July 27, 1943. J. L. BONANNO ET AL 2,325,470

TRANSFORMER

Filed Oct. 18, 1940 3 Sheets-Sheet 1

Fig. 1.

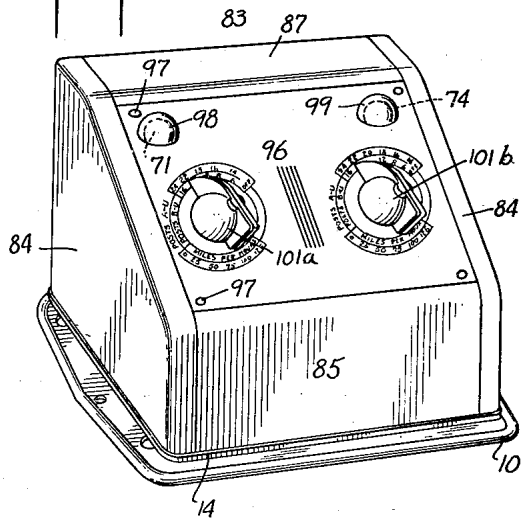


Fig. 2.

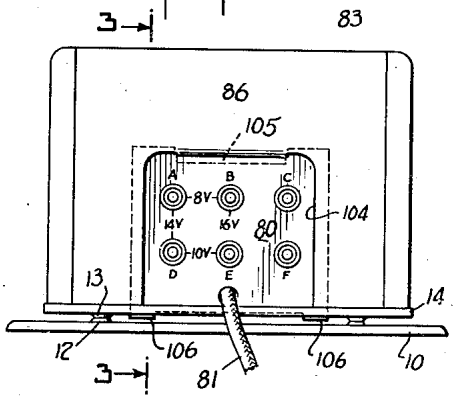


Fig. 3.

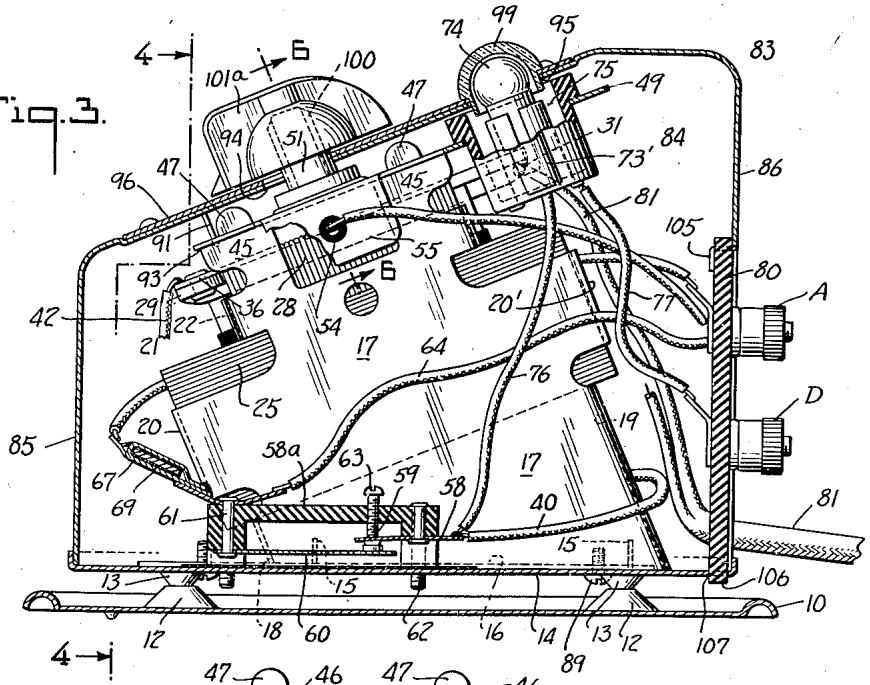
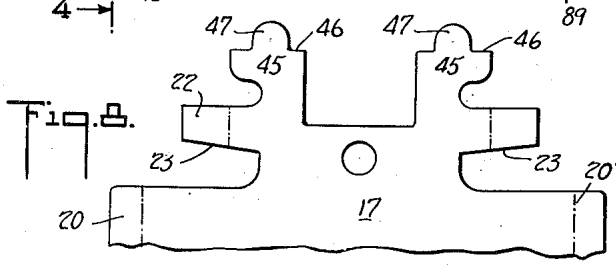


Fig. 8.



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TRANSFORMER

Filed Oct. 18, 1940 3 Sheets-Sheet 2

Fig. 4.

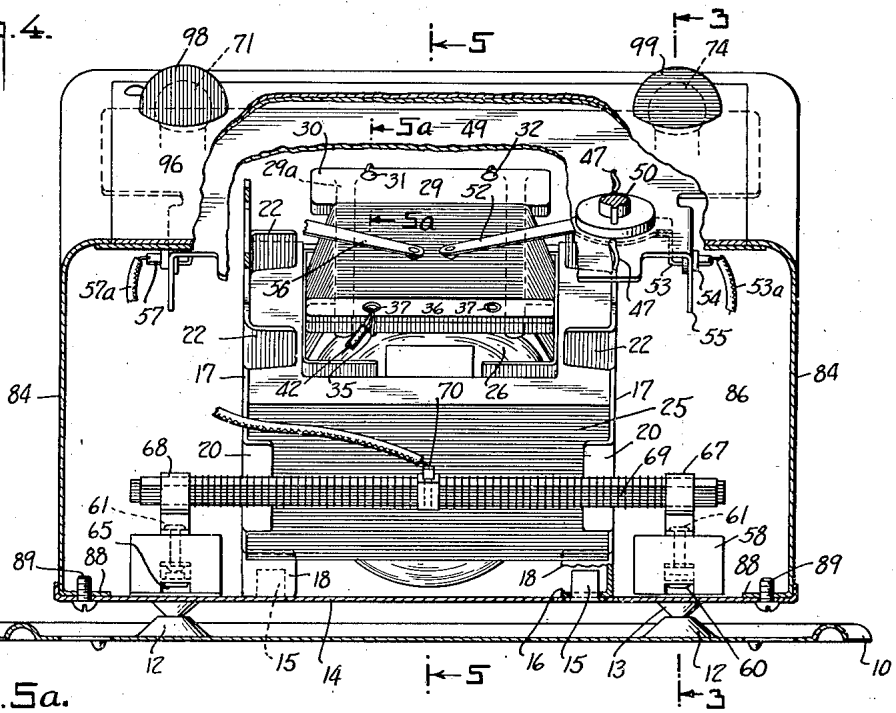

Fig. 5a.

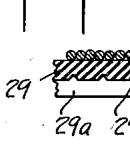

Fig. 5.

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TRANSFORMER

Filed Oct. 18, 1940 3 Sheets-Sheet 3

Fig. 6.

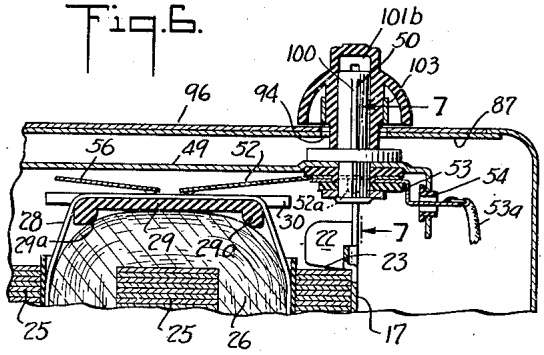


Fig. 7.

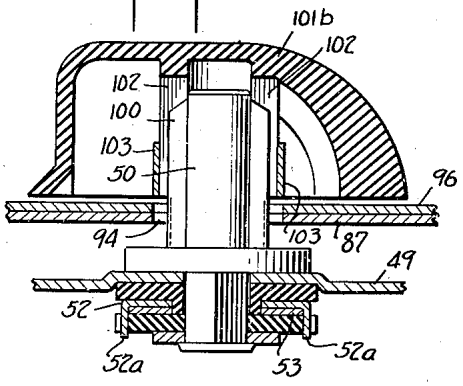
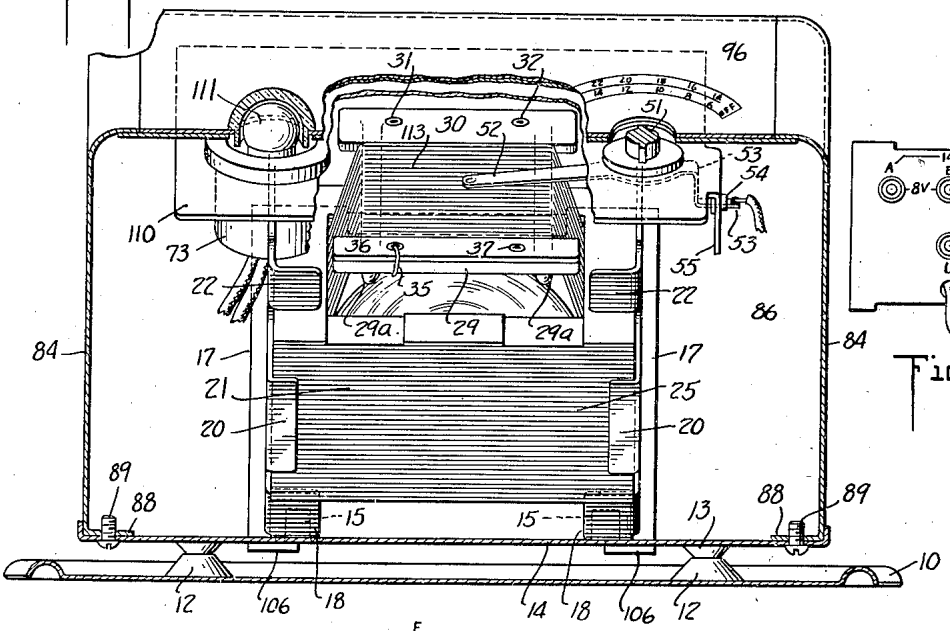


Fig. 10.



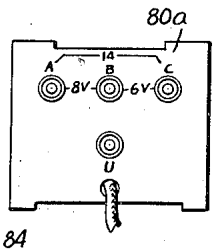


Fig. 11.

Fig. 9.

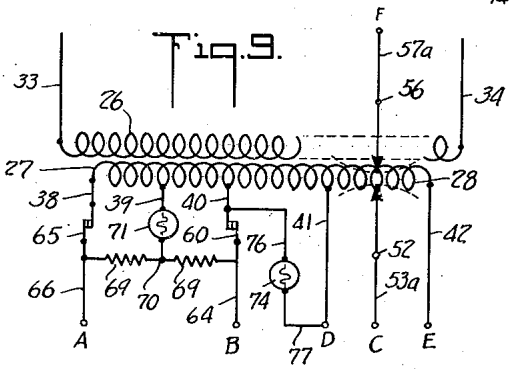
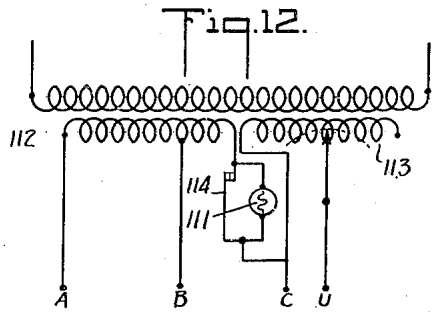


Fig. 12.



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UNITED STATES PATENT OFFICE

2,325,470

TRANSFORMER

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Application October 18, 1940, Serial No. 361,766

11 Claims. (Cl. 171—119)

The present invention relates to transformers, and is more particularly directed to transformers suitable for use in stepping down house current to lower voltages for the operation of toys, such as toy trains.

In the operation of toy trains it is desirable to have available a predetermined voltage for operating accessories in the toy track layout and a variable voltage of selected maximum and minimum voltage for the track circuit or circuits. For example, the accessories generally operate on a maximum voltage of about 12 volts, while the trains may be operated at various voltages, for example, for 6 to 16 volts, from 14 to 24 volts.

According to the present invention the transformer is provided with the primary coil and secondary coil and connections so that the constant voltage may be had for the accessories and selected variable voltages for train operation. In some instances the transformer is designed to provide independently variable circuits for train operation so that two trains can be separately controlled.

A further object of the invention is to provide a transformer construction wherein the core and coil are securely and fixedly held in place on a supporting base and the means which holds the core and coil in place also holds in place the mechanism whereby the variable voltage is obtained.

A further object of the invention is to provide a transformer adapted for providing variable voltage outputs wherein a movable contactor is shifted over the bared surface of the secondary winding of the transformer, and this bared surface is supported on the outside of a flat insulating plate about which a portion of the secondary windings pass. This plate also provides an anchor for the primary leads to the transformer and is arranged so that the contact has a smooth passage from the winding onto the insulating plate for the off position.

The present invention also contemplates providing the transformer with an external casing and housing structure of a very rigid nature so that the structure will be rugged and unlikely to be damaged in use or shipment. The transformer preferably has a sub-base adapted to be secured to a support, a base plate above the sub-base and a unitary casing having side and top walls fixedly secured to the base. The upper part of the case is suitably interlocked with the enclosed structure to minimize the likelihood of damage or injury to the structure.

A further object of the invention is to provide a transformer for the purposes indicated having a requisite number of exposed binding posts carried on an insulated plate and locked in a position when the case is secured to the bottom plate of the device.

The case is apertured to permit access to one or more fixedly supported lamp sockets and the lamp sockets are arranged so that it is impossible to insert foreign objects into the interior of the transformer.

Other and further objects will appear as the description proceeds.

The accompanying drawings show, for purposes of illustrating the present invention, two of the many embodiments in which the invention may take form, it being understood that the drawings are illustrative of the invention rather than limiting the same.

In these drawings:

Figure 1 is a perspective view of a transformer having two control knobs for two track circuits, an overload indicator and a pilot lamp;

Figure 2 is a rear elevational view of the transformer of Figure 1 showing the terminal connections;

Figure 3 is a transverse sectional view taken generally on the broken line 3—3 of Figures 2 and 4, parts being in elevation;

Figure 4 is a sectional view taken on the line 4—4 of Figure 3 looking in the direction of the arrows, parts being removed and parts broken away;

Figures 5 and 5*a* are transverse sectional views on the lines 5—5 and 5*a*—5*a* respectively, of Figure 4;

Figure 6 is a sectional view on the line 6—6 of Figure 3 and showing the control shaft and movable contact;

Figure 7 is an enlarged sectional view on the line 7—7 of Figure 6;

Figure 8 is a fragmentary view showing the upper part of the core supporting plates;

Figure 9 is a wiring diagram of the transformer of Figures 1 and 2;

Figure 10 is a view similar to Figure 4 showing a transformer arranged for one variable voltage circuit;

Figure 11 illustrates the terminal arrangement of the transformer of Figure 10; and

Figure 12 is a wiring diagram of the same.

As shown in the drawings the entire transformer is supported on a sheet metal sub-base 10 having upwardly extending bumps 12. These bumps 12 are welded to downwardly extending bumps 13 on a base plate 14 so that the two

plates form a unitary base for the transformer and the enclosure for the transformer parts is held above the sub-base and out of thermal contact with it.

The base has, as here shown, four upwardly extending prongs 15 which align the base flanges 16, 16 of core supporting side plates 17, 17. The flanges 16 are welded to the plate 14, so that the plates 17 are securely held in place. The plates 17 have narrow inwardly bent flanges 18, 18 at the front, wider inwardly bent flanges 19 at the rear. Above these flanges 18 and 19 the edges of the plates 17 are provided with more widely spaced inwardly extending flanges 20 at the front and 20' at the rear.

A preassembled core and winding unit 21 is of a size to pass down between the two plates 17, 17, between the flanges 20 and 20' and against the flanges 18 and 19. The core winding assembly is firmly secured in place by inwardly bent ears 22 formed out of the material of the side plates 17, 17. As shown in Figures 6 and 8 the lower edges 23 of these ears slope so that as the ears are bent toward the final position they exert clamping action on the core firmly pressing it against the lower flanges 18 and 19.

The transformer has a laminated core 25 of usual construction, a primary winding 26 about the core and a secondary winding 27 about the primary winding. The core was wound about a form of rectangular cross section so that each layer has flat faces and rounded corners. The outer layer 28 of the secondary winding passes about an insulating plate 29, as more clearly illustrated in Figures 5, 5*a* and 6. This insulating plate has longitudinal ribs 29*a*, which engage the rounded corners and prevent slippage sidewise, and an enlarged rear end 30 thicker than the portion which receives the winding and carries two rivets 31 and 32 to which the leads 33 and 34 of the primary winding 26 are soldered. The plate 29 has transverse ridges 29*b* to prevent its sliding lengthwise of the coil. One end 35 of the secondary winding is soldered to a brass plate 36 secured to the insulating plate 29 by rivets indicated at 37, 37. The secondary winding has taps, indicated in Figure 9 at 38, 39, 40, 41 and 42, which will be referred to below. The tap 42 is connected to the terminal marked E to be described.

The plates 17, 17 extend upwardly about the bent ears 22, 22, as indicated at 45, 45 and have upwardly facing shoulders 46 and prongs 47 shown more clearly in Figure 8. These prongs pass through holes in a bearing plate 49 and are twisted as indicated in Figure 4, so that the bearing plate is firmly secured in place.

As shown in Figures 1 to 7 the bearing plate 49 supports two shafts 50 and 51. The shaft 50 insulatedly supports two conducting strips 52 and 53. Strip 52 is a spring arm rotatable with the shaft and presses on the bared secondary winding. The conducting strip 53 extends out through an insulator 54 carried by a downwardly bent ear 55 of the plate 49. The strip 52 has lugs 52*a* which limit the angular movement of the shaft 51. The shaft 51 at the left similarly carries a resilient conducting arm 56 similar to the arm 52 and similarly connected to a fixed conducting strip 57. It will be obvious that by turning the shafts 50 or 51, variable voltages may be taken off the transformer. The strips 53 and 57 are connected by wires 53*a* and 57*a* to terminals C and F to be described.

The secondary tap 40 is connected, as shown at the lower part of Figure 3, to a soldering lug 58 secured to an insulator 58*a*. The soldering lug 58 carries a spring contact 59 above a bimetallic thermostat 60 also secured to the insulator 58*a* by a rivet 61. The insulator 58*a* is secured to the base plate 14 by a screw 62 and the contact 59 is adjustable by means of a screw 63 to control the amount of current which thermostat 60 can carry before it opens the circuit. The rivet 61 is connected by a wire 64 with a terminal indicated at B in Figure 9 and in Figure 2.

The secondary lead 38, shown in Figure 9, is connected through a similar thermal circuit breaker generally indicated at 65 and disposed to the left of the device, as will be clear from Figures 4 and 5. It is connected through a lead 66 to the terminal A, as indicated in Figures 9 and 2. The rivets 61, 61 on the two thermal circuit breakers are connected to straps 67 and 68 which support a resistor 69. When the thermal circuit breakers are closed this resistor is across the leads 38 and 40 and is subject to the voltage developed in this part of the coil. The midpoint 70 of the resistor 69 is connected through a lamp 71 with the tap 39 midway of the coil between the leads 38 and 40. When the two circuit breakers are closed no current flows through the lamp 71.

The lamp 71 is carried in a lamp socket 72 having a molded insulating body 73 ribbed as indicated at 73' and extending down through a non-circular opening in the plate 49. A pilot lamp 74 is carried in a similarly mounted socket 75 on the right-hand side of the plate 49. One side of this pilot lamp is connected by a wire 76 with the lead 40 as shown in Figure 3, while the other side is connected by a wire 77 with the terminal D. The pilot lamp can therefore at all times be across a 10 volt section of the secondary and indicates that the power is being supplied to the transformer.

The terminals A, B, C, D, E and F above referred to are in the form of binding posts and are carried on an insulating plate 80 with corresponding designations. The current supply cord 81 passes through a hole 82 in the lower part of the plate 80 and these wires extend up behind the transformer core and are soldered to the rivets 31 and 32 provided for the primary leads of the transformer.

In manufacturing the transformer the core and coil assembly, the bearing plate with contacts, the overload indicating lamp 71, the pilot lamp 74, and all connections between them and the terminals on plate 80 are completed. These parts are all received in a case 83. This case has sheet metal ends 84, 84, a front wall 85, a rear wall 86 and a top 87. These parts of the case are all welded together to form a strong rugged part. The lower edges of the walls 84, 84 are provided with flanges 88, 88 adapted to receive screws 89, so that the case can be firmly secured to the base 14. The upper part 87 of the case has downwardly extending prongs 90 and 91 adapted to enter openings 92 and 93 in the bearing plate 49. The interengagement of these prongs with the plate 49 forms a secure interconnection between the parts so that there is no possibility of their shifting during use or shipment.

The top part 87 of the casing has two openings 94 for the shafts 50 and 51, and has two openings at 95 for the lamps 71 and 74. A name plate 96 is secured in place by rivets 97 at its corners and this name plate carries a series of indica-

tions about the shafts **50** and **51** and supports colored insulating caps **98** and **99** for the lamps **71** and **72**. The tops of the insulating bodies which carry the lamp sockets are close to the inside of the case so that foreign objects cannot be inserted into the case and so that molten material cannot flow out nor flame escape.

The shafts **50** and **51** are keyed, as indicated at **100**, and slidably receive control knobs **101***a* and **101***b*. These control knobs are made of molded material and are slitted, as indicated at **102** (Figure 7) to fit the keys **100**. A compression spring **103** grips the hub of the knob and frictionally holds the knob on the shaft. This knob assembly forms the subject matter of a separate application for patent in the name of Joseph L. Bonanno, Serial No. 381,659, filed March 4, 1941.

The rear wall **86** of the case is provided with an opening **104** slightly smaller than the terminal plate **80**. The upper edge **105** of this opening is flanged rearwardly and downwardly, as indicated in Figures 3 and 5. The lower edge of the insulating plate **80** has extensions **106** which pass downwardly through openings **107** in the bottom plate **14**. The insulating plate **80** is held securely in place between the flange **105** and the plate **14** when the case is fastened to the base.

In a typical transformer of the type shown in Figures 1 to 9 the maximum output voltage between terminals A and E is 24 volts and the exposed portion of the secondary winding **28** has a 10 volt range. If a track circuit is connected between A and F variable voltages from 14 to 24 volts may be had and the voltage may be read on the dial on the name plate in accordance with the position of the left-hand knob **101***a*. In the same transformer the maximum voltage between B and E is 16 volts and therefore, if the track circuit is connected between B and F, one can obtain a voltage range of from 6 to 16 volts by manipulating the left-hand knob **101***a*. Similar ranges of voltages are obtainable from the right-hand knob **101***b* when the A and C or the B and C binding posts are used. Should an overload occur in either track circuit connected to the terminals A or B the corresponding circuit breaker will open and the lamp **71** be lighted. The circuit arrangement whereby a single lamp in the secondary indicates short circuit conditions in either of the two output circuits forms the subject matter of a separate application for Letters Patent in the name of Joseph L. Bonanno, Serial No. 381,658 filed March 4, 1941.

It will be noted that in use the contacts **52** and **57** readily move over the surface of the bared winding, that when the knob is turned to the "off" position the corresponding spring is moved on to the thickened rear portion **30** of the plate **29**, and that when the full voltage is had the contact spring moves over on to the brass plate **35**. The manipulation of the control knobs **101***a*, **101***b* may therefore be used to open and close a circuit connected to the terminals C or F. The knobs do not control the voltage supplied between terminals, such as the A—B, B—D, D—E, etc., and various combinations of terminals may be selected for connection to circuits to receive a constant voltage. The terminals A—D are normally used to supply current to accessories. Should a short circuit appear in the accessory circuit the circuit breaker **65** would be opened.

In the modified form of construction shown in Figures 10, 11 and 12 intended for controlling a single track circuit the same external structure and the same core-coil assembly and supports may be used, the core and coil being varied, if desired, on account of a difference of wattage output of the transformer. A different terminal plate **80***a* with designations A, B, C and U is employed as indicated in Figure 11. In the arrangement of Figure 10 the shaft **51** contacts strip **52** and connections may be identical with the corresponding parts described previously. The bearing plate **110**, which corresponds to the bearing plate **49**, supports the shaft **51** and also an indicator **111** in the same way that the plate **49** supports the lamp **71**. The name plate has only two holes, one for the shaft and the other for the lamp.

The circuit for the transformer of Figure 10 is indicated in Figure 12. The secondary of the transformer is in two sections **112** and **113**, the section **113** being the part of the winding which is on top of the insulating plate **29**. The coils **112** and **113** are each connected to a terminal C on the back of the transformer and one of the leads to this terminal includes the lamp **111** in parallel with a thermal circuit breaker **114** similar to the one above described. In this transformer the 14 to 24 volt range is available by connecting between the A and U terminals. The 6 to 16 volt range is available by connecting between the B and U terminals and accessory operating voltage of 14 volts maximum is available between the terminals A and C. Other voltages may be had by interconnecting other combinations of terminals. The circuit breaker protects all the circuits likely to be connected to the terminals, except a connection between A and B.

In the discussion the letters A, B, C, D, E, F and U are not intended as reference characters, but are the letters ordinarily applied on the terminal plate of the corresponding transformers.

It is obvious that the invention may be embodied in many forms and constructions within the scope of the claims and we wish it to be understood that the particular forms shown are but a few of the many forms. Various modifications and changes being possible, we do not otherwise limit ourselves in any way with respect thereto.

What is claimed is:

1. A transformer having a preassembled core with primary and secondary windings, the upper face of the secondary winding being bared, a base plate, sheet metal core supporting plates having elements which engage the core to secure it and the windings in fixed position, a bearing plate secured to the core supporting plates and held in spaced relation to the upper bared face of the secondary winding, and a movable contact insulatedly supported by the bearing plate and cooperative with the bared surface of the secondary winding to vary the voltage output.

2. A transformer having a preassembled core with primary and secondary windings, the upper face of the secondary winding being bared, a base plate, sheet metal core supporting plates having elements which engage the core to secure it and the windings in fixed position, a bearing plate secured to the core supporting plates and held in spaced relation to the upper bared face of the secondary winding, a movable contact insulatedly supported by the bearing plate and cooperative with the bared surface of the secondary winding to vary the voltage output, an enclosing case having its lower edges secured to the base plate and its top interlocked with the bearing plate to resist relative movement of the

case and core, and a contact operator secured to the contact and extending through the top of the case.

3. A transformer such as claimed in claim 2, having a lamp socket carried by the bearing plate opposite an opening in the case and connected to the windings, and a lamp bulb insertible into the socket through the opening.

4. A transformer such as claimed in claim 2, having a flanged lamp socket slidably carried in an opening in the bearing plate opposite an opening in the case and connected to the windings, and a lamp bulb insertible into the socket through the opening, the case engaging the socket flange to hold the socket in place.

5. A transformer having a coil unit including primary and secondary windings and a laminated core, a base, and two sheet metal core supporting plates between which the unit is bodily insertible with each of the laminations extending from one plate to the other, the core supporting plates fitting the core by engaging the side and end edges of the laminations and the lower face of the lower lamination, the core supporting plates having inwardly bendable ears which engage the upper face of the upper lamination and hold the core against upward movement.

6. A transformer such as claimed in claim 5, wherein the lower edges of the ears slope upwardly away from the body of the corresponding plate to facilitate passing over the top of the core and secure a clamping action against the top of the core as the ears are bent inwardly.

7. A transformer having a base plate, two parallel side plates extending upwardly from the base plate and having upper and lower inwardly extending flanges at the front and rear edges thereof, the upper flanges being spaced farther from one another than the lower flanges, and a transformer core received between the plates and the upper flanges and resting on the lower flanges, the plates having inwardly bent ears overlying the top of the core and holding the core securely against the lower flanges.

8. A transformer such as claimed in claim 7, wherein the side plates have upwardly extending projections beyond upwardly facing shoulders, and having a bearing plate apertured to receive the projections, the projections being bent to secure the bearing plate in place.

9. A transformer having a base plate, two parallel side plates extending upwardly from the base plate and having upper and lower inwardly extending flanges at the front and rear edges thereof, the upper flanges being spaced farther from one another than the lower flanges, a transformer core received between the plates and the upper flanges and resting on the lower flanges, a bared secondary winding carried above the core, the plates having inwardly bent ears overlying the top of the core and holding the core securely against the lower flanges, the front flanges being lower than the rear flanges and the upper front and rear flanges being oblique so that the core and bared winding slope upwardly and rearwardly, a bearing plate secured to the end plates above the secondary winding, and a wiping contact insulatedly and movably supported on the bearing plate for cooperation with the bared winding.

10. A step-down transformer having a multilayer winding wound about a form of rectangular cross section so that each layer has flat faces and rounded corners, the secondary being outside the primary, a flat insulating plate interposed between the outermost layers of the secondary along one face of the winding, the exposed face of the secondary outside the plate being bared, the plate having longitudinal ribs engageable with the adjacent rounded corners, so that the plate cannot shift sidewise.

11. A step-down transformer having a multilayer winding wound about a form of rectangular cross section so that each layer has flat faces and rounded corners, the secondary being outside the primary, a flat insulating plate interposed between the outermost layers of the secondary along one face of the winding, the exposed face of the secondary outside the plate being bared, the plate having parallel transverse ribs on its inner face to prevent endwise shifting of the insulating plate.

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