

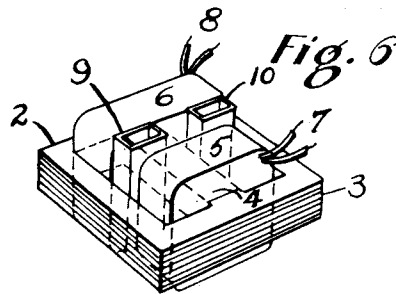
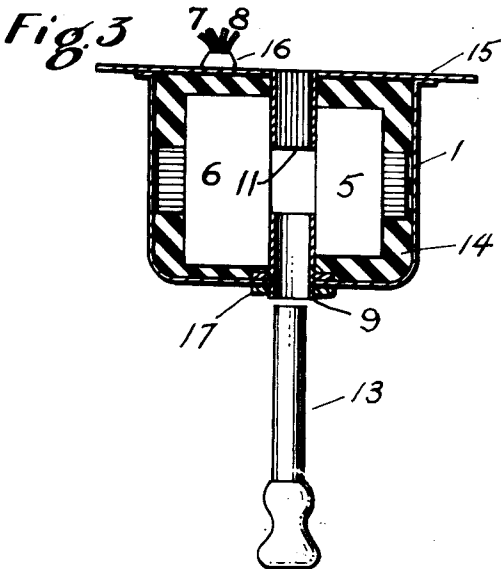
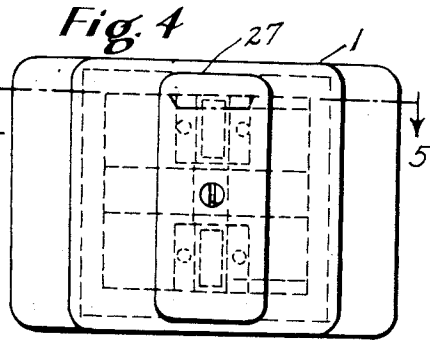
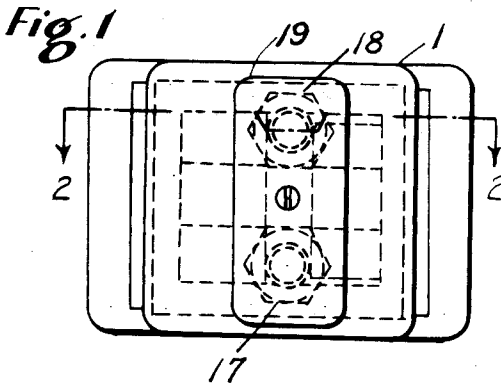
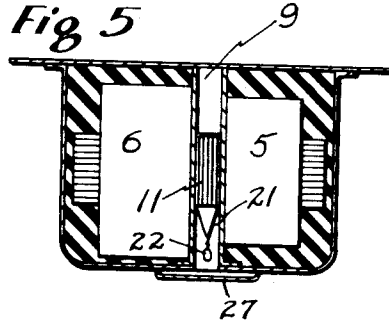
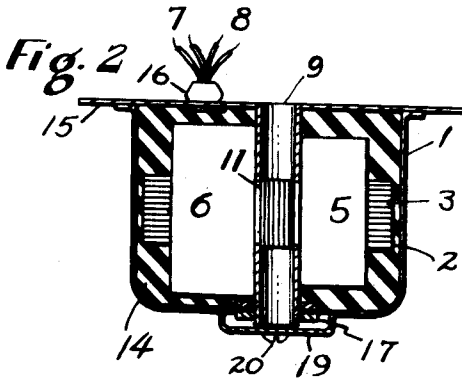
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H. R. STEWART
CONVERTIBLE TRANSFORMER

2,668,947

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2 Sheets-Sheet 1



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2 Sheets-Sheet 2

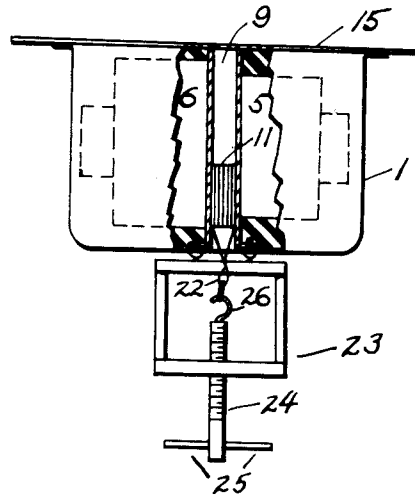


Fig. 7

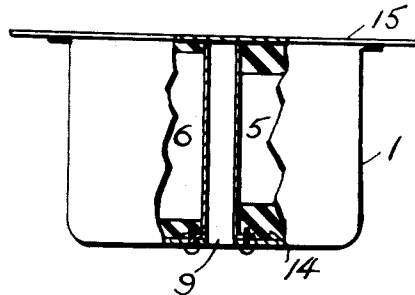


Fig. 8

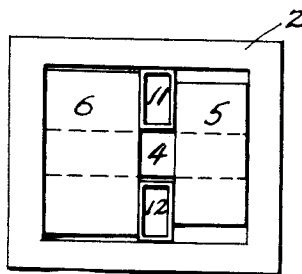


Fig. 9

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CONVERTIBLE TRANSFORMER

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3 Claims. (Cl. 336—90)

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This invention relates to transformers and more particularly to transformers of the specialty type.

Specialty transformers having a relatively high internal leakage reactance are useful in connection with many devices, such as door bells, toys, furnace regulators, lighting circuits, neon fluorescent igniters, and a number of other related devices.

In the field of specialty transformers, the most economical way of adjusting the leakage reactance is by the use of magnetic shunts or stacks of steel punchings between the core legs and the space between the coils.

All transformers have a certain amount of internal leakage reactance due to the fact that a complete interlocking of the primary and secondary magnetic fluxes is not possible, as a portion of the fluxes must necessarily pass through the spaces between the primary and secondary coils. The transformer would have no leakage reactance if all the lines of magnetic force created by the primary threaded through the secondary and if all the lines linking the secondary also link the primary. The so-called leakage flux which does not link either of the coils is manifested in the form of internal leakage reactance of the transformer.

Inasmuch as the induced voltage in a transformer is dependent upon the rate of change of the magnetic flux, the frequency of the alternating current source supplying the transformer becomes a factor in determination of the leakage reactance. Normally, a transformer is designed for use at a particular frequency, which may be, for example, sixty cycles or twenty-five cycles and which remains relatively constant. Thus in the normal use and operation of a transformer there is no need to consider the effect of a change in frequency of the source. However, in view of the foregoing, it is apparent that a change in the frequency of the source of supply would affect, among other things, the leakage reactance of the transformer and would require either a new or different transformer or adjustments to the existing transformer.

In the case of specialty type transformers having a magnetic by-pass or shunts between the coils, the leakage reactance of a given transformer can be varied by changing the shape or position of the magnetic shunts forming the leakage path. Thus, a larger magnetic shunt would provide an increased leakage path and result in a higher leakage reactance. Conversely, a smaller or lesser magnetic shunt would reduce

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the leakage reactance by diminishing the leakage path.

Inasmuch as a transformer once designed and constructed has fixed dimensions, one feasible way of varying the leakage path is by physical adjustment of the magnetic by-pass or shunt in relation to the other components of the transformer. However, a transformer, once the component parts are assembled, is enclosed in a case and sealed therein by some asphalt or similar compound, or filler, and there is no known simple way of changing the leakage path in the foregoing manner.

This problem may be of particular importance in localities where the source of useful electrical power is generated at a given frequency; for example, 25 cycles and it is desired to change over to a power supply system operating at 60 cycles. Most devices embodying specialty transformers would necessarily become obsolete by a frequency conversion of this type.

Accordingly, it is an object of this invention to provide a transformer construction that may be simply converted from operation at one frequency to operation at another frequency.

Another object of this invention is to make accessible and possible the changing of the magnetic by-pass of a transformer after the transformer is mounted in its case and enclosed and sealed therein.

Briefly, in accordance with my invention, I provide a transformer having primary and secondary coils and including tubular inserts passing through the magnetic core between the primary and secondary windings which are adapted to receive the magnetic by-pass or shunts, the tubes having openings which may be accessible from either side or both sides of the transformer, thus providing access to the magnetic shunt whereupon the magnetic by-pass may be adjusted in accordance with the frequency of the source.

These and other objects and advantages of the invention will be further understood from the following description when considered in connection with the accompanying drawings and in the scope as pointed out in the appended claims.

In the drawings: Fig. 1 is an end view of the convertible transformer as enclosed in a casing; Fig. 2 is a section on the line 2—2 through the transformer showing in detail the tubular insert and magnetic shunt; Fig. 3 is another sectional view taken on a line 2—2 showing the application of a drift pin to eject the magnetic shunt

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from its association with the core of the transformer; Fig. 4 is an end view of a different embodiment of the transformer showing in dotted lines rectangularly shaped tubular inserts; Fig. 5 is a section on a line 5—5 showing in detail the rectangular cross section of the tubular insert and the magnetic shunt having a metal band wrapped therearound; Fig. 6 is a perspective view of the embodiment shown in Figs. 4 and 5 showing the physical relation of the component parts of the transformer; Fig. 7 is a cut-away view of the embodiment shown in Figs. 4 and 5 showing the application of a different form of shunt removal device; Fig. 8 is a view of the embodiment shown in Fig. 7 with the magnetic shunt removed; and Fig. 9 is an end view of the transformer with the casing removed showing the physical relation of the components of the transformer.

Referring now to Figs. 1 and 2, the dotted lines in Fig. 1 show the transformer of this invention enclosed in the housing 1, and a more detailed illustration of the transformer construction is shown in Fig. 2 which is a cut-away section along the line 2—2 of Fig. 1. The physical relation of the component parts of the transformer are readily illustrated in the perspective showing of Fig. 6.

The transformer embodies a closed magnetic circuit in the form of a closed shell-type core 2, which core may be made up of a stack of E-shaped laminations 3 in surmounting relation. The laminations may be held together by any suitable means such as nuts and bolts, or rivets.

On the central leg portion 4 of the shell-type core is mounted a primary winding 5 and a secondary winding 6 in spaced physical relation, each of these windings having terminal connections indicated at 7 and 8 respectively which are adapted to be connected to a source of alternating current and voltage. Although the primary and secondary windings are in spaced physical relation they are magnetically coupled in a manner to provide adequate transformer action. The leakage path that would normally exist in the opening between the primary and secondary coils due to their spaced relation or loose coupling is increased in its effectiveness by reason of the tubular inserts 9 and 10 which may be of magnetic material which act as guides for the cylindrical magnetic shunts 11 and 12.

In the particular form shown in Fig. 2 the tubular guide member 9 for the magnetic shunt 11 is shown as being made up of several hollow cylindrical sections mounted in aligned axial relationship, one at either side of the flat faces of the shell-type core. The sections may be of like or unlike material, depending on the characteristics desired. This arrangement allows for an intimate contact between the magnetic shunt and the core 2 when the shunt is at the central position shown in Fig. 2. In this position the magnetic shunt is an effective magnetic by-pass providing a high leakage path between the primary and secondary windings when the transformer, for example, is to be operated on a power supply system operating at twenty-five cycles per second.

Referring now to Fig. 3 where like numerals designate like parts, the magnetic shunt 11 is shown ejected from its intimate relation with the core 2 by application of the drift pin 13, thus effectively decreasing the magnetic by-pass or leakage path between the windings and reducing the internal reactance of the transformer for

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operation on a power system operating at a higher frequency, such as, for example, sixty cycles per second.

A significant feature of this invention is the supporting relation between the magnetic shunts 11 and 12 and the tubular guide members 9 and 10 which may be attained by means of a snug fit, crimping, or other well known means. By reason of this relation, the magnetic shunts may be adjusted in the desired position without the necessity of additional locking or fastening means. Hence, in order to change the position of the shunts to conform to a change-over in the frequency of the power source, it is only necessary to apply a small amount of force by means of either the drift pin 13 or other means herein-after to be described. In any event, the magnetic shunt, once positioned in either central or end location, for example, depending on the frequency of the power source, will remain fixed and self supporting within the tubular guide means.

As shown in both Figs. 2 and 3, once the core and windings, tubular inserts, and magnetic shunts are assembled in operative relation they are sealed within the housing 1 by means of a filler 14 of asphalt compound or other like material. One end of the transformer may be sealed as shown by means of a cover plate 15 out of which extends the terminal bushing 16. The other end may be sealed by means of lock nuts 17 and 18 which may be used to fasten the tubular insert within the housing and then by covering this end of the transformer with a small cover plate 19 which may be removably secured to the housing 1 by means of the twist screw or similar device 20.

Thus it may be seen that a high reactance transformer of the type shown in Figs. 1, 2 and 3, may be constructed for initial operation on a twenty-five cycle power source whereby the particular effective internal reactance is obtained by means of a snug fitting magnetic shunt centrally associated in intimate relation with the closed magnetic core and the windings mounted thereon. Then, in the event of frequency conversion of the power source or supply, for example, to sixty cycles, the transformer may be easily converted for operation on the new system by simply removing the screw 20 and cover plate 19 and ejecting the magnetic shunts 11 and 12 out of intimate contact with the core 2.

Referring now to Figs. 4 and 5 where like numerals designate like parts, a different embodiment of this invention is shown in that the tubular inserts are in the form of hollow rectangular tubes 9 and 10 rather than the cylindrical tubes shown in Fig. 2, and the magnetic shunts shown at 11 and 12 are likewise of rectangular cross section corresponding to the rectangular tubular inserts. Each magnetic shunt, as shown in Fig. 5, has a metal band 21 or strap wrapped about the shunt forming a loop 22 or eye at one end thereof, thereby facilitating ejection or removal of the snug fitting magnetic shunt from the transformer in a different manner than was shown in Fig. 3. The shunt removal device shown in Fig. 7 comprises a retaining frame 23 which carries a pull or jack screw arrangement 24 having handles 25 at one end and a hook 26 extending from the other end.

Thus when it is desired to convert the transformer from operation at a lower frequency to operation at a higher frequency, for example, the small cover 27 is removed and the shunt removal

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device is applied at the end of the transformer. The jack screw 24 may then be turned into the shunt reception chamber in the tubular insert and the hook 26 hooked into the eye 22 which projects from one end of the metal strap wrapped around the magnetic shunt. It is then a simple matter to withdraw the screw 24 and pull the magnetic shunt out from the tubular insert, leaving the passage or chamber entirely free as shown in Fig. 8, thereby respectively reducing the leakage path and the internal reactance of the transformer for operation at the higher frequency.

Fig. 9 is a top view of the assembled transformer without its housing showing the physical relation of the core, the winding, and the tubular inserts which are adapted to receive the magnetic shunts.

The arrangements shown in the drawings illustrate the preferred embodiment of this invention. However, other embodiments and modifications may be readily apparent to those skilled in the art. For example, the transformer, instead of having a shell-type core made up of E-type laminations, may instead comprise a stack of U-shaped laminations abutting an I-shaped stack of laminations so that half of each coil extends beyond the closed core section. Regardless of construction, the tubular inserts can be readily inserted between the spaced relation of the coils so that the desirable high-reactance may be obtained at any given frequency by reason of the adjustability of the magnetic shunt.

It is readily apparent that the concept of a hollow tubular reception chamber which carries a removable magnetic shunt element within the chamber may readily be adapted for use in any type transformer where a given internal leakage reactance is secured by means of a magnetic shunt in association with the windings and transformer core. Thus, in the assembly of a transformer, regardless of the number of windings or the configuration of the core, various forms of reception chambers may be designed and inserted in proper operative relation with respect to the cooperative windings and core prior to the sealing of the transformer elements within a housing. The transformer may then be sealed and yet be susceptible to subsequent conversion for operation on a different frequency of supply by reason of the external access to the magnetic by-pass which may be adjusted in accordance with the desired conversion.

I have shown and described what I consider the preferred embodiment of my invention along with similar modified forms, and it will be obvious to those skilled in the art that other changes and modifications, particularly with respect to the structure and design of the magnetic by-pass and its application to different type transformers, may be made without departing from the scope of my invention as defined by the appended claims.

I claim:

1. In a convertible transformer having a closed-

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type core with opposing parallel legs and having a plurality of coils mounted in spaced relation on one of said legs, an adjustable magnetic by-pass comprising, a plurality of hollow tubular inserts supported between the windings within the closed core in substantial alignment on opposite sides of the core and normal thereto, each of said inserts having one end abutting the adjacent core edges of the parallel core legs in surmounting relation to align opposing inner guide surfaces with the adjacent inner faces of said core legs, and a self-supporting magnetic shunt adjustably carried in snug fitting relation within the tubular passage defined by said aligned hollow inserts.

2. An externally accessible magnetic by-pass for a high reactance transformer comprising, a hollow tubular insert for said transformer and a self-supporting magnetic shunt member adjustably carried in snug fitting relation within said hollow insert, a strap surrounding said magnetic shunt and forming a loop in spaced relation from the shunt within the hollow insert whereby said loop may be engaged by shunt adjusting means applied external to said hollow insert.

3. A transformer convertible for use with one primary frequency to use with a different primary frequency comprising, the assembly of a magnetic core having spaced parallel core legs, a primary and a secondary winding wound about one of said core legs in axially spaced relation from each other, a hollow elongated core guide open at each end disposed in space between said windings to provide access therebetween to the space between said core legs, a housing enclosing the assembly and having an opening aligned with an open end of the hollow core guide, an elongated magnetic core shunt having a dimension transverse to its elongated axis sufficient to provide a self-supporting snug fit within said hollow core guide, said core shunt adapted to be positioned through the hollow core guide into the space between the core legs for operation of the transformer at one primary frequency, and means providing external access through the aligned housing opening and the hollow core guide to enable removal of the core shunt through said guide and housing for converting the transformer to use at a different primary frequency.

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