

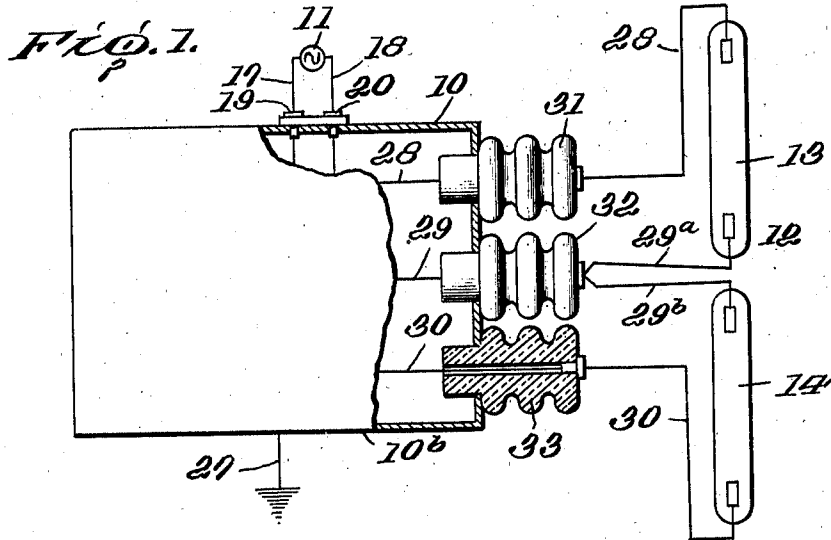
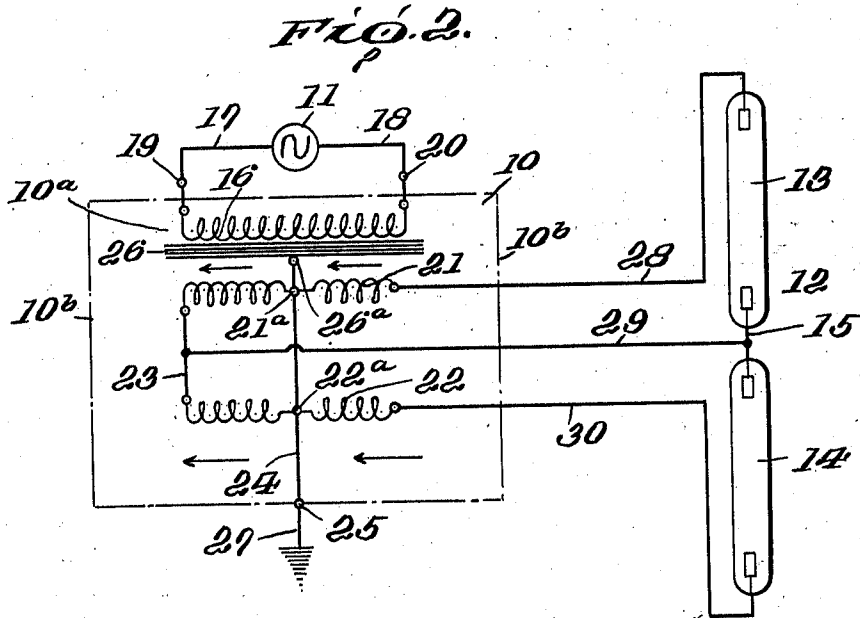
Feb. 13, 1940.

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2,190,010

LUMINESCENT TUBE SYSTEM AND APPARATUS

Filed June 7, 1937



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2,190,010

LUMINESCENT TUBE SYSTEM AND APPARATUS

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Application June 7, 1937, Serial No. 146,907

5 Claims. (Cl. 176—124)

My invention relates to luminescent tube systems and apparatus, and more particularly concerns systems and apparatus employed in the operation of a plurality of gaseous discharge tubes.

One of the objects of my invention is the production of a simple, economical, thoroughly practical and highly efficient system and apparatus of the character described.

Another object is to effect, in such a luminescent tube system, a direct saving in apparatus employed in the energization of a given length of a gaseous discharge tubing.

Another object is to produce, in a luminescent tube system of the character indicated, uniform and balanced operation under the various conditions encountered in actual practical use.

Still another object is the realization of electrical transformer apparatus designed to effect certain economies in construction and installation over heretofore known apparatus.

Other objects will be obvious in part, and in part pointed out hereinafter.

The invention accordingly consists in the combination of elements, features of construction and arrangement of parts as described herein, the scope of the application of which is indicated in the following claims.

In the accompanying drawing:

Figure 1 is a representation of a luminescent tube system and apparatus embodying certain features of my invention in which certain parts are broken away to more clearly disclose others, and

Figure 2 is a diagrammatic representation of the system and apparatus represented in Figure 1.

Like reference characters denote like parts throughout the several views of the drawing.

As conducive to a clearer understanding of certain features of my invention it is to be noted at this point that, in order to operate a maximum length of gaseous discharge tubing at potentials within the values established by the fire underwriters, the secondary winding of the transformer apparatus is grounded at a mid-point. While the potentials to ground, in both the transformer and in its load circuit, are maintained within the permissible values, the potential supplied the gaseous discharge tube amounts to twice the value to ground, thereby permitting a double length of tubing. Although certain savings and economies are realized in this manner, it is to be noted that for each full length of luminescent tubing there are required two high potential supply leads

from transformer to tube. In addition, there are required in the construction of the transformer, two high potential terminals and associated insulated bushings. It is apparent that the mere use of electrical transformer apparatus, in which the mid-point of the secondary winding is grounded, does not solve the problem of properly insulating the output leads; that is, those leads which convey the electrical energy outside of the transformer housing to the gaseous discharge tubes. The proper insulation of such leads always is an expensive and difficult problem.

An object of my invention, therefore, is to effect a substantial economy in the construction of such a gaseous discharge tube system. A further object is to reduce in such systems and apparatus the number of high-tension terminals which must be provided in connection with the operation of the transformer employed.

Now referring more particularly to the practice of my invention, attention is directed to the accompanying drawing wherein electrical transformer apparatus, generally indicated at 10, excited from a standard source of single phase alternating current electrical energy at, say 110 volts, 60 cycles, designated 11, supplies a luminescent display indicated at 12. Preferably the transformer apparatus is of the high leakage reactance type as described in my copending application, Serial Number 41,476, filed September 20, 1935, entitled Electrical transformer apparatus. The transformer includes a casing conveniently fashioned of iron sheet.

Luminescent tube display 12 comprises two gaseous discharge tubes 13 and 14, each rated at, say, 15,000 volts and 15 milli-amperes. These tubes preferably are of like ratings and comprise a pair. It will be understood, of course, that where desired each of 13 and 14 may comprise a series of individual tubes. Tubes 13 and 14 are connected together by way of conductor 15, placing the adjoining ends at a common potential. Electrical transformer 10 comprises an iron core generally indicated at 26, upon which is mounted a low-tension primary winding 16, excited by alternating current electrical energy from source of supply, 11. Primary winding 16 is connected to the source of supply by the two conductors 17 and 18. Conveniently, conductors 17 and 18 are connected to the winding 16 by means of outside terminals 19 and 20.

The transformer also includes a plurality of secondary windings. Illustratively, there are employed the two secondary windings 21 and 22, preferably comprising a pair. These two wind-

ings are connected together by way of conductor 23 in an opposed phased relationship. Their induced electro-motive forces buck each other as diagrammatically illustrated in Figure 2 of the drawing. For the instant of time represented, the electro-motive forces, induced in windings 21 and 22, are toward each other as illustrated by the arrows placed adjacent the windings. A common current, therefore, does not flow in these windings.

In order that maximum output potential may be available at a permissible potential to ground, each of secondary windings 21 and 22 is grounded at its mid-point. Conveniently the mid-points, 22 and 22a, of the windings are connected together by conductor 24 which in turn is connected to transformer casing 10b as at 25, and transformer core 26 as at 26a. The transformer casing is connected to ground as generally indicated at 27.

Energization of tube 13 is had through transformer secondary winding 21 by way of conductors 28 and 29 and intervening high potential terminals 31 and 33 respectively. Similarly, tube 14 is supplied with alternating current electrical energy at high potential by transformer secondary winding 22 using conductors 30 and 29 and intervening high potential terminals 33 and 32. The several terminals are secured in one or more walls of the transformer casing 10b in any suitable manner. It is to be particularly noted that conductor 29 serves as a common supply conductor for both tubes. Also it is to be noted that terminal 32 is common to both secondary windings. The conductor and the terminal must accommodate a current equal to twice that of conductors 28 and 30 and either of terminals 31 and 33.

The near ends of secondary windings 21 and 22 are seen to be of like polarities. For an assumed instant, with electromotive forces established in secondary windings 21 and 22 from right to left as seen in the drawing and as illustrated by arrows, current from winding 21 flows through conductors 23, 29 and 15 to tube 13 and by way of conductor 25 back to the winding to complete the circuit. At the same time current from winding 22 flows through conductors 23, 29 and 15 to tube 14, and by way of conductor 26 back to this winding to complete the circuit.

Of course, where desired, see Figure 1, conductor 29 externally of the transformer may comprise individual parallel conductors 29a and 29b connected respectively to tubes 13 and 14. In such a case then, external conductors all are of the same current-carrying capacity. Internal conductor 29 and terminal 32, however, are of double this capacity, as above noted, since they carry the current of both secondary windings. As a practical matter, however, since the magnitude of the current is but slight, all terminals and conductors are of like size and ratings, all being more than sufficient to handle the maximum current to be encountered.

It is to be particularly noted at this point that by virtue of common conductor 29, there are required only three high potential terminal members 21, 32 and 33, see Figure 1. This effects a saving of twenty-five per cent in this costly item of expense. In addition, the use of three instead of a customary four terminal construction permits a more compact unit in which all of the high-tension terminal members are located on a common side of the transformer. This is particularly advantageous in assuring an

ease of connecting the transformer apparatus to the luminescent tube system. While such construction may be preferred, it will be understood that where desired these terminals may be located on different sides of the transformer casing.

Of particular importance it is to be noted that my novel system and apparatus presents a balanced construction. In operation, under normal conditions, substantially no circulatory or ground current flows. This construction, therefore, permits high operating efficiency with a minimum of loss. In addition, uniform and corresponding brilliance is assured in the luminescent tubes employed. This is especially important when the tubes are included in a large display where uniformity is required.

As an added precaution against damage under short-circuit operating conditions, as by grounding of any one or more of conductors 28, 29 and 30, the current-carrying capacities of the halves of secondary windings 21 and 22, connected between the supply conductors 28 and 30 at grounded mid-points 21a and 22a, conveniently are somewhat greater than those of the other halves of these windings. While the halves connected to conductors 28 and 30 may have a current-carrying capacity of 30 milli-amperes, the halves connected to common conductors 23 and 29 need only have a current-carrying capacity of 25 milli-amperes. The secondary windings 21 and 22 are of like voltage ratings. The precaution indicated merely permits the handling of a ground current under short-circuit conditions without damage to the secondary windings. Under ordinary operating conditions balanced operation is had and no special use is made of this additional feature. Therefore, when desired, each secondary winding may be constructed with identical coil sections comprising each half.

Thus it will be seen that there has been provided in my invention a luminescent tube system and apparatus in which the objects hereinbefore noted, together with many thoroughly practical advantages, are successfully achieved. The system and apparatus presents a certain symmetry in construction and operation which assures a balanced operation with a minimum of extraneous currents and consequent losses.

It will be seen that in the transformer apparatus, a real and distinct saving is effected, in combination with apparatus permitting an ease of handling and installation not realized in the prior art.

As many possible embodiments may be made of my invention, and as many changes may be made in the embodiment hereinbefore set forth, it will be understood that all matter described herein, or shown in the accompanying drawing, is to be interpreted as illustrative, and not in a limiting sense.

I claim:

1. In luminescent tube systems and apparatus of the character described, in combination, a plurality of luminescent tubes, having their one ends connected together, an electrical transformer for energizing said tubes comprising a plurality of secondary windings corresponding in number to said plurality of luminescent tubes having their mid-portions grounded and having their ends of corresponding polarities connected together, conductor means interconnecting the common ends of said windings and the common ends of said luminescent tubes, and individual means interconnecting the other ends of said

windings and the free ends of said luminescent tubes.

2. In luminescent tube systems and apparatus of the character described, in combination, a plurality of luminescent tubes, having their one ends connected together, an encased electrical transformer for energizing said tubes comprising a plurality of secondary windings equal in number to said plurality of luminescent tubes having their mid-portions grounded to the transformer casing and having their ends of corresponding polarities connected together, conductor means, including a high potential terminal member having an insulating bushing positioned in a wall of said transformer casing, interconnecting the common ends of said windings and the common ends of said luminescent tubes, and individual means, including a like number of high potential terminal members each having an insulating bushing positioned within a wall of said casing, interconnecting the other ends of said windings and the free ends of said luminescent tubes.

3. In luminescent tube systems and apparatus of the character described, in combination, a pair of luminescent tubes, having their one ends connected together, an electrical transformer for energizing said tubes comprising a pair of secondary windings having their mid-portions grounded and having their ends of corresponding polarities connected together, single conductor means interconnecting the common ends of said windings and the common ends of said luminescent tubes,

and individual means interconnecting the other ends of said windings and the free ends of said luminescent tubes.

4. In transformer apparatus of the character described, in combination, an electrical transformer including a plurality of secondary windings having their one ends connected together, a casing for said transformer, and a plurality of high potential terminals positioned within the walls of said casing and adapted to conduct high potential electrical energy from said transformer to an external load, one of said terminals being connected to the common interconnected ends of said secondary windings and the others of said terminals being connected to the free ends of said secondary windings.

5. In transformer apparatus of the character described, in combination, a transformer casing, an electrical transformer positioned within said casing and including a pair of secondary windings having their mid-points connected to said casing and their one ends of like polarity connected together, and three high potential terminals mounted within the walls of said casing and adapted to conduct electrical energy from said transformer to a pair of external loads, one of said terminals being connected to the common interconnected ends of said secondary windings and the other two of said terminals being connected to the free ends of said secondary windings.

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