

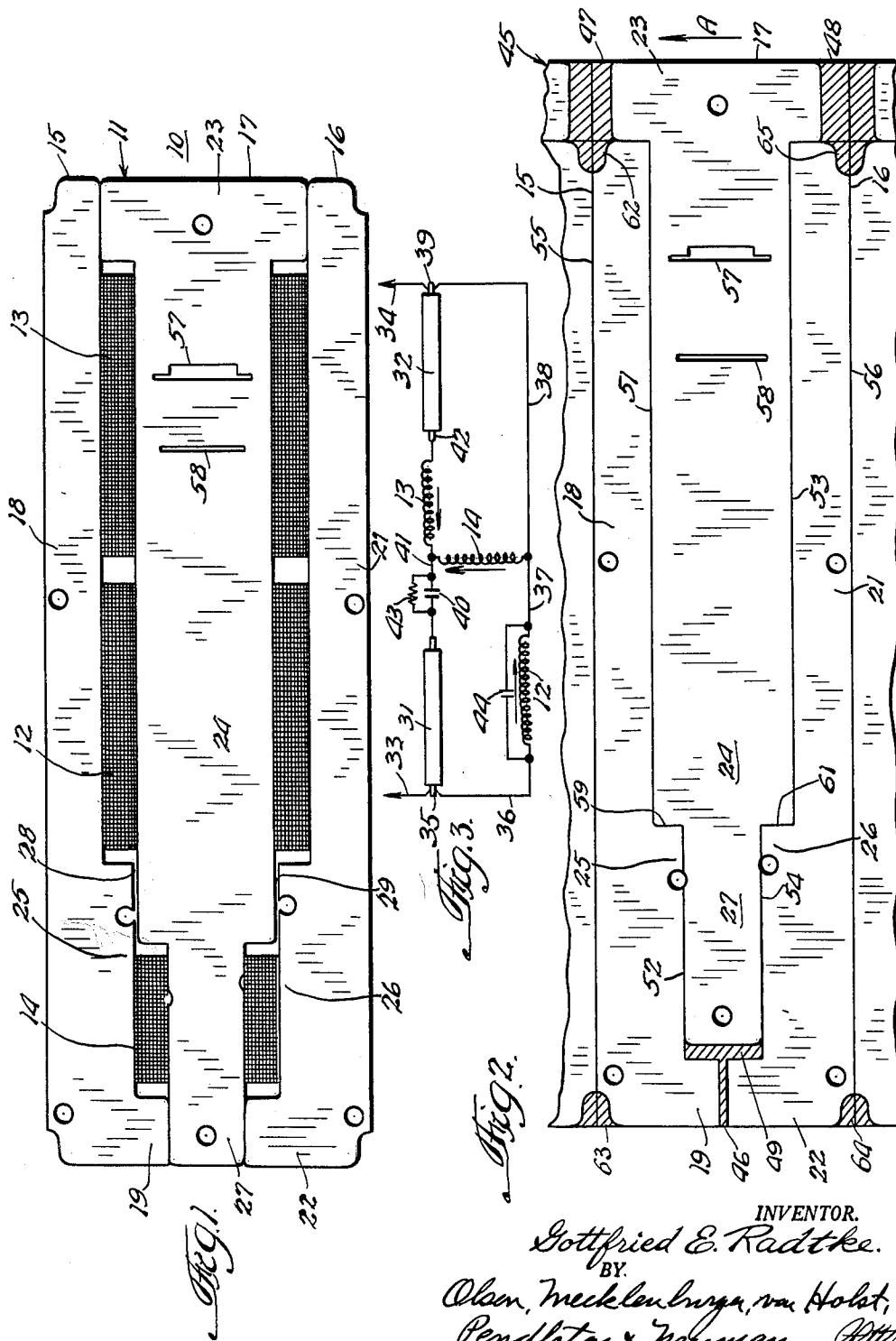
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TRANSFORMER CORE AND LAMINATION THEREFOR

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1

2

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TRANSFORMER CORE AND LAMINATION THEREFOR

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This invention relates to electro-magnetic devices commonly termed ballasts for starting and operating fluorescent lamps or other gaseous discharge devices, and more particularly to the iron cores of such ballasts, the laminations thereof and the method of making the laminations, and it is an object of the invention to provide improved apparatus and method of this character.

The manufacture and sale of ballasts, for example, for fluorescent lamps is very competitive and improvements resulting in savings of material or labor, however small, are eagerly sought. Accordingly, there is continual effort being made in the industry to reduce the costs of ballasts and one important effort of this nature is to form core laminations in such a manner that there is essentially no scrap iron remaining. Laminations of this character are commonly termed scrapless laminations even though some small amount of scrap, such for example, as that occurring from the rounding off of corners, the forming of guide holes and the retention of a small web of material for feeding the lamination stock into the punching machine is inevitable, although it is a very minor portion of the total lamination area. In essence, the term scrapless, as applied to laminations, means that no separate scrap pieces of material are stamped out to form the windows into which the windings are disposed. Thus, the various parts of a lamination are stamped with the parts interfitting or mating with each other along lines which ultimately form the window areas.

Scrapless laminations are well known, not only for ordinary transformers, but for the transformer portion of fluorescent lamp ballasts. However, where the transformer core has included a high reluctance magnetic shunt disposed between two windings on the core, methods for forming scrapless laminations and the resulting so-called scrapless laminations have not been completely satisfactory. Moreover, in ballast transformers, it has long been known that the shell type of core has certain advantages from the standpoint of minimizing stray magnetic fields and the efforts of the industry to develop scrapless laminations has therefore been directed to the shell type of transformer core. Accordingly, it is a further object of the invention to provide an improved scrapless lamination for a transformer core of the shell type including a high reluctance magnetic shunt to be disposed between two particular windings.

It is a further object of the invention to provide an improved ballast for starting and operating fluorescent lamps.

It is a still further object of the invention to provide an improved core for ballasts of the character indicated which is efficient in operation and economical to construct.

In carrying out the invention in one form, a lamination for a transformer core having an area for each of a pair of windings and a high reluctance shunt between such windings is provided comprising, first and second L members and a T member disposed between said L members, the L members each including a leg portion and a foot portion and the T member including a leg portion and a top portion, the leg portions of each of the L members including a wide section adjacent the foot portion and a narrow section extending from the wide section to the extremity of the leg portion, the leg portion of the T member including a wide section adjacent the top portion

and a narrow section extending from the wide section to the extremity of the leg portion, the top portion of the T member being disposed between the extremities of the narrow sections of the leg portions of the first and second L members, the extremity of the narrow section of the leg portion of the T member being disposed between the foot portions facing each other of the L members, the wide section of the leg portion of the T member having such a length and the wide sections of the legs of the first and second L members each having such a length that the extremities of the wide sections of the first and second L members overextend the extremity of the wide section of the leg portion of the T member, said overextension comprising said high reluctance shunt, and the areas between the narrow leg section of the T member and the wide leg sections of the L members forming a window for one winding and the areas between the wide leg section of the T member and the narrow leg sections of the L members forming a window for another winding.

Further objects of the invention will become apparent as the description proceeds and for a better understanding thereof, reference should now be had to the accompanying drawing, in which:

FIGURE 1 is a plan view, partially in section, of a fluorescent lamp ballast transformer incorporating the invention;

FIG. 2 is a plan view of a piece of lamination stock material showing the manner of construction of the laminations utilized in the core of FIG. 1, and

FIG. 3 is a circuit diagram illustrating one form of a fluorescent lamp ballast circuit utilizing a ballast constructed of scrapless laminations, according to the invention.

Referring to the drawings, there is shown a ballast transformer 10 comprising, a core 11, a primary winding 12, a secondary winding 13 and an auxiliary secondary winding 14, the core consisting of a series of laminations which according to the invention comprise two L-shaped pieces 15 and 16, and a T-shaped piece 17. The L-shaped piece 15 includes a side leg 18 and a foot member 19 and similarly, the L-shaped piece 16 includes a side leg 21 and a foot member 22. The T-shaped piece 17 includes a head portion 23 and a leg or central portion 24. Adjacent the foot portion 19 of piece 15, there is a widened portion 25 of side leg 18, and adjacent foot member 22 of piece 16, there is a widened portion 26 of side leg 21. The end of central leg 24 includes a portion 27 which is narrower in cross section than the main body portion of the central leg.

As may be seen in FIG. 1, the overall length of the L-shaped pieces 15 and 16 and the T piece 17 are the same. Thus, when the three pieces of a lamination are assembled together, as shown, with the head portion 23 of the T piece 17 between the extremities of the legs 18 and 21, and with the extremity of the narrow portion 27 of the central leg 24 between the foot portions 19 and 22, the various parts fit together and present the aspect of a single lamination, a stack of which together produces a shell type core as shown. The junction between the narrow portion 27 and the regular width portion of central leg 24 overextends or overlaps the widened portions 25 and 26 of the side legs 18 and 21 respectively, and the overlapped or overextended portions thereby form magnetic shunts disposed between the primary winding 12 and the secondary winding 14. The length of head portion 23 between legs 18 and 21 and the width of narrow portion 27 are chosen, as will become apparent subsequently in this specification, so that non-magnetic gaps, for example, air gaps 28 and 29 are formed as portions of the shunt member.

Referring to FIG. 3, a schematic circuit diagram is shown illustrating one form of electrical connection utiliz-

ing the ballast transformer illustrated in FIG. 1. In this figure, the windings 12, 13 and 14 are shown connected in circuit with a pair of fluorescent lamps 31 and 32, together with certain other circuit components and connections. Also, as shown in FIG. 3, the primary winding 12 may be excited from a suitable source of voltage (120 volts at 60 cycles) available at conductors 33 and 34, the exciting circuit being traced as follows: from conductor 33 through the pin 35 at one end of lamp 31 forming part of a lamp disconnect arrangement, conductor 36, primary winding 12, conductors 37 and 38, pin 39 at one end of lamp 32 forming part of a disconnect arrangement, and to conductor 34.

The primary winding 12 when energized, produces voltages in windings 13 and 14, as is well understood. The shunt members including the non-magnetic gaps 28 and 29 (FIG. 1) between primary winding 12 and auxiliary secondary winding 14 produces a high leakage reactance for winding 14. Similarly, the relatively long windings 12 and 13 disposed side by side, as shown, on central leg 24, results in these windings having relatively high leakage reactances, although not so large as that for secondary winding 14.

The operating circuit for lamps 31 and 32 may be traced as follows: from pin 35 connected to conductors 33 and 36, through lamp 31, capacitor 40, conductor 41, secondary winding 13, pin 42 of fluorescent lamp 32, and through fluorescent lamp 32 to pin 39 connected to conductors 34 and 38. Connected from the juncture of conductors 37 and 38 to conductor 41 is the auxiliary secondary winding 14.

When the circuit as described is energized at conductors 33 and 34, the voltages of primary winding 12 and auxiliary secondary winding 14 combine to strike fluorescent lamp 31, and after lamp 31 has struck; the combined voltages of secondary windings 13 and 14 are sufficient to strike fluorescent lamp 32.

The capacitor 40 in the operating circuit produces a desired high flux density in the secondary portions of the core, thereby producing high input power factor and efficient operation, as is well understood in this art. A bleeder resistor 43 may be connected across capacitor 40 for discharging it when the ballast is not in operation and a radio interference eliminating capacitor 44 may be connected across primary winding 12.

The slots 57 and 58 assist in improving lamp current wave shape under operating conditions and reducing lamp flicker.

The lamination construction and the transformer core as shown in FIG. 1 has a reduced cross-sectional area of the central leg portion 27. The cross section of the central leg portion 27, as thus shown, enables a winding 14 having a substantially shorter mean length of turn to be used whereby a winding utilizing substantially less copper is produced, compared, for example, to a winding of the same number of turns and wire size wound upon a core of the cross section of the adjacent enlarged portion of central leg 24. Such a winding 14 of shorter mean turn length and having the required number of turns will, of course, have a smaller amount of copper and thus will produce less heat during operation and be less expensive to make. In addition, the enlarged portions of the core formed by the widened portions 25 and 26 of the lamination pieces form a heat sink or heat storage component so that the operating temperature rise of the ballast is thereby reduced. Two advantages are thus achieved by the described construction, namely, an increased heat storage capacity and a smaller winding.

Referring to FIG. 2, there is shown a strip of lamination stock material 45 which can be considered to be moving in the direction of the arrow A during the lamination stamping process, the feed of the stock material being effected, for example, by means of a narrow web of stock (not illustrated) extending along each side. In FIG. 2,

the reference characters applied to the various parts are the same as those applied to corresponding parts in FIG. 1 and thus the interfitting or mating of the lamination pieces may be readily seen. Thus it may be seen that the L-shaped pieces 15 and 16 lie directly along the T-shaped piece 17 as along lines 51, 52, 53 and 54, etc. The portion 27 of decreased width of the central leg 24 corresponds, in severing lines and position, directly to the widened portions 25 and 26 of the side legs 18 and 21. The two lines 51 and 53 which form the sides of the enlarged portion of the central leg 24 and the lines 52 and 54 which form the dimensions of its reduced portion 27 are the same lines forming the inside edges of side legs 18 and 21 including the widened portions 25 and 26. The two parallel lines 51 and 52 and the line 59 connecting them forming the punching boundary between the side leg 18 including its wide portion 25 and the central leg 24 including its narrow portion 27, and the two lines 53 and 54 and the line 61 connecting them forming the punching boundary between the side leg 21 including its wide portion 26 and the central leg including its narrow portion 27 result in providing the window spaces for the windings as well as providing for the shunt member when the lamination pieces are moved to their final positions as will become clear. The foot portions 19 and 22 are of such dimensions, thereby also determining the dimensions of the small scrap piece 46, and the transverse dimension of the head portion 23 is such, thereby determining the dimensions of the scrap pieces 47 and 48, that when the L-shaped pieces 15 and 16 are moved apart and the T-shaped piece is moved toward the left the interfitting, as shown, in FIG. 1 comes about and the air gaps 28 and 29 are provided for as well as the window spaces for the windings 12, 13 and 14. L-shaped pieces 15 are severed from adjoining L-shaped pieces 16 along lines 55 and 56 in the punching process.

The dimensions, taken in the direction of the arrow A of scrap portions 46, 47 and 48, vary depending upon the transverse dimensions of the windows as well as the dimensions of the air gaps 28 and 29. The longitudinal dimension of the head portion 23, as shown, is greater than the longitudinal dimension of the foot portions 19 and 22, and this produces a small piece of scrap 49. Appropriate choice of dimensions for some desired constructions can, of course, eliminate the scrap pieces 46 and 49, and eliminate or reduce the size of scrap pieces 47 and 48.

As shown, each of the L-shaped pieces includes corner cut-out pieces 62, 63, 64 and 65, for receiving a clamp for holding the core laminations together in the final construction and this results in certain small pieces of scrap material. The pieces 62, 63, 64 and 65 of scrap material are small and do not represent any significant percentage of the lamination stock material, and with some manufacturing and assembly techniques which can be used, the corner scrap pieces would be eliminated.

The particular point to be borne in mind is that the window space occupied by windings 12, 13 and 14 is achieved by punching the T-shaped piece from the L-shaped pieces in a mating fashion following which the pieces are appropriately shifted to provide the final lamination arrangement.

While the invention as shown and described is in connection with fluorescent lamps, it will be understood that this is exemplary only and other discharge devices may be used in connection therewith.

While a particular embodiment of the invention has been shown, it will be understood, of course, that the invention is not limited thereto since many modifications may be made, and it is, therefore, contemplated by the appended claims to cover any such modifications as fall within the true spirit and scope of the invention.

5

The invention having thus been described, what is claimed and desired to be secured by Letters Patent is:

1. A lamination for a transformer core having an area for each of two windings and a high reluctance shunt between such windings comprising, first and second L members, said L members each including a leg portion and a foot portion and said T member including a leg portion and a head portion, the leg portions of each of said L members including a wide section adjacent the foot portion and a narrow section extending from the wide section to the extremity of the leg portion, the leg portion of said T member including a wide section adjacent the head portion and a narrow section extending from the wide section to the extremity of the leg portion, the head portion of said T member being disposed between the extremities of the narrow sections of the leg portions of said first and second L members, the extremity of the narrow section of the leg portion of said T member being disposed between the foot portions facing each other of said L members, the wide section of the leg portion of said T member having such a length and the wide sections of the legs of said first and second L members each having such a length that the extremities of said wide sections of said first and second L members overextend the extremity of the wide section of the leg portion of said T member, said overextension comprising said high reluctance shunt, and the areas between the narrow leg section of said T member and the wide leg sections of said L members forming a window for one winding and the areas between the wide leg section of said T member and the narrow leg sections of said L members forming a window for another winding.

2. A lamination for a transformer core having an area for each of two windings and a high reluctance shunt between such windings comprising, first and second L members and a T member disposed between said L members, said L members each including a leg portion and a foot portion and said T member including a leg portion and a head portion, the leg portions of each of said L members including a wide section adjacent the foot portion and a narrow section extending from the wide section to the extremity of the leg portion, the leg portion of said T member including a wide section adjacent the head portion and a narrow section extending from the wide section to the extremity of the leg portion, the head portion of said T member being disposed between the extremities of the narrow sections of the leg portions of said first and second L members, the extremity of the narrow section of the leg portion of said T member being disposed between the foot portions facing each other of said L members, the wide section of the leg portion of said T member having such a length and the wide sections of the legs of said first and second L members each having such a length that the extremities of said wide sections of said first and second L members overextend the extremity of the wide section of the leg portion of said T member, said overextension comprising said high reluctance shunt, the length of said head portion and the length of said foot portions being such relative to the width of the narrow section of the leg portion of said L members portion and the width of the wide section of the leg portions of said L members for defining a non magnetic gap in said high reluctance shunt, and the areas between the narrow leg section of said T member and the wide leg sections of said L members forming a window for one winding and the areas between the wide leg section of said T member and the narrow leg sections of said L members forming a window for another winding.

3. In a ballast construction, for starting and operating gaseous discharge devices, including a shell type core having a central leg and an outer leg on each side of said central leg, a primary winding disposed on one portion of said central leg, a secondary winding disposed on another portion of said central leg and a high reluctance

6

shunt disposed between said windings; the improvement which comprises, said other portion of said central leg having a reduced cross-sectional area relative to said one portion, the portions of said outer legs associated with said secondary winding having an increased cross-sectional area relative to the portion of said outer legs associated with said primary winding, and said one portion of said central leg and the increased cross-sectional area portions of said outer legs overextending each other to form said shunt.

4. In a ballast construction, for starting and operating two gaseous discharge devices, including a shell type core having a central leg and an outer leg on each side of said central leg, a primary winding disposed on one portion of said central leg, a first secondary winding disposed on said one portion of said central leg alongside said primary winding, a second secondary winding disposed on another portion of said central leg, a high reluctance shunt disposed between said primary and said second secondary windings, circuit means for connecting such two discharge devices, said primary winding and said first secondary winding in a series operating circuit and circuit means for connecting said second secondary winding in a starting circuit with such discharge devices for starting thereof; the improvement which comprises, said other portion of said central leg having a reduced cross-sectional area relative to said one portion, and the portion of said outer legs associated with said second secondary winding having an increased cross-sectional area relative to the portion of said outer legs associated with said primary winding, and said one portion of said central leg and the increased cross-sectional area portions of said outer legs overextending each other to form said shunt.

5. In a ballast construction, for starting and operating gaseous discharge devices, including a shell type core having a central leg and an outer leg on each side of said central leg, a primary winding disposed on one portion of said central leg, and a secondary winding disposed on another portion of said central leg; the improvement which comprises, said other portion of said central leg having a reduced cross-sectional area relative to said one portion, and the secondary winding disposed on said other portion of said central leg having a reduced mean length of turn as compared with that of the primary winding disposed on said one portion of said central leg.

6. In a ballast construction, for starting and operating gaseous discharge devices, including a shell type core having a central leg and an outer leg on each side of said central leg, a primary winding disposed on one portion of said central leg and a secondary winding disposed on another portion of said central leg; the improvement which comprises, said other portion of said central leg having a reduced cross-sectional area relative to said one portion, the portions of said outer legs associated with said secondary winding having an increased cross-sectional area relative to the portion of said outer legs associated with said primary winding, and the secondary winding disposed on said other portion of said central leg having a reduced mean length of turn as compared with that of the primary winding disposed on said one portion of said central leg.

7. In a ballast construction, for starting and operating gaseous discharge devices, including a shell type core having a central leg and an outer leg on each side of said central leg, a primary winding disposed on one portion of said central leg, a secondary winding disposed on another portion of said central leg and a high reluctance shunt disposed between said windings; the improvement which comprises, said other portion of said central leg having a reduced cross-sectional area relative to said one portion, the portions of said outer legs associated with said secondary winding having an increased cross-sectional area relative to the portion of said outer legs associated with said primary winding, said one portion of said central leg

and the increased cross-sectional area portions of said
outer legs overextending each other to form said shunt,
and the secondary winding disposed on said other portion
of said central leg having a reduced mean length of turn
as compared with that of the primary winding disposed
on said one portion of said central leg.

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