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ELECTRICAL APPARATUS

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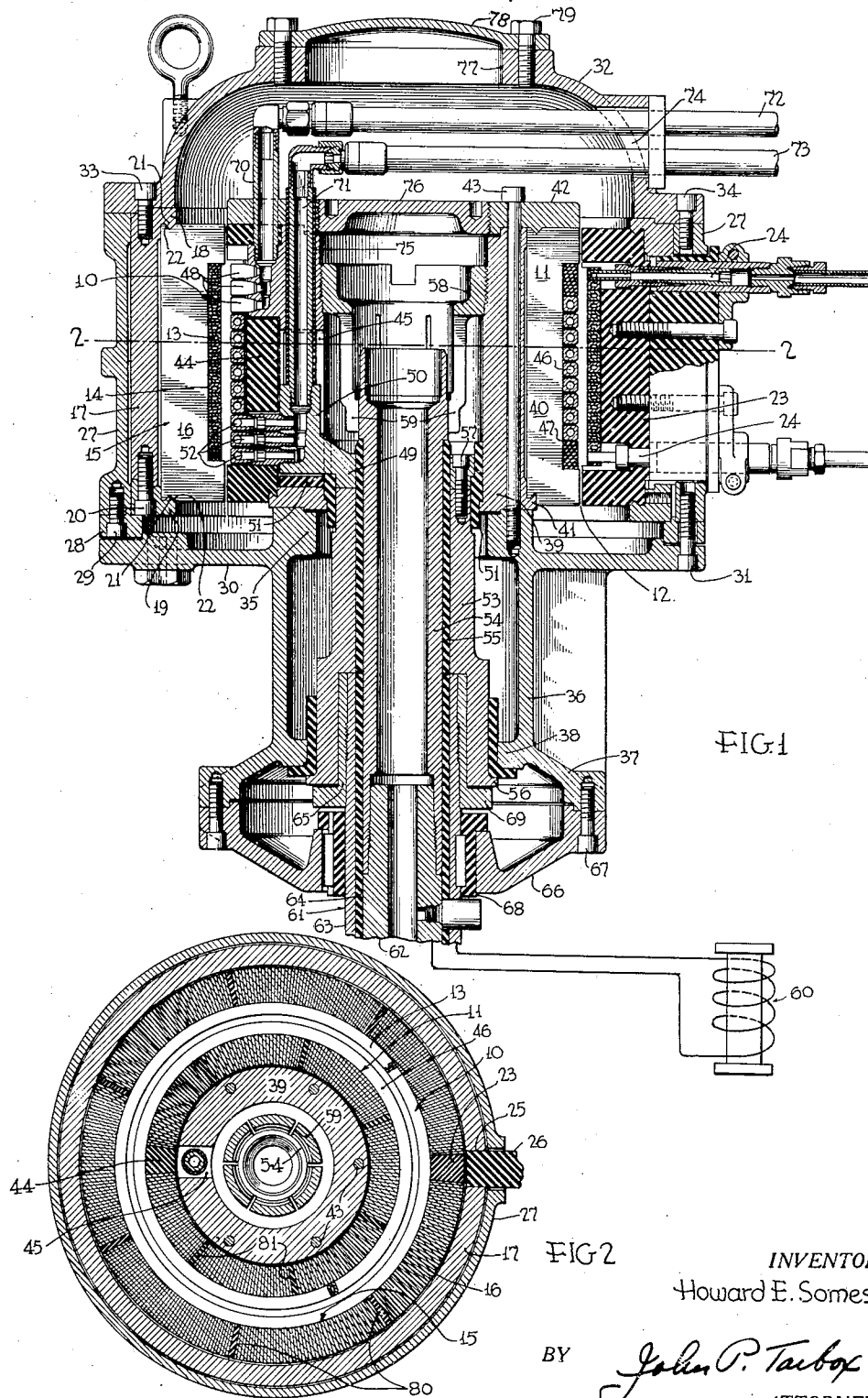


FIG. 1

FIG. 2

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ELECTRICAL APPARATUS

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4 Claims. (Cl. 175—361)

This invention relates to electrical apparatus, more particularly to improvements in transformers and the like of the type shown in my United States Letters Patent No. 2,223,902 dated December 3, 1940.

One of the objects of the present invention is to provide a current conducting coil having a magnetic circuit element or magnetic core with means associated with such element or core in such manner as to divide the same into a plurality of electrically separated units whereby to materially increase the resistance to induced current flow and thereby minimize heating effects resulting from such current flow.

Another object is to provide a transformer having annular magnetic circuit elements of laminated magnetic material for one or both of its windings with non-conductive means for dividing the laminations into a plurality of separated groups whereby to increase the resistance to induced current flow and minimize heating thereof as a result of such flow.

Another object is to provide a transformer mechanism with concentrically arranged primary and secondary elements which are so assembled to a supporting structure as to facilitate disassembly for inspection and repair.

A further object is to provide such a transformer wherein each of the primary and secondary elements may be readily and quickly removed from the supporting structure without disturbing the position of the other.

With the above and other objects in view, which from the following description will be readily apparent to those skilled in the art to which the invention appertains, the present invention consists in certain features of construction and combinations of parts to be hereinafter described with reference to the accompanying drawing and then claimed.

In the drawing which illustrates a suitable embodiment of the invention,

Figure 1 is a longitudinal section through the transformer in question, and

Figure 2 is a transverse section taken approximately on line 2—2 of Figure 1.

Referring to the accompanying drawing in which like numerals refer to like parts throughout the several views, the transformer of the present invention embodies a primary element 10 and a secondary element 11 concentrically arranged within the primary element and circumferentially spaced therefrom by a narrow air gap 12, as in my Patent No. 2,223,902 aforesaid.

The primary element consists essentially of a

primary winding or coil 13 mounted within a recess 14 formed within the inner surface of a primary magnetic circuit element 15 of annular form. The magnetic circuit element 15 is comprised of a plurality of radial tapered laminations 16 arranged in annular formation within a surrounding annular shell 17 having an integral flange 18 at one end and a removable flange ring 19 at its opposite end secured thereto by cap screws 20, the flange 18 and ring 19 having annular V-sectioned projections 21 interfitting with correspondingly shaped grooves or recesses 22 in the ends of the laminations 16 to maintain such laminations 16 in annular formation. The laminations 16 for a short distance are removed and replaced by a segmental block 23 of suitable insulation through which the terminals 24 of the coil 13 extend radially outwardly. Similarly the shell 17 is provided with a longitudinal recess 25 containing an insulation block 26 and the terminals 24 likewise extend through the block 26.

The transformer includes a casing 27 surrounding and positively locating the shell 17, which casing is provided with a clamping ring 28 secured to the lower end of the casing by cap screws 29 to abut the shell ring 19. This structure is supported on an annular support 30, cap screws 31 being provided to extend through the clamping ring 28 to threadably secure the casing 27 to the support 30, clamping the ring 28 therebetween as shown in Figure 1.

The upper end of this structure is closed by an end plate or housing 32, cap screws 33 and 34 being provided to threadably secure the housing 32 to the shell 17 and casing 27.

The support 30 is formed with an annular hub portion 35 and an axially extending coaxial annular extension 36 which terminates in a radially outwardly extending flange 37 and a radially inwardly extending flange 38.

The secondary element 11, as previously described is arranged coaxially within the primary element 10 and embodies an internal annular supporting sleeve 39 surrounded by an annular core comprised of annularly arranged radial tapered laminations 40 clamped between a dovetailing flange 41 at one end of the sleeve 39 and a clamping plate 42 at the other end of the sleeve 39, securing bolts 43 extend through the clamping plate 42 and the sleeve 39 and are threaded in the hub 35 to jointly secure the annularly arranged laminations 40 to the sleeve 39 and the sleeve 39 to the support hub 35 in end abutting engagement.

As in the case of the primary element, the lam-

inations 40 are removed for a short distance and replaced by a segmental insulating block 44, the support sleeve 39 also being provided with a recess 45 extending longitudinally between but not through its ends.

The secondary winding or coil 46 which is located within a peripheral recess 47 in the laminations 40, is illustrated as triple wound and the upper terminals 48 thereof are electrically connected to the support sleeve 39 longitudinally upwardly of the bottom of recess 45.

It will be noted that an annular ring 49 having a projecting portion 50 is arranged within the lower end of the support sleeve 39 with the projecting portion 50 positioned within the recess or slot 45. This ring 49 however is completely insulated from the walls of the sleeve 39 and of the slot 45 as indicated at 51, and the lower terminals 52 of the secondary coil 46 are electrically connected to the projecting portion 50 of ring 49 which is of electrically conductive material. It is thus seen that the sleeve 39 and ring 49 constitute insulated coaxial conductors for the opposite terminals of the secondary coil 46. The ring 49 and sleeve 39 are electrically connected with concentric conductors 53 and 54, respectively, which conductors are separated by an insulating sleeve 55. The outer conductor 53 is positioned within the annular extension 36 of the support 30 and is insulated from the internal flange 38 thereof by an insulating sleeve 56, and is secured in end abutting engagement to the ring 49 by one or more cap screws 57. The upper end of the conductor 53 is disposed within the insulating sleeve 51 and is slidable therefrom. Similarly, the ring 49 is axially slidable from the insulating sleeve 55. Threadably secured within the support sleeve 39 is an annular conductor ring 58 having a number of longitudinal extensions or fingers 59 arranged to have slidable electrical contact with the end of the inner conductor 54 which projects axially beyond the outer conductor.

I have diagrammatically illustrated a heating or inducing coil 60 which is to be energized by the transformer secondary coil 46 through the medium of a supporting arbor 61 comprised of inner and outer concentric conductors 62 and 63, respectively, which are separated from each other by an insulating sleeve 64 that forms a continuation of the insulating sleeve 55.

The upper end of the outer arbor conductor 63 is provided with a flanged sleeve 65 arranged to have a close sliding electrical contact with the inner wall of the outer conductor 53, and the inner arbor conductor 62 is threaded into the interior of the inner conductor 54 whereby the arbor 61 can be readily removed and connected to the transformer conductors. In order to prevent inadvertent unthreading of the arbor 61 it is surrounded by an annular plate 66 which is secured by cap screws 67 to the external flange 37 of the support extension 36 and insulated from the arbor 61 by an insulating sleeve 68. It will be noted that the flange 69 of the sleeve 65 overlaps the hub of annular plate 66 so that should the arbor 61 become inadvertently threaded from the conductor 54, the flange 69 will engage the insulation 68 and prevent the arbor 61 from dropping from the apparatus and thus safeguard it from injury.

In order to cool the hollow secondary coil 46 tubular connectors 70 and 71, respectively, connected with conduits 72 and 73 extending through an opening 74 in the end housing 32 are pro-

vided. The connector 70 is threaded into the support sleeve 39 in fluid communication with the coil terminals 48. Similarly, the connector 71 is threaded to the projecting portion 50 of conductor ring 49 in fluid communication with the coil terminals 52. The connector 71, however, is surrounded by an insulating sleeve 75 to insulate it from the support sleeve and end plate 42.

In order to provide access to the threaded connector 58, an end plate or cap 76 is threaded into the annular plate 42, and in order to provide access for attachment and removal of the conduits 72 from connectors 70 and 71 the end housing 32 is provided with a hand hole 77 which is closed by a removable plate 78 secured to the housing 32 by cap screws 79.

The transformer primary coil terminals 24 are adapted to be connected to a source of current (not shown) and in the case of high power high frequency current, the currents, induced by the current flowing through the primary and secondary coils, and flowing through the magnetic circuit elements composed of the laminations 16 and 40 tend to generate considerable heat by reason of the induced current flow in the laminations of magnetic material. In order to reduce the current flow of the primary magnetic circuit element 15 and in the magnetic core of the transformer secondary element, I propose dividing each of these elements into a plurality of groups of laminations in such manner as to provide a plurality of induced current paths instead of one path, as has been the usual practice. I accomplish this by regularly separating adjacent laminations by the use of non-magnetic strips, such as for example, mica. These strips are indicated at 80 in the primary element 16 and at 81 in the secondary element 11. Six such strips are illustrated for each of these elements in the drawing and by using such mica strips reduced voltage current is induced in each of the separately insulated core sections. In other words, the current flow in the laminated core is definitely reduced by reducing the value of the E. M. F. and breaking it up so that current flow does not take place in a single path. Hence, the resistance to current flow is very materially increased with the result that the amount of generated heat is very materially reduced. It is to be readily appreciated, however, that any desired number of mica strips may be employed to provide any desired number of current paths. While such mica strips have been illustrated in connection with the magnetic circuit or core elements of a transformer, it is to be understood that this feature is equally as applicable to any current device employing a magnetic circuit or core element, such as for example, to the induction heating head shown in my United States Letters Patent No. 2,256,873, dated September 23, 1941, with equal advantages.

The apparatus described presents many other advantageous features which from the foregoing description, will be obvious to those skilled in the art, including a simplicity of construction which enables easy removal of various parts for inspection, repair and replacement.

It will be seen that by removing end plate 78 by removal of the cap screws 79 access may be had to the interior of the end housing 32 to disconnect the connectors 70 and 71 from the secondary winding 46 and that by subsequent removal of the screws 31 the entire primary element and surrounding casing 27 may be axially

removed as a unit together with the end housing 32 from the support without disturbing the secondary element.

On the other hand, after removal of the plate 78 to disconnect the connectors 70 and 71 and the removal of cap screws 33 and 34, the end housing 32 may be removed and removal of the secondary element can be readily accomplished without disturbing the primary element and surrounding casing by first removing plate 76, which may, if desired, be omitted entirely, then threading the connector sleeve 53 outwardly from sleeve 39, removing cap screws 57 and finally removing the securing bolts 43. The secondary element including its support sleeve 39 can then be lifted readily from within the primary element. At this time the conductors 53 and 54 may be removed as a unit by merely removing screws 67 and sliding this assembly axially from within the annular extension 36.

The divided magnetic core is described and claimed in my copending divisional application Serial No. 532,282, filed April 29, 1944.

Inasmuch as various changes may be made in the details and arrangement of the parts, which will be apparent to those skilled in the art, without departing from the spirit and substance of the present invention, reference is had to the appended claims which define the limits of the invention.

What is claimed is:

1. A transformer comprising a main support, concentric transformer primary and secondary elements secured to said support, each including a winding, said secondary element being hollow axially and having inner and outer concentric conductors insulated from each other and extending axially therewithin, one of said conductors being electrically connected to one end of said secondary winding and the other conductor being electrically connected to the other end of said secondary winding, one of said conductors having a threaded end portion, an arbor comprising inner and outer conductors and an insulating sleeve between said last mentioned conductors, one of said arbor conductors being threadably secured to said threaded end portion and the other of said arbor conductors being slidably engaged with the other of said first mentioned conductors, said outer arbor conductor having a projection extending radially outwardly therefrom, and an annular member surrounding said arbor and being secured to said support in overlapping relation with said projection whereby to prevent said arbor from falling from said support in the event of inadvertent disengagement of said arbor from said first mentioned conductors.

2. A transformer device comprising an annular main support, concentric transformer primary and secondary elements secured to one side of said support, each having a winding, inner and outer concentric conductors insulated from each other and having electrical connections with the

winding of the inner transformer element, said conductors extending axially through said annular support, said support having an integral annular extension extending from the side opposite said transformer elements and surrounding said conductors, said outer conductor being insulated from and supported by said extension against lateral movement, and an arbor including inner and outer concentric current conducting elements insulated from each other and having overlapping electrical contacts with said inner and outer conductors, respectively, one of said inner and outer conducting elements having a threaded connection with the conductor electrically contacted thereby.

3. A transformer device comprising an annular main support, concentric transformer primary and secondary elements secured to one side of said support, each having a winding, inner and outer concentric conductors insulated from each other and having electrical connections with the winding of the inner transformer element, said conductors extending axially through said annular support, said support having an integral annular extension extending from the side opposite said transformer elements and surrounding said conductors, said outer conductor being insulated from and supported by said extension against lateral movement, said outer conductor having an end portion circumferentially spaced from the inner conductor and said inner conductor being tubular, and an arbor including inner and outer current conducting elements insulated from each other, said inner element being threaded within the inner conductor in electrical contact therewith and said outer conducting element extending within said end of said outer conductor in electrical contact therewith.

4. In a transformer device, an annular main support having an annular conductor-supporting portion extending from one side thereof, inner and outer concentric conductors insulated from each other and supported within and by said extension in coaxial alignment with the opening of said support, the inner conductor at least extending through said opening and projecting axially beyond said outer conductor, an annular member surrounding the projecting end of said inner conductor and having an electrical connection therewith, an annular current conducting ring within said annular member and surrounding said inner conductor, said ring abutting the end of said outer conductor and being insulated from said inner conductor and said annular member, and an annular transformer element carried by said annular member and including a winding, said winding having a first terminal connection with said annular member and a second terminal connection with said annular ring, said second terminal connection extending through and insulated from the wall of said annular member.

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