the transformer tank.

I claim:

1. In a transformer, a magnetic structure comprising a radially laminated cylindrical core, a

plurality of U-shaped laminated yokes surrounding said core with the yoke laminations arranged in planes parallel with the core axis, the two end flange portions of each said yoke confronting said core and being provided with concave end faces the curvature of which is the complement of the convex outer surface of said core so as to lie directly against the core with the core and yoke laminations arranged in substantially radial alignment, spaced and confronting rigid strips welded respectively to and extending axially outward from the opposite ends of said core and the opposite ends of said yokes, and means extending between and drawing said confronting core and yoke strips towards one another thereby to draw the end faces of the flange portions of said yokes into pressure contact with the outer surface of said core.

2. A transformer magnetic structure as defined in claim 1 wherein the laminations of each said yoke are constituted by U-shaped stampings.

3. A transformer magnetic structure as defined in claim 1 wherein the yoke laminations are constituted by rectangular stampings interleaved to form the U-shaped contour of the yoke.

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