Descriptions

Title: Multiple Coils Fluorescent Lamp Ballast

TECHNICAL FIELD

This invention relates to a device for lighting up fluorescent lamp by means of two or more coils in a single unit of ballast choke coil device.

BACK GROUND ART

At present the fluorescent lamp ballast choke coil consists of a single winding coil encapsulated with silicon steel laminates in the shape of butterfly; by means of U-T laminate cores. However, due to the current fluorescent lamp casing design, the size of the coil is restricted and the capacity of the ballast depend solely on the amount of silicon steel laminates that are stuffed into a unit of ballast. Wire length is longer when stuffing in more laminates but number of turn can not be increased due to space constraint and that is a waste of wire material and resulted in waste of energy. Additional copper or aluminium wire length that is not used to increase number of winding turns become a burden to the ballast unit that brings down it performance.

The new design focus is to make any increase of copper or aluminium wire is used to increase the winding turns thereby increases the ballast inductance. The new simple design consist of a round loop of laminates with air gap(s) and coupled with two or more coils (wire that revolves around the laminates). This new design construction would require less laminate materials and more wire winding turns can be added onto the ballast unit compare to the similar size of present ballast available in the market. Larger wire diameter size can be used as more space is available which will improve the ballast performance with lower heat lost.

DISCLOSURE OF INVENTION

The new ballast construction consist of two or more sets of multi-layers of laminates being inserted into two or more pre-wound coils; be it an air coils or bobbin coils. The terminals of the coils can be connected together in the manner of serial connections or parallel connections.

The two sets of multi-layer laminates forms a complete loop for magnetic flux to flow; with one or more than one air gap on the laminates looping. The air gap(s) can be located at the center of the coil(s) or external area of the coil(s).

The semi-completed assembly is then inserted into a casing; following by paint application onto the unit before a base plate is attached to it.

The multi-layer laminate cores construction have a few possible shapes combination; as describe in Fig. 2 to Fig 10. The laminate cores are packs of many thin layers of silicon steels that has high permeability. The silicon steel laminate thickness is 0.5 millimeter in normal cases. However, thicker also possible to be used but would probably has poorer result. Thinner laminate is good but increase production cost.

The coil design may or may not be of center tapped or multi-center tapped terminals as in Fig. 12 type of winding coil or it could be a simple coil that simply has a Start Wire Terminal (ST) and a End Wire Terminal (ET) as in Fig. 11. By having two sets of simple coil on the laminates, the ballast is already capable to function. The center taps are for the purpose of reducing the number of turns that is used to operate the fluorescent lamp during light up period. A device is used to cut of the connection of center tap after light up and uses full capacity of the ballast for optimum current consumption. Alternative ways of not having center taps but getting the same results is by utilizing a few simple coils bundle together as in Fig. 13. Fig. 11 and Fig. 12 and Fig. 13 show only the coils of enameled magnetic wire with bobbin. The coil also can be produced without bobbin that is an air coil; by means of using self-bonding wire wound on mandrel and then cure by heat or solvent.

The air gap is important to prevent magnetic saturation of the cores. There may be two air gaps at both meeting point of the two sets of laminates; or one side meeting each other tightly and create only one air gap on the other side of meeting laminates. The air gap size range from 0.1 ~ 0.8 millimeter. However in most cases, a single air gap of size 0.3 ~ 0.5 millimeter is already sufficient to prevent such magnetic saturation. The air gap can be an empty air space or the laminate stacks being separated by a thin piece of non-ferrous material such as plastic.

DESCRIPTION OF DRAWING FOR CARRYING OUT THE DESIGN

Figure 1 illustrates the upside-down view of ballast assembly design; which consist of multi-layer laminates cores with two coils inserted on it and the laminates being held by cover which has multiple clamping flanges (R4, R5, R6 & R7) on bottom plate M2 and caulking ridges on top cover. M1 being the top cover and M2 being the bottom plate.

Fig. 2, 3, 4, 5, 6, 7, 8, 9 and 10 demonstrate the possible shapes of the laminated cores Fig. 2 is U-U shape; Fig. 3 is L-L shapes; Fig. 4 is L-J shapes; Fig. 5 is I-U shapes; Fig. 6 is C-C; Fig 7 is L-L-U shapes, Fig. 8 is L-L-L-L shapes, Fig. 9 is E-E shape and Fig. 10 is I-E shape. In the case of laminates cores construction in Fig. 9 and Fig.10; three coils will be used for the ballast to operate. The corners of the laminate can be of right angle or cut in curving shape of round edges.

Figure 11 displays a simple bobbin coil. ST being the start terminal of the winding and ET being the end terminal of the wire on the coil.

Figure 12.shows a schematic diagram of the multiple centre tapped terminals bobbin coils. The center tapped terminals CT or link wire between winding coils can be of multiple tapped out of two or more center tapped terminals as in Fig. 13 which are denote as LW1-2 and LW2-3. For simple application, a single center tapped would be sufficient. The

center taps may be for the purpose of reducing the number of turns that is used to operate the fluorescent lamp during light up period with lower start up current. An external device is required to cut off the connection of center tap after light up and uses full capacity of the ballast for optimum current consumption. ST denote the start wire terminal of the first coil and ET denote the end wire terminal of the last coils. Winding process is wound to form the first coil and without breaking the wire, continue to wind the subsequent coil and so on until the desired quantity of coils stacks is completed. As shown in Fig. 13, LW1-2 is the link wire between coil stack 1 and coil stack 2 which is actually the end wire of the first coil and start wire of the second coil; the same goes to LW2-3, LW3-4 and so on given that the numbers of coils is more than 3. For the case of odd and even numbers of coils stacks (WC) for serial connection, it is straight forward as can be seen from the diagram that if the odd number of coil stacks (WC) is used in the design, for example says that 7 coil stacks is used, then LW7-8 will be the end wire terminal. Thus there is no need to interconnect the coils stack later during assembly as the link wire between the coils (WC) is readily available. In the case of two coils serial connection application, one coil is position in an upside-down orientation from the other coil given that the coils are wound in the same clockwise direction and leaving only two wire terminal whereby one wire terminal is connected to the Live connection of the AC power source on and the other wire terminal being connected to the ballast lamp.

However, in the case of parallel connection, the alternate link wires are interconnected between the coils stacks (WC) such as joining up the start wire of the first coil to link wire between second coil to the third coil and link wire between forth coil to fifth coil and so on to form a single terminal connection. The link wire between first coil to the second coil and link wire between third coil to the forth coil and so on are joined up to form a second single terminal connection. The link wires between the coils stacks (WC) are interconnected to the start wire of the first winding and the end wire of the last winding giving that an even number of winding coils stacks (WC) are used. However, it shall not be done on the end wire of the last winding coil stack giving that an odd number of winding coils stacks (WC) are used. In the case of odd number of winding coils stacks (WC) are used, the end wire of the last coil stack shall be interconnected to the link wire of the first coil to the second coil. For the example of 8 coils stack design assembled on 8 legs laminate core stack, then all wire terminals such as ST, LW2-3, LW4-5, LW6-7 and ET shall be link up and the terminal LW1-2, LW3-4, LW5-6 and LW7-8 shall be link up. There shall be ultimately only two effective terminals from the coils that is one terminal connected to the AC current and the second terminal connected to the fluorescent tube lamp. Thus, all coils (WC) would ultimately act as a single coil and create a single direction of magnetic flux flow in the laminate loops. Referring now to Fig. 11 and Fig. 12, there are illustrated only the coils (WC) of enameled magnetic wire with bobbin. The coil (WC) also can be produced without bobbin that is an air coil, by means of using self-bonding wire wound on mandrel and then cure by heat or solvent.

Figure 13 shows 2 coils bundle together to get the same result as Figure 11 of two center tapped terminals case.Figure 14 shows the assembly of 2 coils with 2 stack of U-U shape multi-layer laminate cores.

Figure 15 shows the assembly of 2 coils with 2 stack of L-J shape multi-layer laminate cores.

Figure 16 shows the assembly of 2 coils with 2 stack of I-U shape multi-layer laminate cores.

Figure 17 shows appearance of semi-finish ballast assembly of Fig. 13, Fig. 14 and Fig. 15.

Figure 18 shows the assembly of 2 coils with 2 stack of C-C shape multi-layer laminate cores.

Figure 19 shows the assembly of 3 coils with 2 stack of E-E shape multi-layer laminate cores with one air gap at the center of the middle coil for best performance.

Figure 20 shows the ridges construction of both sides of the cover design to hold the semi-completed ballast assembly. Ridge R3 has longer cut and slightly bent outward. R3 will be bend in after crimping during assembly. H1 holes and H2 & H3 groves are for crimping bottom plate to top cover.

Figure 21 shows another choice of possible casing design whereas in this case the C channel is the base bracket. In this bracket design, alternative ridges design is also demonstrated. Ridges R5 are punched out in the opposite direction than ridges R2 in Figure 20. Ridge R4 is punched downward in the opposite direction to Ridge R1 in Figure 20. Ridges R4 and R5 have identical mirror image features on the opposite side of the wall. Ridges R6 are formed by punching a C shape hole on both side of the bracket walls. Two holes H4 at two ends of the bracket is similar to H1 holes in Figure 20; but the material at the side of the hole is deformed upward into an embossed shape E1. Two holes H5 and four holes H6 are formed at the bottom. Four holes H7 are form such that link rod can be attached between the two walls to enhance the holding force of the walls.

Figure 22 shows another choice of possible cover design whereas six Ridges R6 clamp onto base bracket of Figure 21 and two ridges of R7 clamp through H4 holes and hiding the excess part underneath embossed areas E1. Two to four terminal wires exit holes can be in the shape of H8 and / or H9. Four cut out grooves H10 on the corners of the bent cover is for assembly access purpose.

Figure 23 shows a more detail description of Fig. 2 laminate (LC) design of a single piece of U shape offset laminate design that is not symmetry. The two legs of the laminate (LC) are different in their length that is distinguished by differential distance (D1). Cut out grooves (C21 and C22) are meant for clamping grooves purpose whereby the flanges of the housing bracket shall clamp onto these grooves. The groove (C21) is an offset manner that create differential distance (D2) such that the differential distance is distinguishable by the naked eye or when the laminate (LC) is placed on an assembly jig, there is no way that the laminated can be placed in wrong orientation. Other method of identifying the laminate (LC) orientation would be to have a cut out groove of C23 or C24. C23 and C24 are actually C1 and C2 in Fig. 2.

Claims

1. A fluorescent lighting ballast choke coil comprising,
   at least two laminated core stacks; and
   at least two winding coils;

   characterized in that

   said laminated core stacks comprise two or more sets of multi-layered laminate inserted into the winding coils to form a complete loop for magnetic flux to flow, and
   said winding coils are equal in number with laminate legs and have coil terminals interconnected together in serial or parallel such that all of the winding coils, as a whole, act as a single winding coil.

2. A fluorescent lighting ballast choke coil as claimed in Claim 1 wherein said laminated core stacks comprise multi-layer laminates which form a complete loop comprising U-U laminated cores; L-L laminated cores; L-J laminated cores; I-U laminated cores; C-C laminated cores; L-L-U laminated cores; or L-L-L-L laminated cores for a minimum of two winding coil and E-E laminated coils for a minimum of three winding coils.

3. A fluorescent lighting ballast choke coil as claimed in Claim 1 comprising at least one air gap located at a meeting point of said laminated core stacks wherein said air gap is hidden within the winding coils (G1, G2, G5, G11, G13, G14, G16, G18, G19, G20) or exposed at position where there is no winding coil (G3, G4, G6, G7, G8, G9, G10, G12, G15, G17, G21, G22, G23).

4. A fluorescent lighting ballast choke coil as claimed in Claim 1 wherein said winding coils comprise at least one center tapped (CT) terminal located between a start terminal (ST) of the winding coils and an end terminal (ET) of said winding coils for reducing the number of turns used to operate the fluorescent lamp during light up period.

5. A fluorescent lighting ballast choke coil as claimed in Claim 1 including an array of two or more winding coils which have wire terminals connected in serial or parallel connection internally dependent on designed power selection; said wire terminals having only two external connections (P1, P2) for connection to a power supply and fluorescent lamp circuit and having up to a total of four external connections (P1, P2, P3, P4).

6. A fluorescent lighting ballast choke coil as claimed in Claim 4 further comprising at least one web (W1) separating the winding coils if there is more than one center tapped (CT) terminal.

7. A fluorescent lighting ballast choke coil as claimed in Claim 1 further comprising at least one cutting groove, wherein said cutting groove is constructed from the first outside periphery of the laminated core stacks to the second outside periphery of the laminated core stacks for identification of the orientation of the laminated core stacks.

8. A fluorescent lighting ballast choke coil as claimed in Claim 1 wherein said laminated core stacks include at least one clamping groove which may have two different sizes such that they do not form a mirror image thereby allowing for orientation identification.

9. An assembly comprising:
   a fluorescent lighting ballast choke coil as claimed in Claim 1; and
   a housing for a ballast choke coil device, said housing comprising;
      at least a top cover;
      at least a bottom plate;
   wherein said top cover and bottom plate are joined by spot welding them together and/or crimping flanges (R4, R5) to holes (H1) at the two ends of the cover and flanges (R6, R7) to a first groove (H2) and a second groove (H3).

10. An assembly as claimed in Claim 9 wherein flanges (R1, R2, R3, R4, R5, R6) on both sides of a cover wall of the housing are punched out such that a first pair of flanges (R1, R4) provide for guiding the laminated core stacks into position, a second pair of flanges (R3, R5) on both sides provide for crimping laminated core stacks of different width and a third pair of flanges (R2, R6) on both sides provide for caulking both ends of the laminated core stacks to firmly hold the laminated core stacks.

11. An assembly as claimed in Claim 9 wherein said housing includes access areas for assembly purposes, said access areas including cut out grooves (H10) and/or cut out holes (H5, H6) in the housing.