Aug. 2, 1960 J. C. SPINDLER 2,947,957

TRANSFORMERS

Filed April 22, 1957 3 Sheets-Sheet 1

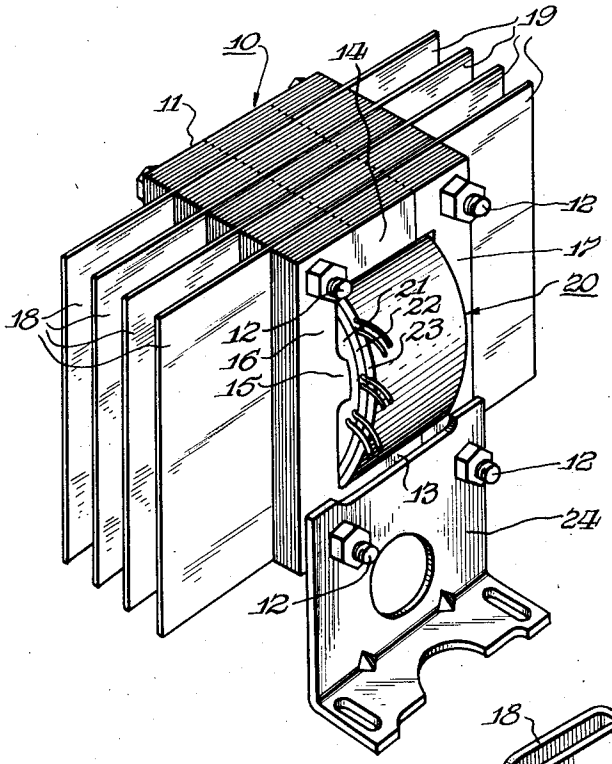


Fig. 1

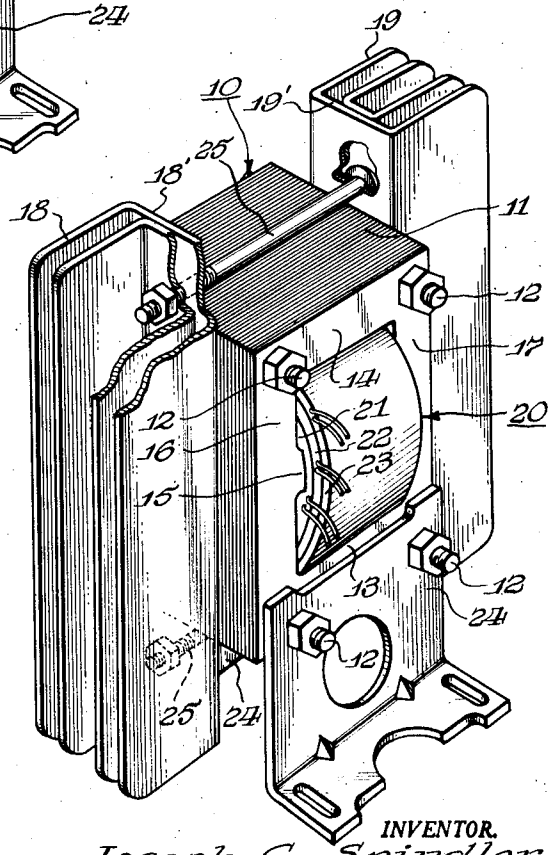


Fig. 2

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FIG. 3

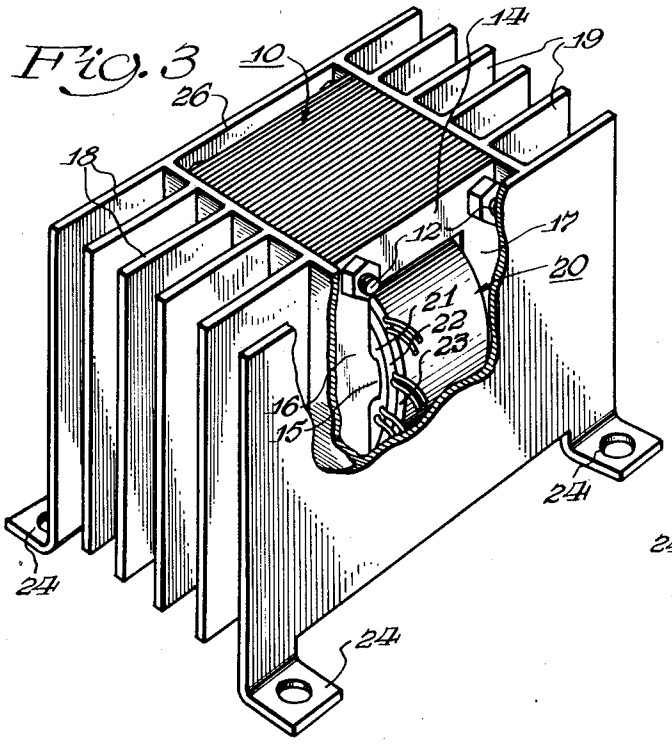


FIG. 4

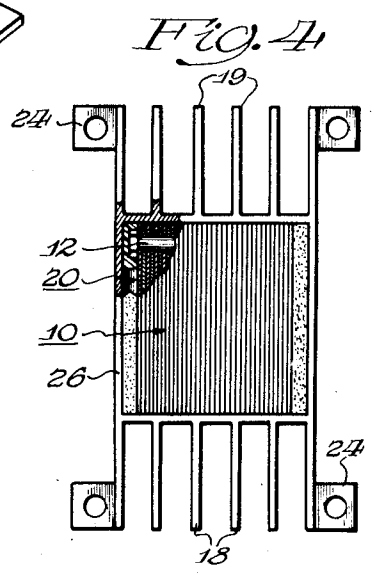
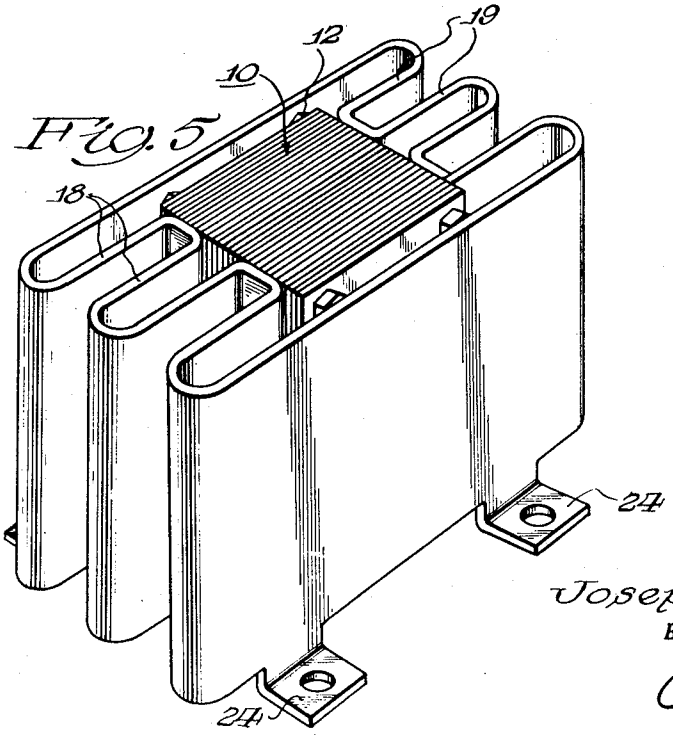


FIG. 5



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Fig. 6

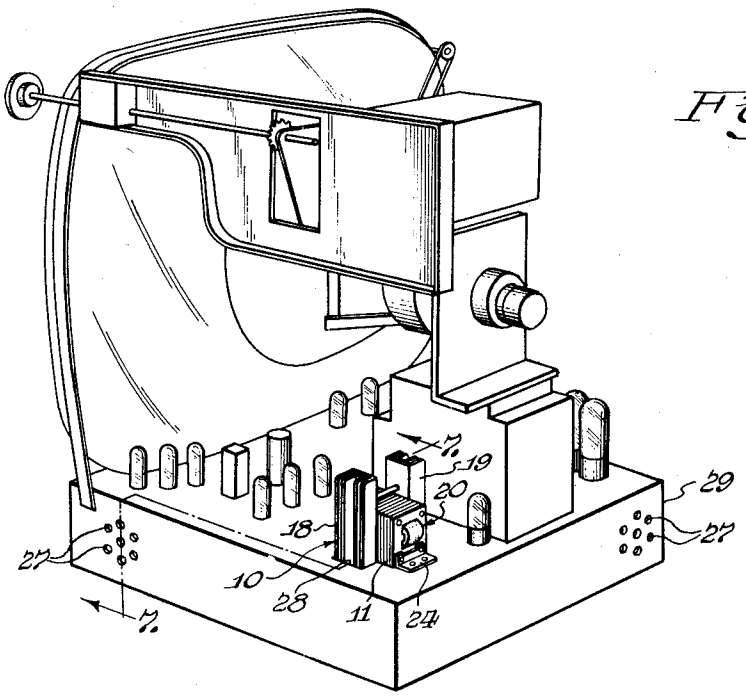
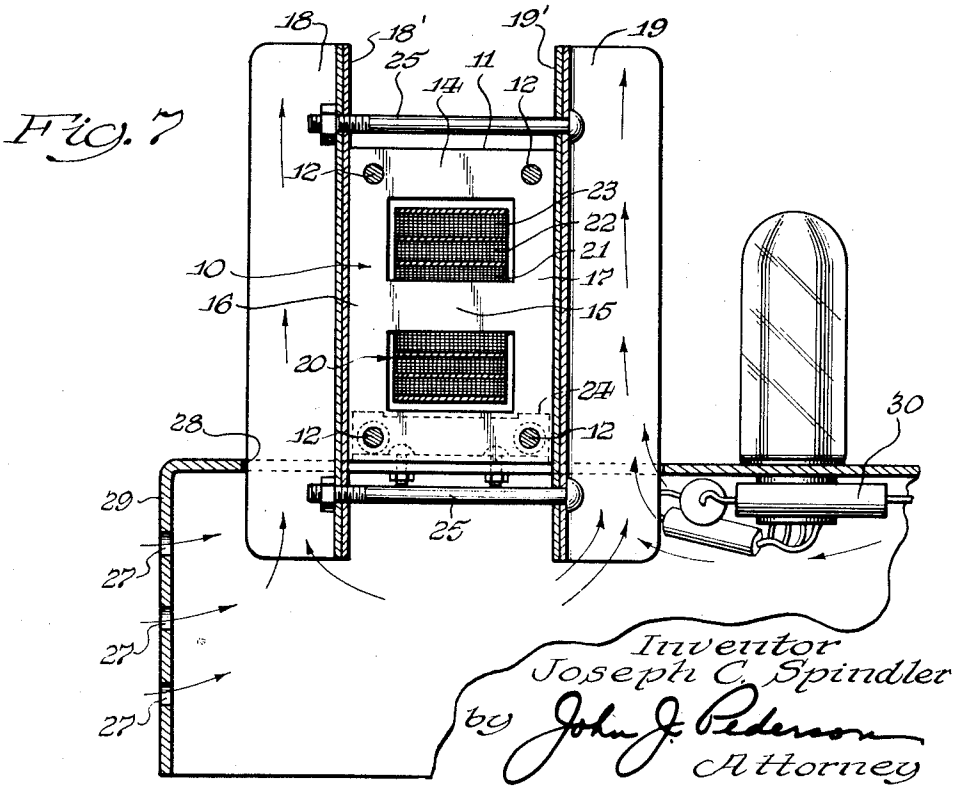


Fig. 7



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United States Patent Office 2,947,957
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2,947,957

TRANSFORMERS

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Filed Apr. 22, 1957, Ser. No. 654,142

12 Claims. (Cl. 336—61)

This application is a continuation-in-part of a previously filed copending application Serial No. 619,278, filed October 30, 1956, now abandoned, and assigned to the present assignee. The invention relates generally to electronic devices such as radio and television receivers and the like and more specifically relates to a new and improved apparatus for such devices for utilizing heat conduction and radiation cooling in a unique manner.

It is quite well-known in the art of transformer design, that during transformation, essentially all of the energy lost in a transformer appears as heat which increases the temperature of the windings and the core. Such an increase in temperature must be controlled and kept below the maximum limit at which deterioration of the insulation sets in. Therefore, it is frequently necessary to provide additional external heat dissipation means for removing the heat at a sufficiently fast rate to keep the rise in temperature of the transformer within proper limits. Such transformation losses are mainly the so-called "copper losses" and "core losses" and are of the following origin: When a current flows in a conductor, it causes an irreversible transfer of energy, in the form of heat, to the ambient atmosphere surrounding the conductor. This irreversible transfer of energy is what constitutes the so-called copper loss and varies as the square of the current flowing in the conductor. Thus, copper losses are produced in both the primary and secondary windings and vary as the square of their respective currents. The core losses are caused by the variation of the flux in the ferromagnetic core and are due to the combined effects produced by hysteresis and eddy-currents. The magnitude of the core losses varies as functions of the frequency and maximum amplitude of the flux wave, the quality and type of ferromagnetic core material, the thickness of each lamination, if laminated, and the total cross-sectional area of the core. Thus it might be considered that core losses vary directly as the total volume of the core while the amount of heat that can be dissipated varies directly as the area of the surface exposed.

It is known that heat may be transferred from one point to another in three different ways, namely conduction, convection and radiation. Heat is transferred by conduction when the heat energy diffuses gradually through a mass by passing from one particle to another. It is transferred by convection when carried along by the motion of a fluid such as air, oil, water, etc., and is transferred by radiation when transmitted in the form of heat waves.

In the past, various types of cooling methods have been proposed and utilized for cooling large size substation type distribution transformers to maintain the rise in operating temperature within the limits as set forth by the standardization rules of the A.I.E.E. of not more than 50° C. above the surrounding ambient temperature. Such methods usually include one of the following: (1) Natural-air-cooling, for which the natural circulation of the surrounding air is relied upon to carry away the heat

generated by the losses. (2) Natural-oil-cooling, in which the transformer is immersed in a transformer oil which carries the heat to the walls of the containing tank. (3) Oil and water cooling, in which the transformer is immersed in a transformer oil and cooling water is circulated through coils of pipe placed near the top of the tank under the surface of the oil. (4) Cooling by forced circulation of the oil, in which the oil is drawn from the tank, passed through cooling coils on the outside of the tank, and returned to the bottom of the tank. (5) Cooling by air blast, in which a continuous stream of cool air is forced through the core and windings.

Usually, for such distribution type transformers, a plain welded sheet-steel tank is used. However, for larger-capacity distribution transformers, it is difficult to obtain sufficient radiating surface with just plain sheet steel tanks to dissipate the heat without excessive temperature rise. To increase the radiating surface, cooling vanes or ribs are usually welded to the tank or even corrugated sheet steel tanks are used.

However, it is to be noted and appreciated at the outset that present day power transformer production for communication devices, such as for radio and television sets, is an extremely highly competitive field so that a high-quality low-cost price advantage is an extremely important asset to such manufacturers. Therefore, it must be constantly borne in mind that even the slightest added expenditure for improvement of such transformers must at all times be economically justified. For those reasons, no one has ever successfully devised a method of utilizing external transformer cooling in power transformers for communication uses.

Therefore, one of the principal objects of this invention is to devise a new and improved economical power transformer for use in communication circuitry which uniquely utilizes combined conduction and radiation cooling in a simple yet highly efficient and economical manner.

Another object of this invention is to devise a new and improved power transformer for communication devices which will have a substantially higher power rating than heretofore possible at a minimum of cost increase.

Still another object of this invention is to devise a new and improved power transformer for communication devices having substantially the same power rating as before but at a substantial decrease in cost thereof.

Another object of this invention is to devise a new and improved apparatus for utilization by electronic devices in a unique manner whereby the cooling efficiency of the transformer is greatly increased in a simple yet highly effective manner.

Still another object of this invention is to devise new and improved apparatus uniquely adaptable to such electronic devices whereby not only the cooling efficiency of the transformer is greatly increased in a simple yet highly effective manner, but in addition, the maximum temperature variations of the circuit components of such devices are also substantially reduced.

In accordance with one aspect of the present invention such a new and improved power transformer comprises a closed ferromagnetic core having at least two generally parallel legs and a pair of connecting base portions extending in a direction generally perpendicular to the legs. A primary winding and at least one secondary winding encompasses one of the legs of the core. A heat dissipating attachment is provided comprising a base member and a plurality of thermally conductive cooling fin elements which project from the base member and which are in intimate thermal contact therewith. The fin elements are disposed in substantially parallel planes and spaced from one another by a distance of an order of

magnitude greater than the thickness of an individual one of the fin elements. Finally, means are provided for securing the base member in intimate thermal contact with a peripheral surface of at least one of the base portions of the core along substantially its entire length and with the fin elements oriented to extend outwardly from the core.

In accordance with another aspect of the present invention, there is provided a new and improved electronic apparatus comprising an electric circuit supporting chassis having at least one unobstructed opening formed therein. At least one heat generating electrical energy translating device is connected in the electric circuit and is mounted on the chassis adjacent the aforementioned opening. As in the first mentioned aspect of the invention, a heat dissipating attachment comprising a base member and a plurality of parallelly spaced thermally conductive cooling fin elements projecting from the base member and in intimate thermal contact therewith is provided. The fin elements extend partially through the chassis opening in order to establish convection air current flow through the opening and through the channels defined by the fin elements. Additionally, means are provided for securing the base member in intimate thermal contact with a peripheral surface of the heat generating device so that the fin elements are oriented to extend outwardly from the device.

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. The organization and manner of operation of the invention, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawings, in the several figures of which like reference numerals identify like elements, and in which:

Figure 1 is a perspective view of a power transformer constructed in accordance with one embodiment of the present invention;

Figure 2 is a perspective view of a power transformer constructed in accordance with another embodiment of the invention;

Figure 3 is a perspective view of a power transformer constructed in accordance with still another embodiment of the invention;

Figure 4 is a plan view of the power transformer shown in Figure 3;

Figure 5 is a perspective view of a power transformer constructed in accordance with still another embodiment of the invention;

Figure 6 is a perspective view of a television receiver chassis illustrating an important feature of the present invention; and

Figure 7 is a fragmentary view partly in section of the television receiver as viewed along lines 7—7 of Figure 6.

With reference to Figure 1 of the drawings, there is shown a shell-type power transformer for use in communication devices such as radio or television receivers or the like, constructed in accordance with one embodiment of the present invention and comprising a closed ferromagnetic core, indicated generally by the reference numeral 10, having a plurality of stacked ferromagnetic laminations 11, electrically insulated from one another by any suitable means such as an oxide or varnish coating therebetween, which are held together by through-bolts 12. Laminations 11 are illustratively shown in this particular embodiment, for purposes of economy of core material, to be composed of two E-shaped or a conventional E-I shaped sections which are conventionally stacked so that the joints butt in individual layers and overlap in alternate layers and form a ferromagnetic core having outer legs 13 and 14 and a central leg 15, all of which are joined together by two parallel base portions 16 and 17 substantially perpendicular thereto; the major geometric axes of base portions 16 and 17 preferably are coplanar.

In accordance with the present embodiment of the invention, selected ones of the E or I sections of laminations 11 are so constructed that the widths of the base portions thereof, being perpendicular and common to the three remaining leg portions, are much wider than those of the remaining E or I sections and thus protrude beyond core 10 to form a plurality of substantially parallel spaced cooling fin elements, indicated as 18 and 19, in thermal contact with substantially the entire length of the peripheral areas of base portions 16 and 17, respectively. A conventionally designed coil, indicated generally by the reference numeral 20, is centrally disposed about central leg 15 and is insulated therefrom in any well known manner and may comprise any number of variously interleaved or stacked layer-wound primary and secondary windings without departing from the spirit and scope of this invention. Coil 20 is shown, for purposes of illustration, as comprising a secondary winding 21 wound in concentric layers about central leg 15 with each layer individually insulated from the other. A primary winding 22 is wound in concentric layers about secondary winding 21 and, in turn, has a second secondary winding 23 disposed in concentric layers thereabout. Angle brackets 24 are secured to the main core by through-bolts 12 for suitable mounting of the transformer with fins 18 and 19 having the proper orientations. In addition, conventional end-shells, not shown, are provided to completely enclose the primary and secondary windings to prevent dust, moisture and other foreign substances from interfering with the operation of the transformer. The end-shells are also normally secured to the main core by through-bolts 12 with one end-shell having a grommeted opening through which the lead-in connections for the primary and secondary windings extend, all in a well known manner.

After the transformer is completely assembled, the whole assembly is then usually impregnated by being dipped in a filled polyester resin, wax, asphalt compound, or other suitable thermally conductive potting compound. Such an impregnation, when hardened, in addition to increasing the ruggedness of the transformer, also greatly increases the rate of heat conductivity from the windings to the core to be dissipated into the surrounding atmosphere.

In a transformer such as shown, a definite incremental amount of heat is developed in each turn of each layer of both the primary and the secondary windings due to copper losses as heretofore described. As the exposed peripheral area of the outermost layer of secondary winding 23 is much larger than that of the remaining layers, the heat developed in secondary winding 23 is most efficiently dissipated into the surrounding atmosphere so that the normal operating temperature thereof is generally much lower than that of the remaining windings. However, as secondary winding 21 has the smallest heat radiating surface and is the innermost winding of coil 20, the heat developed herein is not immediately dissipated but instead is essentially trapped. Therefore, secondary 21 ordinarily has a much higher normal operating temperature than that of the remaining windings. As the maximum power rating is limited by the maximum temperature at which the windings may be operated before deterioration of the insulation begins, it is now appreciated that as secondary winding 21 operates at a much higher temperature than that of the remaining windings, the maximum operating temperature of secondary winding 21 becomes the prime factor in determining the maximum power rating of the transformer.

In the design of the core of such shell-type transformers, it is a normal practice to design the laminations so that the cross-sectional area of central leg 15 is twice that of base portions 16 and 17 and outer legs 13 and 14. The reason for this is that as the primary and sec-

ondary windings of the transformer are completely disposed about central leg 15, the total transformer flux flows through the central leg, whereas essentially only one-half of the total transformer flux flows through each of the base portions 16 and 17 and outer legs 13 and 14. Therefore, as base portions 16 and 17 and outer legs 13 and 14 carry only one-half of the total transformer flux, the individual cross-sectional areas thereof need only be one-half of the cross-sectional area of central leg 15 in order to satisfy flux-saturation design considerations while at the same time giving equal core losses per unit core volume so that the temperature increases of all of the leg and base portions due to core losses are equal.

It is well known that the total amount of heat conducted from one member to another member of similar heat conductivity properties is proportional to the temperature gradient or difference in temperature between the two members. Therefore, as the secondary winding 21 is in intimate thermal contact with central leg 15, a certain amount of heat is conducted therefrom to central leg 15 proportional to the temperature gradient therebetween. Thus, as central leg 15 is additionally supplied with heat energy due to the copper losses of secondary winding 21, its maximum operating temperature becomes much higher than that of the remaining leg and base portions of the core. Therefore, as fins 18 and 19 are in immediate thermal contact with both central leg 15 and secondary winding 21, the heat thus generated therein is immediately withdrawn and dissipated into the ambient atmosphere and at the same time the temperature gradient between central leg 15 and secondary winding 21 is increased which increases the rate of such dissipation to substantially reduce the normal operating temperature of secondary winding 21. As the operating temperature of secondary winding 21 has been substantially reduced below normal, the transformer is now permitted to be loaded more heavily which substantially increases the power rating thereof while still operating within the same temperature limits. In fact, it has been discovered in practice that the power rating of a standard television receiver power transformer is increased by as much as 30% which greatly offsets the additional cost of construction.

In order to get the maximum cooling effect from the addition of fins 18 and 19, it is desirable to orient the planes of the fins parallel to the plane defined by the major axes of base portions 16 and 17 and to mount the transformer on the chassis in such a manner that the fins are vertically oriented and spaced above the chassis by a given amount. With the fins mounted in this manner, the so-called "chimney-effect" is created which comes about due to the fact that the air between the fins rises when heated and consequently causes a circulation of cooler air through the channels defined by the fins, thus greatly increasing the rate of heat dissipation. Although the absolute spacing between the fin elements is not critical, for the most efficient cooling it is preferred that the spacing be an order of magnitude 5 to 50 times greater than the thickness of each fin element. It has been found that for spacings in excess of or less than an order of magnitude greater than the fin thickness, the desired chimney effect is no longer obtainable and thus heat convection is impeded which results in a substantial reduction in the amount of heat dissipated by the fins.

Power transformers for most communication devices, such as radio and television or the like, are usually designed for minimum cost without regard to the losses. However, there is a lower limit to the cost for which a transformer can be constructed as the copper density cannot be worked above a certain value due to heating considerations and also the core density is fixed by saturation of the magnetic circuit. With the densities fixed in the core and the copper, the minimum total loss and thus the maximum efficiency of a transformer at full load occurs when the core and copper losses are approximately equal. As the addition of the cooling fins causes a substantial increase in dissipation of the core and copper losses, these losses may now be substantially increased in such a manner that the total cost of the transformer is substantially reduced while at the same time preserving the same power rating as before.

To bring about this cost reduction, the copper losses are intentionally increased by utilizing a much smaller diameter wire in the primary and secondary windings than before which reduces the volume and thus the cost of the copper. Again, the use of smaller diameter wire results in a decrease in the mean-length-per-turn of each winding so that the total wire length of each winding is also reduced for the same number of turns which again results in a decrease in necessary copper. As the mean-length-per-turn is reduced and in order to utilize the winding space most efficiently, the core "window" is reduced by decreasing the dimensions of the core which results in a saving in iron cost. However, in order to again maintain the desirable relation of equal core and copper losses at full load, the core is constructed of much thicker laminations of a more economical and higher loss grade of ferromagnetic material which increases core losses while again substantially reducing the cost of the core.

With reference to Figure 2, there is shown a power transformer constructed in accordance with another embodiment of the present invention in which cooling fin elements 18 and 19 are constructed of U-shaped configuration with base portions 18′ and 19′ externally clamped to the main core by bolts 25 or any other suitable means. As before, cooling fins 18 and 19 are in intimate thermal contact with the peripheral areas of base portions 16 and 17 substantially along their entire lengths. And in addition, as the base portions 18′ and 19′ of elements 18 and 19, respectively, are in immediate physical contact with the peripheral areas of base portions 16 and 17, respectively, they function essentially as heat collector members which absorb the heat generated in base portions 16 and 17 and immediately transfer the heat to the radiating fins to be radiated into the ambient atmosphere. Fins 18 and 19, in this embodiment, are constructed of a high thermal conductivity material such as aluminum or the like which greatly facilitates conduction of heat from base portions 16 and 17. It is known that the rate of heat conductivity along a lamination is in the order of 50 to 100 times greater than the heat conductivity from one lamination to another. Consequently, the heat generated in secondary winding 21 is immediately conducted to the edge portions of each lamination, and thus the peripheral areas of base portions 16 and 17, and immediately absorbed by fins 18 and 19 and then dissipated into the ambient atmosphere as heretofore described.

In Figure 3, there is shown another embodiment of the present invention in which fin elements 18 and 19 are extrusions of an extruded rectangular box-like container 26 having the transformer placed therein so that the peripheral areas of base portions 16 and 17 are again in intimate thermal contact with fins 18 and 19 as additionally shown in Figure 4. This embodiment has the further advantage that container 26 may be filled with a suitable polyester resin, wax, asphalt compound, or any other suitable thermally conductive potting material which greatly enhances the heat conductivity to container 26 and cooling fin elements 18 and 19 and thus increases the amount of heat radiated by fins 18 and 19. In this embodiment the necessity for the conventional end-shells, not shown, has been alleviated thus again decreasing the cost of the transformer. Figure 5 shows still another embodiment of the present invention similar to the embodiment of Figure 3 with the exception that fin elements 18 and 19 are in the form of volutes of a corrugated type container.

In order to give a full appreciation of the scope of the present invention by way of illustration and in no sense by way of limitation, there is shown in the table a direct

comparison between a standard commercially available television receiver power transformer Model No. 95–1503, as manufactured by the present assignee, and a transformer constructed as Model No. 95–1498 in accordance with one embodiment of the present invention as shown in Figure 2 of the drawings.

Table

Transformer Model No.	95–1503	95–1498
Primary Winding:		
Voltage (no-load)	117 v. 60 c.p.s.	117 v. 60 c.p.s.
Voltage (full-load)	117 v. 60 c.p.s.	117 v. 60 c.p.s.
No. of turns	268	240.
Wire size	21 gauge, copper plain enamel.	22 gauge, copper plain enamel.
D.C. resistance	2.6 ohms	2.85 ohms.
Current (excitation)	.400 A. Max	.400 A. Max.
Secondary Winding #1:		
Voltage (no-load)	572 v	610 v.
Voltage (full-load)	500 v	500 v.
No. of turns	1320	1256.
Wire size	#28 P.E.	#29 P.E.
D.C. resistance	52 ohms	66.5 ohms.
Current	.250 A	.265 A.
Secondary Winding #2:		
Voltage (no-load)	5.6 v	5.85 v.
Voltage (full-load)	5.0 v	5.0 v.
No. of turns	13	12.
Wire size	#21 P.E.	#22 P.E.
D.C. resistance	.2 ohms	.152 ohms.
Current	3.0 A	3.0 A.
Secondary Winding #3:		
Voltage (no-load)	7.0 v	7.3 v.
Voltage (full-load)	6.3 v	6.3 v.
No. of turns	16	15.
Wire size	15 gauge, baked vinyl acetal resin varnish.	16 gauge baked vinyl acetal resin varnish.
D.C. resistance	.05 ohms	.064 ohms.
Current	9.0 A	9.0 A.
Core:		
Core dimensions (overall)	3⅞ x 3 57/64 x 1¼ inches.	1 13/16 x 2⅜ x 1 15/16 inches.
Core dimensions (central leg).	1 11/16 x 1¼ in.	1⅜ x 1 15/16 in.
Core material	26 gauge, American Iron and Steel Institute grade M–19.	24 gauge, American Iron and Steel Institute grade M–27.
Treatment	Permafil [1]	Permafil.[1]
No. of cooling fins (total)	None	8.
Area dimensions of fins		1½ x 5½ in.
Thickness of fins		.025 in.
Spacing between fins		⅜ in.
Material of fins		aluminum.
Total Cost	$4.08	$3.97.

[1] Polyester resin as manufactured by the General Electric Corp.

Thus, from an analysis of the table it is seen that transformer 95–1498, which is constructed in accordance with the present invention, has several distinct economic advantages over the standard commercially available type of power transformer such as 95–1503, namely: a smaller number of turns of smaller size wire, consequently a substantial decrease in the volume and cost of copper; a smaller core size, consequently a substantially decrease in the cost of core material; the use of a larger gauge, consequently a more economical lamination; and the use of a more economical grade of lamination.

It has been found that with transformer 95–1498 having 8 aluminum cooling fins each of which are 1½ inches wide, 5½ inches long, .025 inch thick and spaced from one another by a distance of ⅜ inch, when attached in the manner as shown, in Figure 2 of the drawings, the same power rating may be obtained as in standard transformer 95–1503 while also conforming to the temperature standards for power operated radio and television receiving apparatus as set forth by Underwriters Laboratories, Inc., sponsored by The National Board of Fire Underwriters. The total cost of production by the present assignee of each of standard power transformers 95–1503 is $4.08 while the cost of production of each of power transformers 95–1498 is $3.97. Thus, the transformer constructed in accordance with the present invention has the same power rating as the conventional type, but may be manufactured at a substantial decrease in cost.

With reference to Figure 6 of the drawings, there is shown a typical television receiver having the previously described power transformer mounted on the circuit supporting chassis of the receiver in a unique manner whereby the cooling effect obtained from fins **18** and **19** is further enhanced. It is to be understood, of course, that the television receiver is shown for illustrative purposes only and is intended to be representative of a multitude of various other electronic devices which are easily adaptable to utilize the many advantages to be gained by the present invention.

As shown, a substantially rectangular-shaped opening or slot **28** is formed in the topmost side of chassis **29**. The power transformer is mounted on chassis **29** adjacent opening **28** by brackets **24** with cooling fin elements **18** and **19** vertically oriented and extending at least partially through the opening as shown more clearly in Figure 7.

By mounting the transformer in a position, as shown, above a ventilated chassis, the heat generated in the transformer due to electrical losses raises the temperature of the air in the channels defined by fins **18** and **19** as heretofore described. However, as a substantially high temperature gradient normally exists between the ambient above and the ambient below the receiver chassis, convection air current flow is established through the fin channels of much higher magnitude than with an unventilated chassis. In fact, it has been found that with the transformer mounted in this manner, the maximum operating temperature of the transformer is additionally reduced from 5 to 8° C. thus, again, further increasing the maximum power rating of the transformer with substantially no increase in cost. There are also other advantages to be gained by utilizing such a novel mounting technique. For example, it is now possible to form a plurality of holes **27** at strategic positions along the sides of the chassis so that cool air is drawn from the outside ambient atmosphere to create a convection flow of cool air surrounding the various critical tuned circuits and components shown generally as **30**. As a result, the maximum temperature increase of these components during warm-up of the receiver is substantially reduced to substantially increase the circuit stability so that maximum quality of performance is obtained from the television receiver. Also, the maximum life of the circuit components is extended and, additionally, it is now possible to utilize less rigid component temperatures specifications so that less expensive components may be used. From the foregoing, it is quite apparent that other heat generating energy translating devices such as power rectifiers and the like may also be provided with cooling fin elements in intimate thermal contact with the device. The desired chimney effect is obtained as before by vertically orienting and extending the fin elements through an opening in the receiver chassis as heretofore described.

Thus it is seen there has been devised a new and improved economical power transformer for use in communication circuitry which uniquely utilizes a combination of heat conduction, convection, and radiation cooling in a simple but highly efficient manner to substantially increase the power rating of the transformer at a minimum of cost increase or to substantially decrease the cost of the transformer while still preserving the same power rating. The invention is also applicable to other electronic apparatus components, such as power rectifiers, which generate large amounts of heat in normal operation. Other features of the invention provide additional cooling of the heat generating energy translating device and also an increase in circuit stability.

While particular embodiments of the invention have been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from the invention in its broader aspects, and, therefore, the aim in the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of the invention.

I claim:

1. A power transformer for use in domestic appliances such as television receivers and the like comprising: a

closed ferromagnetic core having at least two generally parallel legs and a pair of connecting base portions extending in a direction generally perpendicular to said legs; a primary winding and at least one secondary winding each encompassing one of said legs of said core; a thermally conductive heat collector member in thermal contact with the peripheral surface of at least one of said base portions of said core along substantially its entire length; and a plurality of thermally conductive outwardly extending cooling fin elements in thermal edge contact with said collector member and disposed in planes substantially parallel to the plane defined by the geometric axes of said base portions of said core and spaced from one another by a distance of an order of magnitude greater than the thickness of an individual one of said cooling fin elements.

2. A power transformer for use in domestic appliances such as television receivers and the like comprising: a closed ferromagnetic core having at least two generally parallel legs and a pair of connecting base portions extending in a direction generally perpendicular to said legs; a primary winding and at least one secondary winding each encompassing one of said legs of said core; and a thermally conductive container surrounding said core in thermal contact with at least a portion of each of the peripheral surfaces of said base portions of said core along substantially their entire lengths, said container being provided with a plurality of thermally conductive outwardly extending cooling fin elements disposed in planes substantially parallel to the plane defined by the geometric axes of said base portions of said core and spaced from one another by a distance of an order of magnitude greater than the thickness of an individual one of said cooling fin elements.

3. A power transformer for use in domestic appliances such as television receivers and the like comprising: a closed ferromagnetic core having at least two generally parallel legs and a pair of connecting base portions extending in a direction generally perpendicular to said legs; a primary winding and at least one secondary winding each encompassing one of said legs of said core; and a thermally conductive corrugated container surrounding said core with respective corrugations in thermal contact with at least a portion of each of the peripheral surfaces of said base portion of said core along substantially their entire lengths and spaced from one another by a distance of an order of magnitude greater than the thickness of said container.

4. A power transformer for use in domestic appliances such as television receivers and the like comprising: a closed ferromagnetic core having at least two generally parallel legs and a pair of connecting base portions extending in a direction generally perpendicular to said legs; a primary winding and at least one secondary winding each encompassing one of said core legs; a plurality of thermally conductive U-shaped pieces of different sizes, the bight portions of said pieces forming heat collector members and the leg portions forming cooling fin elements; and fastener means securing said U-shaped pieces in nested contacting relation to one base portion of said core, with the heat collector member of one U-shaped member in thermal contact with the peripheral surface of one of said core base portions along substantially its entire length, and said cooling fin elements spaced from one another by a distance of an order of magnitude greater than the thickness of an individual cooling fin element.

5. A power transformer for use in domestic appliances such as television receivers and the like comprising: a closed ferromagnetic core having at least two generally parallel legs and a pair of connecting base portions extending in a direction generally perpendicular to said legs; a primary winding and at least one secondary winding each encompassing one of said core legs; a plurality of thermally conductive U-shaped pieces of different sizes, the bight portions of said pieces forming heat collector members and the leg portions forming cooling fin elements; and fastener means securing said U-shaped pieces in nested contacting relation to one base portion of said core with the bight portions of said pieces parallel and contiguous to one another, the heat collector member of the largest U-shaped member being in thermal contact with the peripheral surface of one of said core base portions along substantially its entire length, and said cooling fin elements being spaced from one another by a distance of an order of magnitude greater than the thickness of an individual cooling fin element.

6. A power transformer for use in domestic appliances such as television receivers and the like comprising: a closed ferromagnetic core having a pair of connecting base portions generally parallel to each other and three legs extending in a direction generally perpendicular to said base portions, one of said legs being centrally disposed in said core; a primary winding and at least one secondary winding each encompassing said central leg; a plurality of thermally conductive U-shaped pieces of different sizes, the bight portions of said pieces forming heat collector members and the leg portions forming cooling fin elements; and fastener means securing said U-shaped pieces in nested contacting relation to one base portion of said core, with the heat collector member of one U-shaped member in thermal contact with the peripheral surface of one of said core base portions along substantially its entire length, and said cooling fin elements spaced from one another by a distance of an order of magnitude greater than the thickness of an individual cooling fin element.

7. A power transformer for use in domestic appliances such as television receivers and the like comprising: a closed ferromagnetic core having at least two generally parallel legs and a pair of connecting base portions extending in a direction generally perpendicular to said legs; a primary winding and at least one secondary winding each encompassing one of said legs of said core; a heat dissipating attachment comprising a base member and a plurality of thermally conductive cooling fin elements projecting from said base member and in intimate thermal contact therewith, said fin elements being disposed in substantially parallel planes and spaced from one another by a distance of an order of magnitude greater than the thickness of an individual one of said fin elements; and means for securing said base member in intimate thermal contact with a peripheral surface of at least one of said base portions of said core along substantially its entire length and with said fin elements oriented to extend outwardly from said core.

8. A power transformer for use in domestic appliances such as television receivers and the like comprising: a closed ferromagnetic core having at least two generally parallel legs and a pair of connecting base portions extending in a direction generally perpendicular to said legs; a primary winding and at least one secondary winding each encompassing one of said legs of said core; a heat dissipating attachment comprising a base member and a plurality of thermally conductive cooling fin elements projecting from said base member and in intimate thermal contact therewith, said fin elements being disposed in substantially parallel planes and spaced from one another by a distance of an order of magnitude greater than the thickness of an individual one of said fin elements; and means for securing said base member in intimate thermal contact with a peripheral surface of at least one of said base portions of said core at the region of said peripheral surface in closest proximity of said one leg of said core.

9. An electronic apparatus comprising: an electrical circuit supporting chassis having at least one substantially unobstructed opening formed therein; at least one heat generating electrical energy translating device connected in said circuit and mounted on said chassis adjacent said opening; a heat dissipating attachment com-

prising a base member and a plurality of thermally conductive cooling fin elements projecting from said base member and in intimate thermal contact therewith, said fin elements being disposed in substantially parallel planes and spaced from one another by a distance of an order of magnitude greater than the thickness of an individual one of said fin elements and extending partially through said opening to establish convection air current flow through said opening and through the channels defined by said fin elements; and means for securing said base member in intimate thermal contact with a peripheral surface of said heat generating device and with said fin elements oriented to extend outwardly from said device.

10. An electronic apparatus comprising: an electric circuit supporting chassis having at least one substantially unobstructed opening formed therein, said electric circuit including a plurality of circuit components electrically connected in said circuit operatively related to one another; at least one heat generating electrical energy translating device connected in said circuit and mounted on said chassis adjacent said opening; a heat dissipating attachment comprising a base member and a plurality of thermally conductive cooling fin elements projecting from said base member and in intimate thermal contact therewith, said fin elements being disposed in substantially parallel planes and spaced from one another by a distance of an order of magnitude greater than the thickness of an individual one of said fin elements and extending at least partially through said opening to establish a convection air current flow surrounding said components and through said opening and the channels defined by said fin elements whereby the maximum temperature variations of said components and the maximum temperature of said translating device are reduced to substantially increase the operating stability of said circuit; and means for securing said base member in intimate thermal contact with a peripheral surface of said heat generating device and with said fin elements oriented to extend outwardly from said device.

11. Apparatus in accordance with claim 10 in which said chassis is ventilated to substantially increase said convection air current flow.

12. An electronic apparatus comprising: an electric circuit supporting chassis having at least one substantially unobstructed opening formed therein, said electric circuit including a plurality of circuit components electrically connected in said circuit operatively related to one another; a power transformer comprising a closed ferromagnetic core having at least two generally parallel legs and a pair of connecting base portions extending in a direction generally perpendicular to said legs, a primary winding and at least one secondary winding each encompassing one of said legs of said core; a heat dissipating attachment comprising a base member and a plurality of thermally conductive cooling fin elements projecting from said base member and in intimate thermal contact therewith, said fin elements being disposed in substantially parallel planes and spaced from one another by a distance of an order of magnitude greater than the thickness of an individual one of said fin elements; means for securing said base member in intimate thermal contact with a peripheral surface of at least one of said base portions of said core along substantially its entire length; and means for mounting said transformer adjacent said opening with said cooling fin elements substantially vertically oriented and extending at least partially through said opening to establish convection air current flow surrounding said components and through said opening and the channels defined by said fin elements whereby the maximum temperature variations of said circuit components and the maximum temperature of said transformer are reduced to substantially increase the operating stability of said circuit.

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