

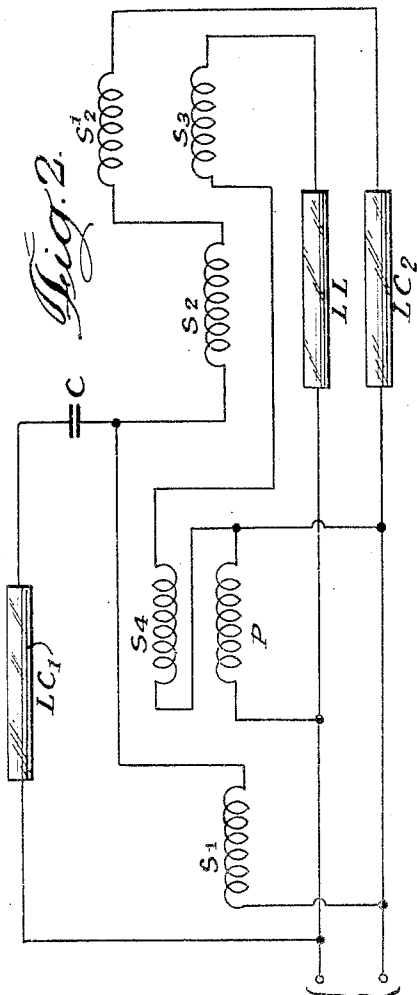
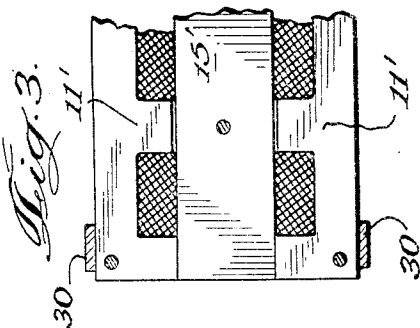
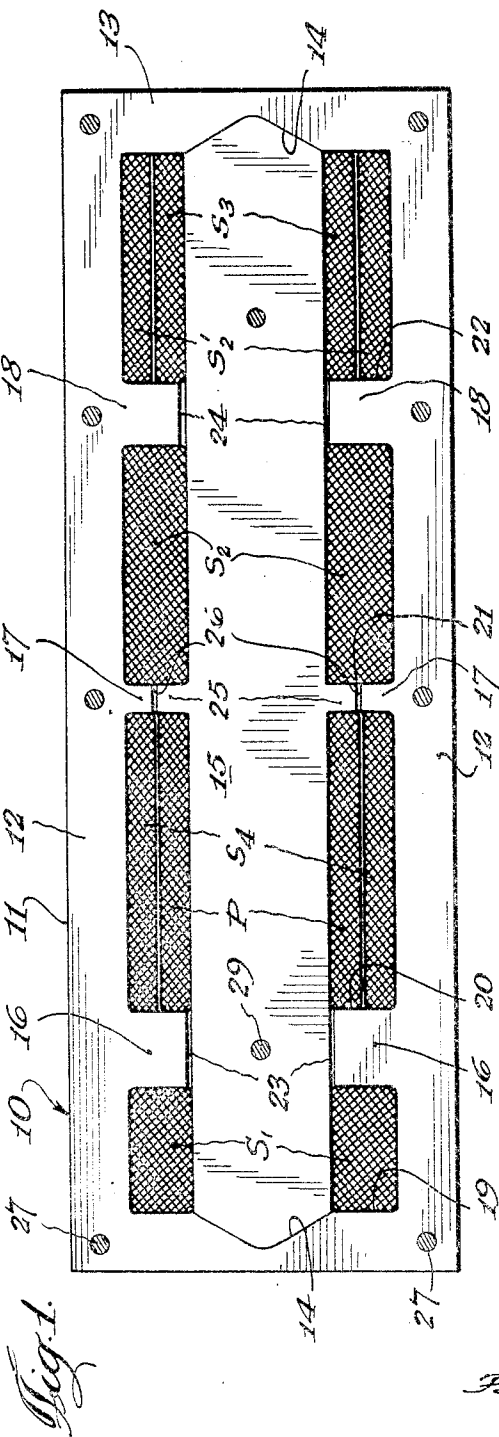
May 24, 1955

A. E. FEINBERG

2,709,231

CONSTRUCTION FOR TRANSFORMER

Filed Jan. 21, 1952



Inventor
Albert E. Feinberg
By J. L. Silverman
Attorney

1

2,709,231

CONSTRUCTION FOR TRANSFORMER

Albert E. Feinberg, Chicago, Ill.

Application January 21, 1952, Serial No. 267,350

5 Claims. (Cl. 315—138)

This invention relates generally to transformers and more particularly is concerned with a novel transformer for use as a ballast, functioning to provide the ignition voltage for a plurality of gaseous discharge devices connected in circuit therewith, and, after ignition of the said devices, to provide the operating voltages for the said devices.

The instant invention principally relates to the particular construction of transformer core for use in connection with certain apparatus claimed and described in a co-pending application, filed jointly by the applicant herein and Paul Berger, filed May 5, 1950, Serial No. 160,366, entitled "Apparatus for Igniting and Operating Gaseous Discharge Devices." To that extent this application is a continuation-in-part of the said co-pending application. The core construction generally referred to, but not claimed in the said co-pending application, is the sole invention of the applicant herein.

The principal object of the invention is to provide a novel transformer core having a single magnetic circuit with suitable flux paths and shunts to be associated with a circuit for igniting and thereafter operating a plurality of gaseous discharge devices.

Other objects of the invention lie in the provision of a transformer core of great simplicity, economy, and efficiency, and one which will provide a good wave shape to current flowing through the gaseous discharge devices.

Many other objects will occur to those skilled in the art to which the invention appertains as the description thereof proceeds in connection with which there has been illustrated and described a preferred embodiment.

In the drawing:

Fig. 1 is a plan view of the transformer of the invention, the windings thereof being shown schematically and in proper association therewith.

Fig. 2 is a diagrammatic view of a circuit suitable for use with the transformer.

Fig. 3 is a fragmentary view of a portion of a modified form of the invention.

The invention rests in the combining of cores for a plurality of gaseous discharge devices, and providing a core which is smaller, more compact, and easier to manufacture than would be the cores for apparatus for a plurality of gaseous discharge devices, were said cores made in the conventional manner. Thus, for a four device circuit, it has been customary to provide two transformer cores with two magnetic circuits, and the attendant expense and weight. For a three device circuit, the practice has been to provide two transformers also.

The reference character 10 designates generally the transformer of the invention herein. Same comprises an outer rectangular shell 11 having an elongate formation formed with parallel long sides 12, and bridging end portions 13. The end portions 13 are provided with seating recesses 14 to receive the mating ends of the central winding leg 15. The central winding leg is intended to have the various windings mounted thereon and then is assembled by being forced into the shell 11.

2

The long sides 12 each have inwardly extending lugs 16, 17, and 18 which are to form magnetic shunts between windings and thereby provide winding windows 19, 20, 21, and 22. The lugs 16 and 18 each terminate short of the sides of the central winding leg 15 to form non-magnetic gaps 23 and 24. The lugs 17, however, are about half as short as the others, and the sides of the winding leg 15 are provided with integrally formed extensions 25 which meet the shortened lugs 17 to form the non-magnetic gaps 26 thereat. This aids in positioning windings on leg 15.

It will be seen throughout that the amount of steel used in the transformer 10 is a minimum. The view of Fig. 1 shows the outline of a single lamination, the transformer core is formed by stacking a number of laminations in a manner well known and fastening same together by rivets 27. The winding leg 15 is also formed of a stack of laminations riveted together by rivets 29. In the fabrication of the laminations, the winding leg laminations are the punched out centers of the shell laminations, the gaps being formed by shaving.

The identical transformer described can be formed in a slightly different manner as shown in Fig. 3 by providing a central winding leg 15' which is rectangular and extends the entire length of the ballast. The outer shell 11 is replaced by a pair of inwardly directed core members 11' which are identical in configuration to the upper and lower portions of the shell 11. The same shunts, windows, and gaps are formed in the resulting core, and the core is held in assembly by any suitable means such as clamping members symbolically illustrated at 30.

The circuit which is suitable for use with the transformer cores 10 or 10' is illustrated schematically in Fig. 2. The primary P is energized from an A. C. line 31. The primary P serves two separate and distinct circuits, but the circuits all use the same magnetic core and cooperate to provide good power factor and wave shape.

One circuit can be described as a seriatim starting series operating, leading circuit. It ignites and operates the lead lamps LC₁ and LC₂. The other circuit could be also a seriatim starting, series operating circuit of a type illustrated in said co-pending application above referred to, but here is a simple connection of a lamp LL adapted to be ignited and operated by an auto-transformer arrangement. Since the transformer or ballast which normally would be used in igniting and operating even a single lamp would be about the same size and weight as one which would serve two lamps, it is immaterial whether this invention eliminates the one or the other. The saving is just as great. The transformer core of the invention has been found ideally suited for use with the particular circuit illustrated.

The first sub-circuit comprises the primary P cooperating with the windings S₁, S₂, and S₂'. Note that windings P, S₁, S₂, and S₂' are connected end to end in the order named, that the lamp LC₁ and a series condenser C are connected across S₁ and P together, while the second lamp LC₂ is connected across the three secondaries together. S₁ is a winding of fine wire and many turns, and is considered the auxiliary starting secondary. It is a high leakage reactance winding, and in order to develop such leakage reactance, it is placed in the window 19, separated from the remainder of the transformer by the shunt formed of lugs 16 and gaps 23. It and the primary P, which is placed in window 20, develop sufficient voltage during starting to ignite the lamp LC₁. When current flows there is a component of voltage developed in S₁ which combines with S₂ to ignite lamp LC₂. Since the coupling between S₂ and P is necessarily loose, but not as loose as that between S₁ and P the shunt formed by lugs 17 and gaps 26 cooperating with extensions 25 is not as

great as the shunt formed by lugs 16. S₂ is positioned in window 21.

In order to prevent saturation in the core, and to assure that both lamps of the leading circuit will be balanced, a part of the winding S₂' is wound on window 22 in bucking arrangement with winding S₂. The winding S₂' is influenced flux-wise by the winding S₃, but no voltages required for igniting or operating the lead lamps are obtained from S₃.

When both lead lamps LC₁ and LC₂ are operating, current principally flows through the secondary S₂ and its bucking winding S₂', the lamps and the condenser C, by-passing winding S₁.

As for the second, or lag sub-circuit, it ignites by virtue of voltages developed in the primary P, an auto-transformer winding S₄ closely coupled and consequently wound in the same window as P, and the voltage of the winding S₃. The lamp LL being ignited, there is sufficient leakage reactance by virtue of the shunt formed by lugs 18 and gaps 24 to ballast lamp LL. Note that windings S₃ and S₂' are together mounted in window 22, and that the bucking effect of winding S₂' is achieved by virtue of close coupling with winding S₃.

Both sub-circuits are energized simultaneously and hence commence their ignition and operation together, although there is a definite order in the ignition of lamps LC₁ and LC₂.

I desire to point out that a commercial embodiment of the invention has been constructed of a stack of laminations one and one-eighth inches high for use with a circuit, the physical details of which are set forth in the said co-pending application. As for the dimensions of the core 11, the drawing as illustrated herein has been drawn in the proper proportions. Hence one dimension will enable all to be determined. The width of the core may be taken as three and one sixteenth inches. The gaps for this particular transformer, which was designed to be used with three 40 watt lamps, of the high voltage instant start variety, were: 23—.025 inch, 26—.030 inch, and 24—.020 inch.

Attention is invited to the narrow shunt between the two center windows. This shunt has been found advantageous in providing good wave shape to the lamp currents by decreasing the flux density in the core in the vicinity of winding S₂. In other words, not all of the flux developed in the primary P will thread the core in the vicinity of S₂, but a good deal will leak back by way of the shunt.

It is believed that no further explanation of the invention is required to enable those skilled in the art to which same appertains to understand the same and to construct the same. Variations are possible without departing from the spirit of the invention as defined in the appended claims.

I claim:

1. An elongate four window transformer core, comprising a rectangular unitary shell having elongate sides, bridging ends, recesses at the opposite ends, and a central winding leg having mating ends received in said recesses in magnetic direct connection therewith, three projections formed on each of the elongate sides and extending towards the central winding leg and terminating short thereof to form non-magnetic gaps, the projections on one side being aligned respectively with those on the other side and combining therewith and with the central leg and gaps to form magnetic shunts providing thereby four windows along the core, half of each window being on opposite sides of the central winding leg, the central shunt having a cross sectional area substantially less than the cross sectional area of either of the other shunts whereby the coupling between windings carried in the

center two windows of the core will be closer than the coupling between either of the two center windings and windings in their next adjacent window, the shell providing only a single magnetic loop of relatively low reluctance along its entire length and ends for flux originating in the vicinity of one only of said center windows.

2. A transformer core as described in claim 1 in which the central shunt includes an extension on opposite sides of the central winding leg, and the projections meeting said extensions are shorter than the other projections whereby to aid in the positioning of windings upon said center leg.

3. A system for igniting and operating gaseous discharge devices from a source of A. C. power of voltage lower than the igniting voltages of any of said devices which comprises, a unitary iron core of elongate construction and providing only a single magnetic circuit, a transformer mounted on said core for energizing two sub-circuits, one sub-circuit drawing leading current from said source, and the second sub-circuit drawing lagging current from said source, a common primary winding serving both sub-circuits and having a pair of terminals, with leads connected from the source to the terminals; the first sub-circuit comprising a first secondary winding on one end of the core and having shunt means spacing same from the primary winding, and a second secondary winding on the core on the side of the primary winding opposite the first secondary winding and closer coupled to the primary winding than the first secondary winding, the first and second secondaries being in voltage bucking relationship, a condenser, the first secondary winding having one side connected to one of said terminals, and having its second side connected to one side of the second secondary winding to form a juncture therewith, a first gaseous discharge device in series with the condenser and together therewith connected from said juncture to one of said terminals, and a second gaseous discharge device connected from the second side of said second secondary to the other of said terminals, said second sub-circuit comprising a third secondary winding, a fourth secondary winding and a third gaseous discharge device all in series, the third and fourth secondary windings connected in auto-transformer relation to said primary winding with the third secondary winding tightly coupled to the primary winding, and the fourth secondary winding mounted on the core with shunt means separating same from the other windings of said transformer, the secondaries all being energized by the same flux and said flux being produced by said primary winding.

4. A system as described in claim 3 in which the third gaseous discharge device and series condenser are connected across the primary and first secondary windings while the second gaseous discharge device is connected across both first and second secondaries.

5. A system as described in claim 4 in which there is a fifth secondary winding in series with said second secondary winding and electrically connected as though a part thereof, and arranged on said core closely coupled with the said fourth secondary winding but in bucking voltage relation thereto.

References Cited in the file of this patent

UNITED STATES PATENTS

931,114	Conrad	Aug. 17, 1909
2,317,844	Boucher et al.	Apr. 27, 1943
2,346,621	Sola	Apr. 11, 1944
2,461,029	Boucher et al.	Feb. 8, 1949

FOREIGN PATENTS

599,802	Great Britain	Mar. 22, 1948
---------	---------------	---------------