T. E. BARNUM.

TRANSFORMER.

APPLICATION FILED MAY 15, 1911.

1,098,549.

Patented June 2, 1914.

2 SHEETS—SHEET 1.

Fig. 1.

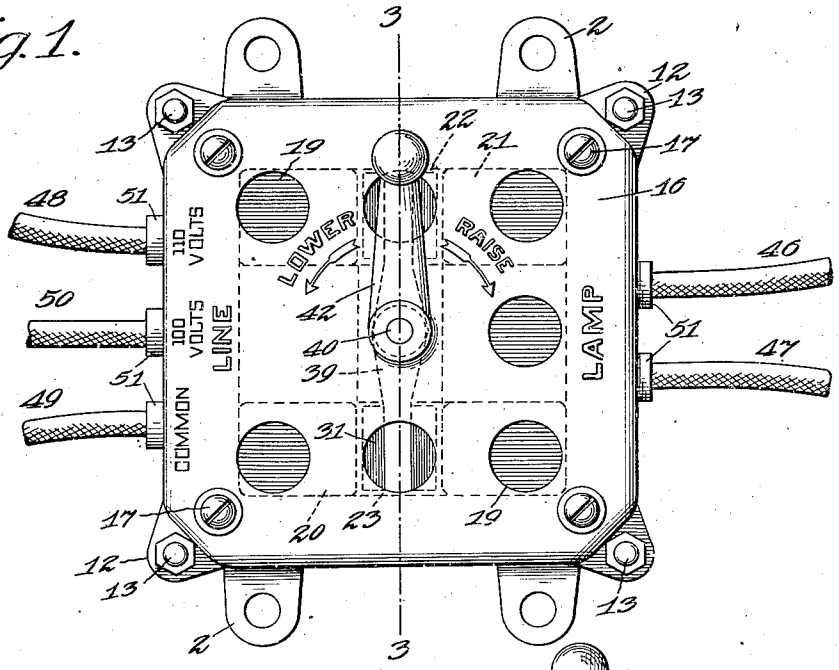
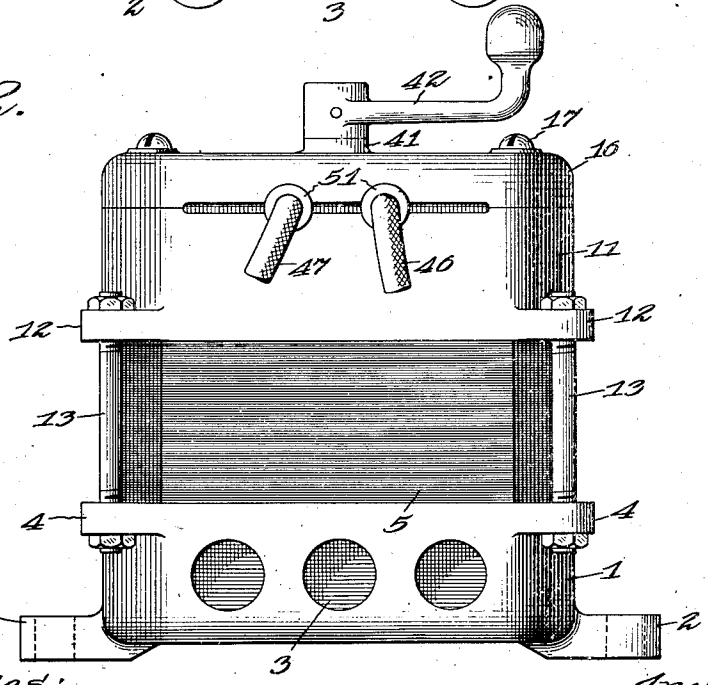


Fig. 2.



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2 SHEETS—SHEET 2.

Fig. 3.

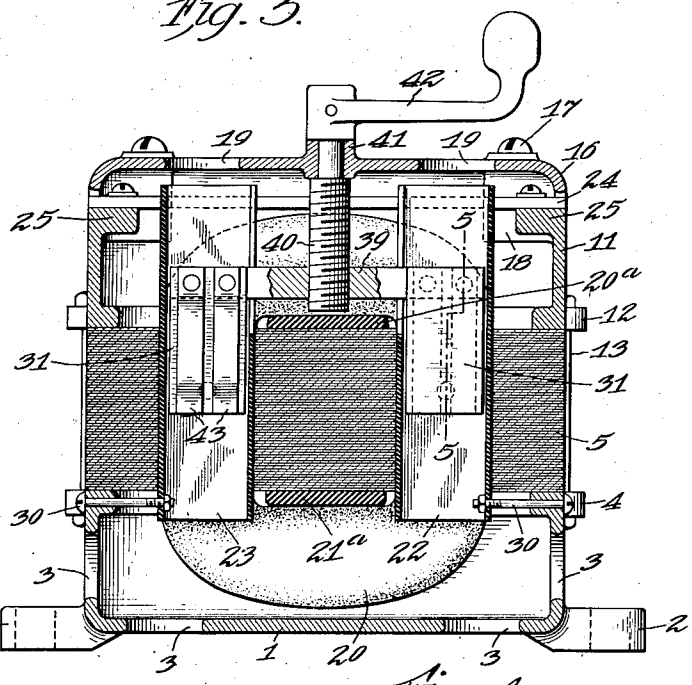


Fig. 4.

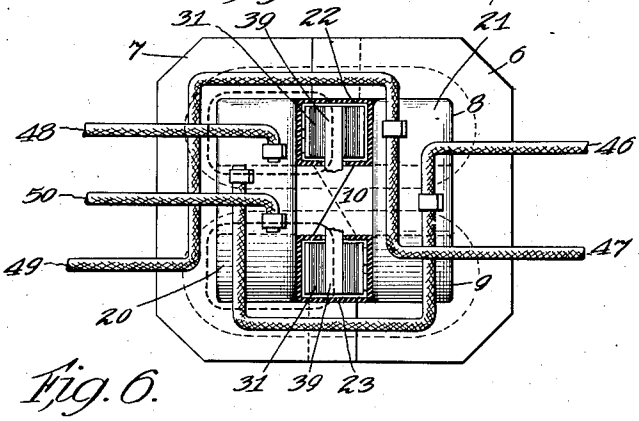


Fig. 5.

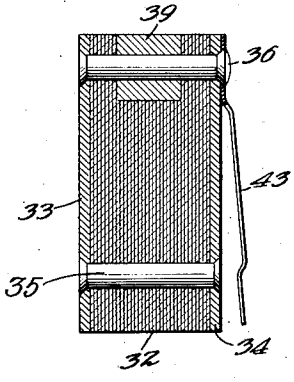
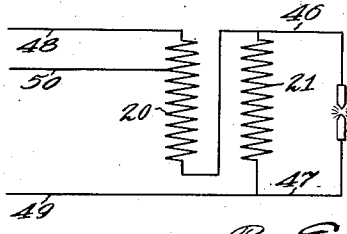


Fig. 6.



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UNITED STATES PATENT OFFICE.

THOMAS E. BARNUM, OF MILWAUKEE, WISCONSIN, ASSIGNOR TO THE CUTLER-HAMMER MFG. CO., OF MILWAUKEE, WISCONSIN, A CORPORATION OF WISCONSIN.

TRANSFORMER.

1,098,549. Specification of Letters Patent. Patented June 2, 1914.

Application filed May 15, 1911. Serial No. 627,366.

To all whom it may concern:

Be it known that I, THOMAS E. BARNUM, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented new and useful Improvements in Transformers, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawing, forming a part of this specification.

My invention relates to improvements in adjustable transformers.

My invention is particularly applicable to transformers for arc lamps, but is not limited to this particular application.

One of the objects of my invention is to provide a device of simple, compact and durable construction.

A further object of my invention is to provide a device which will enable voltage regulation between predetermined limits in very minute degrees.

Various other objects and advantages of my invention will be hereinafter set forth.

In order to disclose the nature and characteristic features of my invention I shall describe the embodiment thereof illustrated in the accompanying drawings.

It should be understood that my invention is not limited to the specific embodiment thereof illustrated in the accompanying drawings, but is susceptible of various modifications.

In the accompanying drawings: Figure 1 is a top plan view of the device. Fig. 2 is a side elevation of Fig. 1. Fig. 3 is a sectional view taken on line 3—3 Fig. 1. Fig. 4 is a top plan view of the transformer frame and movable plug. Fig. 5 is a sectional view of the movable plug on the line 5—5 Fig. 3. Fig. 6 is a diagrammatic view showing the device connected to a lamp circuit.

The structure illustrated includes a base or supporting member 1 having lugs or ears 2 formed thereon for facilitating its attachment to a suitable supporting device. The member 1 is preferably made in the form of a hollow box as illustrated of a rectangular form. The sides and bottom of the member 1 are provided with apertures 3 suitably arranged therein for ventilating purposes. At each corner of the supporting member 1 is provided a perforated lug or ear 4.

Superimposed upon the open end of the box member 1 is a substantially rectangular magnetic frame 5 which in top plan appears as in Fig. 4. This frame is preferably formed of a series of layers or laminations, each layer preferably comprising two overlapping substantially E shaped members 6 and 7, which when fitted together as illustrated in Fig. 4 provide two parallel slots 8 and 9 on opposite sides of an intermediate portion 10. The laminations are so built up that the slots 8 and 9 therein all register, thereby producing continuous openings through the frame. The frame 5 preferably has its corners beveled as illustrated, Fig. 4, for a purpose hereinafter set forth. Superimposed upon the laminated frame 5 is a box-like member 11 provided at its corners with perforated lugs or ears 12. The member 11 is secured to the member 1 by bolts 13 passing through the corner lugs of both members, the frame 5 being thus firmly clamped between the two members 1 and 11. The purpose of beveling the corners of the laminated member 5 is to provide clearance for the bolts 13, and at the same time utilize said bolts for engagement with the beveled edges of the frame 5 to retain the same in position relative to the members 1 and 11. The box-like member 11 is provided with a removable cover 16 preferably held in place by screws 17 at the corners thereof which thread into suitable blocks 18 provided at the corners of the member 11. As illustrated in Fig. 1 the cover 16 is provided with a plurality of apertures 19 for ventilating purposes.

Within the device described are located two transformer coils 20 and 21 best illustrated in Fig. 4. These coils may be of any suitable construction. They are mounted upon the laminated frame 5. More specifically they are wound around or fitted on to the central portion 10 of the laminated frame 5, said portion 10 forming a core therefor. These coils are disposed at opposite ends of the member 10, or in other words at opposite ends of the openings 8 and 9 through said frame 5 leaving spaces between the same into which are fitted two vertically disposed tubular members 22 and 23. These members hold the coils in spaced relation, and said coils are further secured in place by wooden wedges 20^a and 21^a, best illustrated in Fig. 3 interposed between the same and the member 10 on which they are

supported. The tubes 22 and 23 are preferably rectangular in form and composed of a non-conducting material preferably fiber or leatheroid. These tubes are preferably supported at their upper ends between two parallel bars 24 extending across the box member 11 and resting upon and secured to lugs 25 within said member. Only one of these bars is illustrated, the same being shown in Fig. 3. The tubes are also preferably secured in place by bolts 30 connecting their lower ends to the sides of the supporting member 1 as illustrated in Fig. 3.

Arranged to move longitudinally in each of the tubes 22 and 23 is a magnetic plug member 31 preferably formed of laminations 32 confined between outside plates 33 and 34, the laminations and said plates being secured together by suitable rivets 35 and 36. The two plug members 31 are connected to a cross head 39, said cross head preferably having its ends set into said members 31 and secured thereto by the rivets 36. The cross head 39 works in vertical slots provided in adjacent sides of the tubular members 22 and 23. For a purpose hereinafter set forth it is desired to raise and lower the plug members in the tubes, and to provide for this movement I thread into the cross head 39 a screw threaded vertically disposed shaft 40 revolubly mounted in a suitable bearing 41 provided in the top 16. Secured to the end of the shaft 40 exterior to the top 1 is a handle 42. The handle 42 provides means for rotating the shaft 40, and through its screw threaded engagement with the cross head 39 to raise and lower said cross head. In practice I have found that there is a tendency of the plug members 31 to vibrate laterally, and so to prevent undue vibration of these members I have provided each of the same with leaf springs 43 adapted to bear against a side of the tube in which it works, to steady the same.

Before proceeding further I shall describe the purposes and functions of the above structure in connection with Fig. 6. As before stated in the arrangement shown in Fig. 6 the device is used for regulating an arc lamp circuit. The lamp is schematically illustrated as provided with carbons 44 and 45 and as being connected by conductors 46 and 47 respectively to the terminals of the transformer coil 21. The two coils 20 and 21 are connected in series and are provided with leads 48 and 49 for connecting the same across a suitable single phase alternating current circuit. The coil 20 is the primary coil, and the coil 21 is the secondary coil. For providing for connection of the device to circuits of different potentials, I have provided a tap 50 from the coil 20. This tap may be arranged to cut out any predetermined number of turns of the coil 20 and thus be used where connection is made to a circuit of a lower potential than that for which the whole coil is designed. By relative variation of the number of turns in each coil any predetermined induced potential across the lines 46 and 47 connecting the arc light to the coil 21 may be obtained. This will readily be understood by those skilled in the art from the connections illustrated by which the coils are connected to produce an auto transformer. It will further be understood by those skilled in the art that variations in the number of lines of force passing through the core of the secondary coil 21 will cause variations in the induced voltage in the coil. That is to say by decreasing the number of lines of force through the core of the coil 21, the induced potential across said coil may be decreased and that by increasing the number of lines of force passing therethrough the induced potential across said coil may be increased. It is for the purpose of thus controlling the number of lines of force passing through the core of the coil 21 that I have provided the adjustable plugs 31. These plugs when inserted fill or partially fill, according to the degree of insertion thereof, the air gap between the central portion 10 of the frame 5 and the outside portions thereof, and divert a portion of the magnetic flux which normally takes the path indicated by the light dotted lines to the shorter path indicated by the darker dotted lines. In other words the insertion of the plugs shunts a portion of the magnetic flux away from the core of the coil 21 and in consequence for the reason above stated decreases the voltage induced in the said coil. The number of lines of force thus diverted and consequent decreased potential across the terminals of the winding 21 depends upon the degree of insertion of the plugs 31. Obviously the greater the degree of insertion of these plugs the greater will be the number of lines of force shunted away from the coil 21. Here it should be noted that the screw threaded shaft operating means for the plugs enables a very fine adjustment thereof, or in other words adjustment thereof in a minimum degree, and accordingly permits of a very fine adjustment of voltage. Still further the provision of the shunt or leakage path by the adjustable plugs gives a drooping characteristic to the secondary voltage which is very advantageous in the control of arc lamps. As will be understood by those skilled in the art as the secondary current increases when the carbons are moved together, the secondary voltage decreases; and as the current decreases by virtue of the carbons burning away, the voltage increases, thereby insuring a good light at all times.

Again referring to the mechanical structure it will be observed from Figs. 1, 2 and

4 that the ingoing leads 48, 49 and 50 enter the casing at one side thereof while the outgoing leads 46 and 47 leave the casing at the opposite side thereof. All leads pass through bushings 51 preferably of rubber which as illustrated in Fig. 2 are preferably inserted and clamped between the cover 16 and the upper edges of the portion 11 of the casing. The portions of the leads within the casing are preferably arranged and connected as illustrated in Fig. 4 which connections if traced will be found to be the same as those shown in Fig. 6.

By referring to Fig. 3 it will be readily appreciated that the structure is so designed as to greatly facilitate assembly of the parts and to provide convenient and expeditious access to all parts for inspection and repairs, etc. The mere removal of the cover 16 gives ready access to the whole interior of the device exposing the leads and their connections, the adjustable magnetic plug and its guiding tubes and operating means and in fact everything above the upper face of the frame 5. It will further be observed that provision is made for thorough ventilation of the device notwithstanding the obvious compactness thereof.

What I claim as new and desire to secure by Letters Patent is as follows:—

1. In a transformer, in combination, a support, a transformer frame carried thereby, transformer windings mounted on said frame in a parallel relation, non-magnetic tubes interposed between said windings to maintain the same in a spaced relation and magnetic plugs slidably mounted within said non-magnetic tubes.

2. In a transformer, in combination, a support, a transformer frame carried thereby, transformer windings mounted on said frame in a parallel relation, non-magnetic tubes interposed between said windings and magnetic plugs slidably mounted within said non-magnetic tubes and having means engaging said tubes to minimize the vibrations of said plugs.

3. In a transformer in combination, a laminated transformer frame having parallel openings on opposite sides of an intermediate portion, transformer windings mounted on said intermediate portion of said frame in a parallel relation at opposite ends of said openings, rectangular non-magnetic tubes inserted in the openings in said frame between said windings, magnetic plugs movable longitudinally in said tubes and provided with means engaging said tubes to minimize their vibrations.

4. In a transformer, the combination with two relatively inverted box like members of a horizontally disposed laminated magnetic frame clamped between said members, transformer windings mounted on said frame in a spaced and parallel relation and entirely inclosed by said frame and said members, and vertically movable magnetic plugs adapted to be projected into said magnetic frame between said windings, said plugs being adjustably mounted in the upper box like member, said upper member having a removable cover for giving access thereto.

5. In a transformer, the combination with two relatively inverted box like members of a horizontally disposed laminated magnetic frame clamped between said members, transformer windings mounted on said frame in a spaced and parallel relation and entirely inclosed by said frame and said members, vertically movable magnetic plugs adapted to be projected into said magnetic frame between said windings, said plugs being adjustably mounted in the upper box like member, and said upper member having a removable cover for giving access thereto, the incoming and outgoing leads for said windings all entering said upper member and being accessible for connection and disconnection upon removal of said cover.

In witness whereof, I have hereunto subscribed my name in the presence of two witnesses.

THOMAS E. BARNUM.

Witnesses:
FRANK H. HUBBARD,
G. W. HAYNES.