

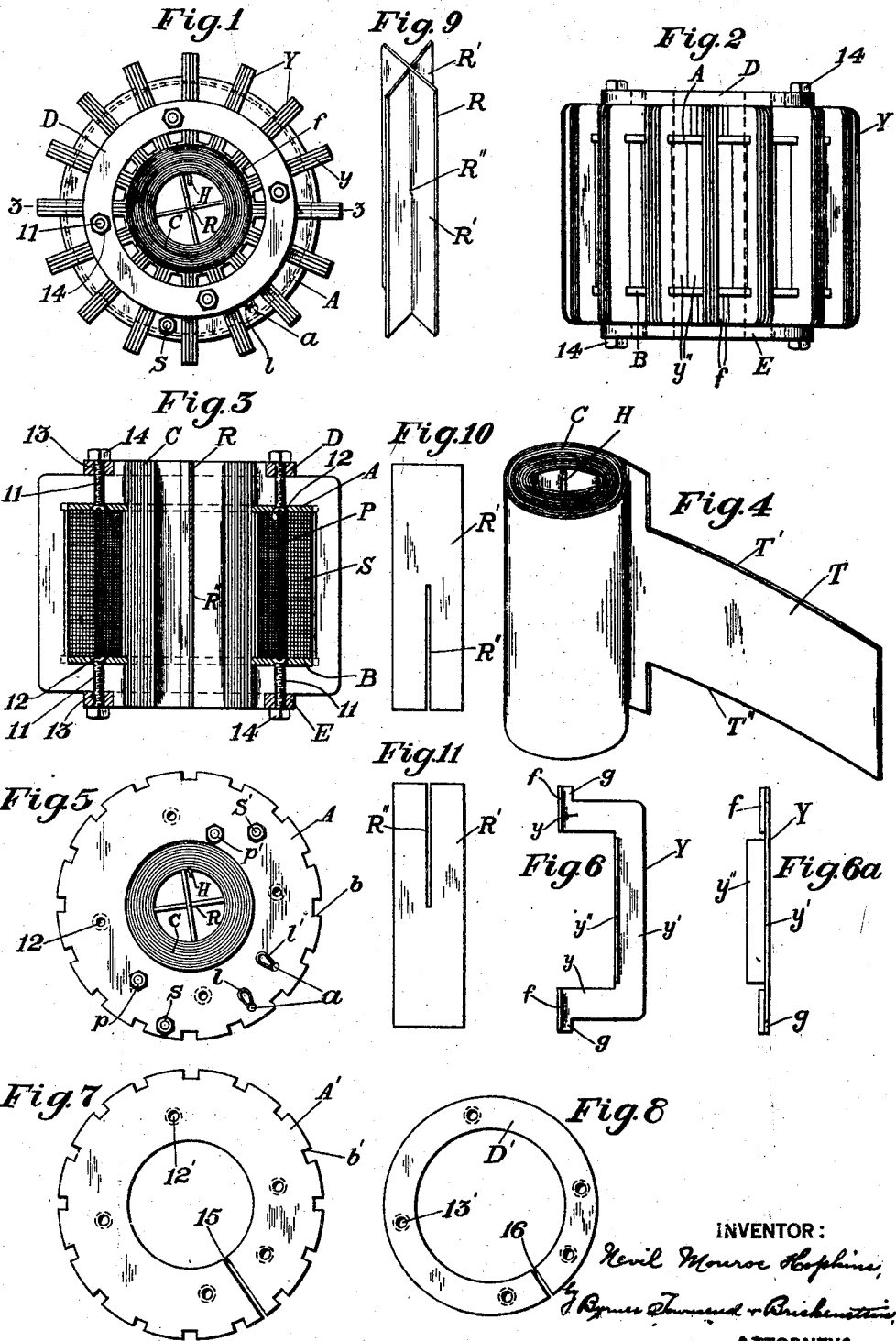
April 5, 1927.

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1,623,345

ELECTRICAL APPARATUS AND CORE THEREFOR

Filed Feb. 18, 1921



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ELECTRICAL APPARATUS AND CORE THEREFOR.

Application filed February 18, 1921. Serial No. 446,126.

This invention relates to electrical apparatus, and particularly to an improved electrical transformer and an improved core therefor. While the novel features disclosed are especially desirable in transformers adapted for use in conjunction with alternating current rectifiers, it will be understood that they may also be used advantageously in other types of electrical apparatus.

Transformers generally, and especially the smaller enclosed types employed in alternating current rectifiers of battery charging outfits, develop considerable heat which, if not sufficiently dissipated, may injure the windings of the transformer.

An important object of this invention is, therefore, to provide a transformer having an improved type of core in which the heat developed may be effectively dissipated to prevent injurious heating of the transformer winding. Another object is to provide a transformer that may be economically constructed and one in which a portion or all of the flux set up in the main core may be conducted through an external circuit of magnetic material to improve its efficiency.

Broadly speaking, these objects may be obtained by providing a transformer, the core of which comprises a hollow central leg having radially disposed yokes secured thereto. Such yokes may form magnetic links between the opposite ends of the central leg and also constitute heat radiating fins.

The above and other objects and the novel features of the invention will be apparent from the following description taken in connection with the drawings which form a part of this application and in which—

Fig. 1 is a plan view of a transformer embodying this invention,

Fig. 2 is a side elevation of the same,

Fig. 3 is a longitudinal sectional view of the same taken on the line 3—3 of Fig. 1,

Fig. 4 is a perspective view of the main leg of the transformer core, the same being slightly unwound to show the construction thereof,

Fig. 5 is a plan view of the transformer, with the yokes and clamping rings therefor removed,

Figs. 6 and 6^a are side and end views of one of the yokes,

Figs. 7 and 8 are plan views of metal rings adapted to be substituted for non-metallic rings shown in Figs. 1, 2, 3 and 5, and

Figs. 9, 10 and 11 are views of a heat dissipating spider inserted in the main leg of the transformer core.

Generally speaking, the transformer comprises an improved core having a main leg C and auxiliary legs or yokes Y which are secured to and disposed radially relatively to the axis of the main leg. The yokes Y have portions thereof spaced from a surface of the main leg C providing an intervening space to receive the transformer primary and secondary windings P and S. The yokes contact with the surface of the leg C to conduct heat from the latter and accordingly constitute heat radiating fins as well as external magnetic links to complete the magnetic circuit between the opposite ends of the main core leg C.

As illustrated, the main leg C comprises a hollow centrally disposed laminated unitary body of magnetic material, and is desirably formed by spirally winding a strip of magnetic material T upon a suitable mandrel, the inner end of such strip being temporarily secured as by a hook portion H to a suitable part of the mandrel. The outer end of the strip T is cut away along opposite parallel edges thereof, as shown, providing inwardly offset edges T' and T'', which form exterior shoulders on the leg C when the end of the strip T is completely wound on. The shoulders T' and T'' provide abutments for the insulating annular cheek plates A and B. The primary winding P is wound on or otherwise applied to the exterior of the core C between the shoulders T' and T'' and the secondary winding is wound about or otherwise applied about the exterior of the primary winding, the cheek plates A and B confining these windings at the ends thereof. The windings P and S may be wound on forms, and slipped into position on the central leg if preferred.

As best shown in Fig. 5, the ends of the primary winding terminate at binding posts p, p' to which the electric supply circuit may be suitably connected. Likewise the ends of the secondary winding S terminate at the binding posts s, s' to which the deliv-

ery circuit may be suitably connected to obtain the full secondary voltage of the transformer. In order to obtain intermediate secondary voltages from the transformer, suitable taps 1, 1' are provided to which leads may be connected, as by soldering. Thus different fractions of the maximum secondary voltage may be obtained by connecting the delivery circuit to the secondary terminal post *s* and to the desired tap 1 or 1'. The secondary winding *S* consists of the necessary number of turns of wire or other conductor to give the desired secondary voltage, and the taps 1, 1' are desirably provided by forming loops in different turns of the wire and drawing such loops outwardly to a sufficient length to render them accessible for connecting suitable leads thereto. The taps 1, 1' may thus be made without severing the conductor forming the secondary winding or producing tap, and enlargements on the winding proper. The taps 1, 1' are desirably drawn through holes *a* in a cheek plate *A* where the insulation may be removed therefrom and the desired leads soldered or otherwise connected thereto.

The heat generated in the primary and secondary windings and in the central core leg *C* should be dissipated in order to avoid injurious heating of the winding. Such heat is in part carried away by the circulation of cooling medium, such as air, through the passage in the center of the hollow leg *C*. Heat dissipating fins are also desirably provided to conduct the heat from the central leg *C* and from the windings *P* and *S* outwardly to provide a greater cooling surface accessible to the cooling medium circulated about the exterior of the transformer. As illustrated, suitable fins are provided in the form of U-shaped yokes *Y* which are secured to the central leg *C* and extend outwardly radially relatively to the axis of the core leg *C*. The U-shaped yokes *Y* are desirably stamped from sheet metal and have parallel limbs *y*, the ends of which contact with the outer surface of the central leg *C* above and below the annular cheek plates *A* and *B*, which latter bear against the inner sides of these limbs and space the windings therefrom. The yoke plates *Y* may be arranged in groups to form laminated yokes or fins, and in order to increase the contacting and heat conducting surface engagement between the central leg *C* and these yokes, the outside yoke plates of each group may be provided with laterally extending portions or feet *f*, as best shown in Figs. 1, 6, and 6^a adapted to bear against the outer surface of the central leg *C*. The yoke plates have portions *y'* intermediate the limbs *y* thereof which fit into notches *b* in the peripheries of the cheek plates *A* and *B* and bear against the outer or secondary

winding *S* to conduct or radiate heat therefrom. The intermediate portions *y'* of the outer laminae of each group of yokes may have laterally projecting wings *y''* formed integrally therewith and arranged to bear against the outer winding *S* to provide a greater surface of contact, whereby heat will be more readily conducted from the windings.

The yokes or fins *Y* are held in assembled relation on the central leg *C* by insulating end rings *D* and *E* which engage against the shoulders formed by offset projections *g* on the limbs *y*, and clamp the ends of the limbs against the outer surface of the central leg to provide a substantially uninterrupted good heat-conducting path between the central leg and the yokes. The end rings *D* and *E* may be held in position by any suitable means. Screws 11 having the heads thereof counterset in holes 12 in the plates *A* and *B* project outwardly through holes 13 in the rings *D* and *E* and receive clamping nuts 14 on their outer ends to secure the parts together.

It will be understood that the central core leg *C* and the yokes *Y* are desirably of magnetizable material, whereby the yokes serve as external magnetic links between the ends of the central leg *C*, providing a very efficient transformer structure. For certain purposes some or all of the yokes *Y*, or some or all of the yoke plates in each group of laminated yokes, may consist of non-magnetic material, such as brass, which will act as heat dissipating fins. In such apparatus, the yokes may be designed to carry only a portion of the magnetic flux set up in the core leg *C* by the magnetizing winding *P*, the magnetic circuit thus formed becoming saturated under load and causing a certain amount of leakage magnetic flux.

The cheek rings *A*, *B* and the end clamping rings *D*, *E*, may be made of metal. Such rings are illustrated at *A'* and *D'* in Figs. 7 and 8 and are similar to the rings *A* and *D* except that suitable slots 15 and 16, respectively, are cut transversely therethrough so that short circuited secondary currents will not be induced therein. In order that the interior of the core shall more readily radiate heat, a suitable spider *R* may be inserted into the hollow core leg *C*. As illustrated in Figs. 1, 9, 10 and 11, this spider may consist of two similar plates *R'* provided with central longitudinal slots *R''* extending only part way into the strips so that they may be interfitted in intersecting relation with one another and held together as shown in Fig. 9. When in position, as shown in Figs. 1 and 3, the outer edges of the plates *R'* engage against the inner wall of the core leg *C* and conduct heat away therefrom so that such heat may be more readily dissipated by the air pass-

ing through the core. This spider is, however, not essential to the operation of the transformer.

As previously indicated, certain novel features of this invention may be advantageously employed in other types of electrical apparatus and therefore, the application thereof is not limited to electrical transformers. The type of transformer illustrated is particularly suitable for use in combination with alternating current rectifying apparatus, the hollow central core C being adapted to receive the vibrator of such rectifier, substantially in the axis thereof, in a manner similar to that disclosed in application Serial No. 432,020, filed in my name on December 20, 1920. In employing the herein disclosed type of transformer in a rectifier of the above type, the spider R may of course be omitted, and the yokes are designed to provide heat radiating surface as well as an external magnetic circuit that will only allow a part of the flux set up in the central leg to pass therethrough. Sufficient leakage magnetic flux may thus be provided to operate the vibrator that is disposed within and in the axis of the hollow central leg. Moreover, in some types of apparatus, the arrangement of the parts may be reversed and the passage in the hollow cylindrical leg may be made of such diameter as to accommodate the yokes and the windings therein, as well as a vibrator.

While the invention is shown and described in detail, it will be understood that various features thereof may be modified without sacrificing any of the advantages thereof, and therefore it is to be understood that the invention is not limited to the exact construction disclosed.

I claim:

1. In electrical apparatus, in combination, a core comprising a hollow central unitary leg, and yokes secured thereto and disposed radially relatively to the axis of said leg, and an electrical winding disposed between portions of said yokes and said leg.

2. In electrical apparatus, in combination, a core comprising a laminated hollow central leg comprising a spirally wound strip of magnetizable material, and yokes secured to said central leg and radiating therefrom, said yokes having portions spaced from said leg to provide an intervening space, and an electrical winding in said space.

3. In an electrical transformer, in combination, a core comprising a central unitary leg, yokes extending radially from the axis of said leg, means for securing said yokes to said leg, and a transformer winding between said leg and portions of said yokes.

4. In an electrical transformer, in combination, a core comprising a hollow cylindrical leg, yokes disposed radially relatively to the axis of said leg, and rings for clamp-

ing the opposite ends of said yokes to said leg, and an electrical winding between said leg and portions of said yokes.

5. An electrical transformer comprising in combination a core having a hollow cylindrical laminated leg, heat dissipating yokes extending radially outwardly from said leg, opposite end portions of said yokes engaging said leg and intermediate portions being spaced from the outer surface thereof, and means for securing said yokes to said leg, and transformer windings in the spaces between said leg and such intermediate portions.

6. An electrical transformer comprising in combination a central leg, yokes engaging said central leg and having portions spaced therefrom, means for clamping said yokes to said leg, a transformer winding between said leg and said portions of said yokes, and spacers between said winding and said yokes.

7. In electrical apparatus, in combination, a core comprising a main leg having spaced shoulders, yokes having end portions engaging said leg outside said shoulders and having intermediate portions spaced from said leg, and means for clamping said end portions to said leg, a winding between said shoulders and between said leg and said intermediate portions of the yokes, and means for confining said windings, such confining means bearing against said shoulders and said yokes having such clamping means secured thereto.

8. An electrical transformer comprising, in combination, a hollow central leg, U-shaped yokes having feet engaging said leg and having portions spaced therefrom, rings for clamping said yokes to said leg, a transformer winding between said leg and said portions of said yokes, annular plates between said winding and said yokes, and means for securing said rings to said plates.

9. Electrical apparatus comprising coaxial primary and secondary windings, a magnetizable core coaxial with said windings, and magnetic material cooperating with said core to provide a closed magnetic circuit, said magnetic material having a flux carrying capacity substantially less than that of said core, whereby a leakage flux is produced after said circuit becomes saturated.

10. In electrical apparatus, the combination with a magnetizable hollow unitary core leg, of heat-dissipating yokes secured thereto and arranged radially relatively to the axis of said leg.

11. In electrical apparatus, the combination with a magnetizable core leg, of heat-dissipating yokes secured thereto and radially disposed relatively to said leg, said yokes comprising non-magnetic material.

12. In electrical apparatus, the combination with a magnetizable hollow unitary

core leg, of heat-dissipating yokes secured thereto and radially disposed relatively to the axis of said leg, certain of said yokes comprising non-magnetic material.

5 13. A core for electrical apparatus comprising, in combination, a hollow unitary leg and yokes secured thereto and having portions spaced therefrom to form a space
10 between said hollow leg and said yokes to receive an electrical winding.

14. A core for electrical apparatus comprising, in combination, a laminated hollow cylindrical unitary leg and radially disposed laminated yokes secured thereto and
15 having portions thereof spaced from a surface of said hollow leg to provide an intervening space adapted to receive an electrical winding.

15. A core for electrical apparatus comprising, in combination, a substantially central unitary leg substantially U-shaped yokes extending outwardly therefrom, and
20 means for securing such yokes to said leg.

16. A magnetizable core for electrical apparatus comprising, in combination, a hollow substantially central unitary leg and
25 yokes extending outwardly therefrom.

17. A transformer core comprising in combination, a laminated magnetizable central unitary leg and yokes secured thereto and
30 radiating therefrom, said yokes having portions spaced from the exterior surface of said central leg adapted to provide a space to receive a transformer winding.

18. A core for electrical apparatus comprising in combination a magnetizable leg, radially disposed yokes, and means comprising
35 rings for securing said yokes to said leg.

19. A core for electrical apparatus comprising in combination a hollow magnetizable leg, radially disposed U-shaped yokes, and rings securing said yokes to said leg.
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20. A core for electrical apparatus comprising in combination a magnetizable leg,

radially disposed U-shaped yokes having
45 feet engaging a surface of said leg, and rings securing said yokes to said leg and clamping said feet against said surface.

21. A core for electrical apparatus comprising in combination a main leg, and yokes
50 secured to and arranged radially relatively to the axis of said main leg and comprising foot portions having extended engagement with the surface of said main leg to
conduct heat from the latter. 55

22. A core for electrical apparatus comprising in combination a main leg, and yokes comprising groups of laminations secured
thereto and arranged radially relatively to the axis of said main leg, the outer laminations of each group being provided with
60 laterally extending foot portions having extended engagement with the surface of said main leg to conduct heat from the latter.

23. In a core for electrical apparatus, in combination, a laminated central leg comprising a spirally wound strip of magnetizable material, and yokes secured thereto,
portions of said yokes being spaced from said leg to provide an intervening space to
70 receive a magnetizing winding.

24. A core for electrical apparatus comprising a leg consisting of a spirally wound strip of magnetizable material, such strip
having a portion at its outer end narrower than the main portion of the strip whereby
75 an edge of said narrow portion forms a shoulder on the exterior of said leg.

25. A core for electrical apparatus comprising a leg consisting of a spirally wound strip of magnetizable material, such strip
having portions along the opposite sides of the outer end thereof cut away leaving a narrow portion having edges providing
80 shoulders on the exterior of said leg.

In testimony whereof, I affix my signature. 85

NEVIL MONROE HOPKINS.