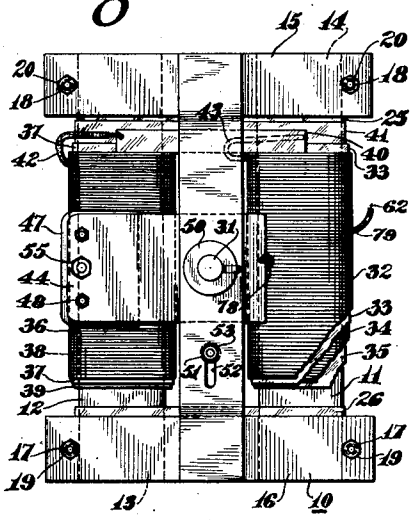
Nov. 17, 1936. J. A. COMSTOCK ET AL 2,061,452

VARIABLE VOLTAGE TRANSFORMER

Filed Sept. 11, 1935

Fig. 1.



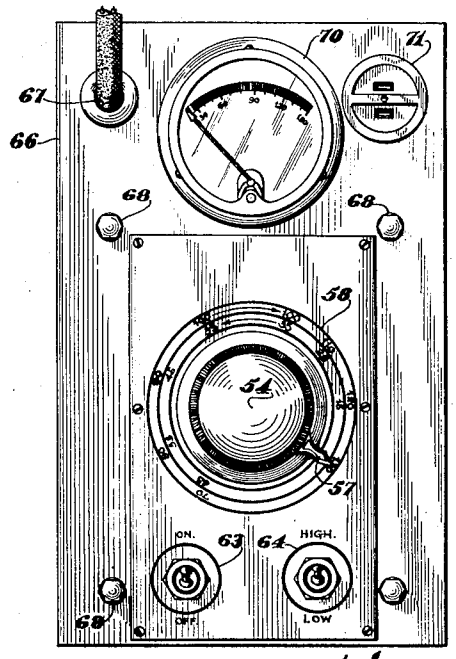


Fig. 2.

Fig. 3.

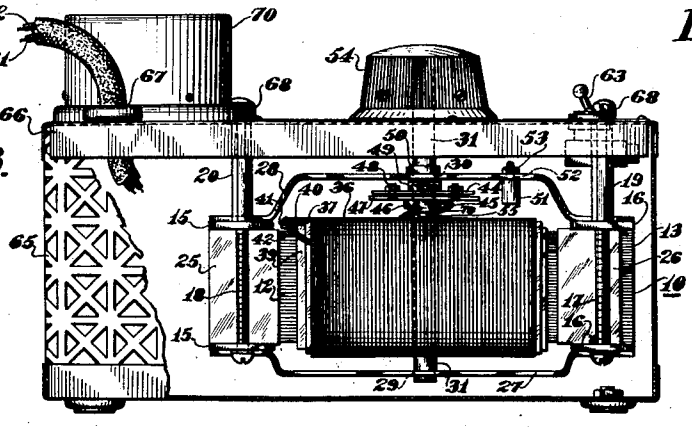
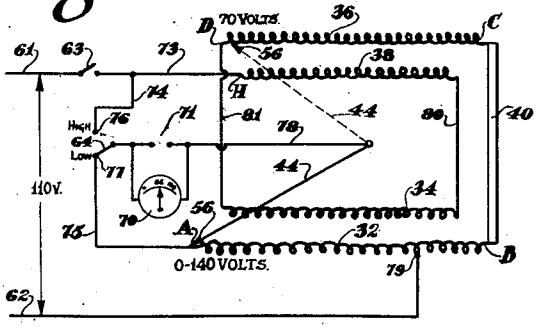


Fig. 4.



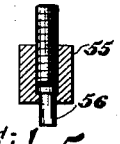


Fig. 5.

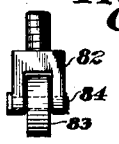


Fig. 6.

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VARIABLE VOLTAGE TRANSFORMER

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Application September 11, 1935, Serial No. 40,123

13 Claims. (Cl. 171—119)

Our invention relates to transformers and more particlularly to variable voltage transformers.

An object of our invention is the provision of obtaining variable voltage by varying the ratio of turns of the windings by a sliding contact means which slides over a portion of the windings.

A further object of our invention is the provision of having the slidable contact means to engage only a portion of the windings by utilizing a transfer switch to obtain a full voltage range of the entire windings.

A further object of our invention is the provision of an inner and an outer set of windings in which the slidable contact means engages only the outer set of windings, together with a transfer switch to obtain full voltage across both the inside and the outside windings thereby giving a voltage ranging from zero to a maximum value.

Another object of our invention is the provision of a slidable contact means which engages a portion of a winding so that as the slidable engaging means is moved in one direction, a voltage is obtained from a low value to an intermediate value and so that as the slidable engaging means is moved in the opposite direction, a voltage is obtained from an intermediate value to a high value.

Other objects and a fuller understanding of our invention may be had by referring to the following description and claims taken in conjunction with the accompanying drawing, in which:

Figure 1 represents a plan view of a transformer embodying the features of our invention with the cover removed to show the cooperatively associated parts.

Figure 2 is a plan view of a transformer embodying the features of our invention, showing the actuating knob, the meter, and the various switches.

Figure 3 is a side elevational view of a transformer embodying the features of our invention with a portion of the side of the container removed to show the parts more clearly.

Figure 4 is a diagrammatic view of the circuit connections utilized in our variable voltage transformer.

Figure 5 is a cross-sectional view of a slidable contact means, and

Figure 6 is a view of a modified form of a slidable contact means.

With reference to Figures 1 and 2, the reference character 10 designates generally the magnetic core means for our variable voltage transformer. In accordance with actual practise, the magnetic core means may be constructed of a plurality of stacked laminations and comprise substantially a rectangular form of core having two side legs 11 and 12, and a lower leg 13, and an upper leg 14. Any suitable means may be employed to hold the laminations together and as illustrated, we utilize a set of clamping strips 15 which holds the upper end of the laminations together and a set of clamping strips 16 which holds the lower end of the laminations together. The set of clamping strips 15 may be held together by longitudinal screws 18 having the upright longitudinal nuts 20. Similarly, the set of clamping strips 16 may be clamped together by the screws 17 and the upright longitudinal nuts 19. In this manner, the magnetic core means is firmly held together as a rigid unit. Under the set of clamping strips 15 and around the upper end of the magnetic core means 10, there is positioned a suitable strip of insulating material 25, such as fish paper or any other suitable means. Similarly, under the set of clamping strips 16 and around the lower end of the magnetic core means 10, there is positioned a suitable strip of insulating material 26, such as fish paper or any other suitable means. Interconnecting the two sets of clamping strips 15 and 16 and below the magnetic core means, we mount a lower shaft bearing bracket 27 having an opening 29 to guide the lower end of a rotating shaft 31. This lower shaft bearing bracket may have its ends bent upwardly and attached to the two sets of clamping strips 15 and 16 by any suitable means such as welding. Above the magnetic core means and attached to the clamping strips 15 and 16, there is provided an upper shaft bearing bracket 28 having an opening 30 for guiding the upper end of the rotating shaft 31. The ends of the upper shaft bearing bracket 28 may be bent downwardly and connected to the two sets of clamping strips 15 and 16 by any suitable means such as welding.

Upon each of the side legs 11 and 12 of the magnetic core means, we mount an inner and an outer set of windings. These windings are mounted upon the two side legs 11 and 12 during the course of the assembly of the magnetic core means. As illustrated, the outside winding upon the side leg 11 is indicated by the reference character 32. Beneath this winding, there is suitable insulation means 33. Then underneath

the suitable insulation means 33, there is positioned the inner winding 34 and underneath the inner winding 34, there is positioned suitable insulating means 35 which is wrapped around the side leg 11. By a similar construction, the outside winding upon the side leg 12 is indicated by the reference character 36 and the inside winding is designated by the reference character 38 which are insulated from each other and from the magnetic core means by suitable insulating means 37 and 39. Connected across the upper end of the two outside windings 32 and 36 is a current connecting strip 40 which comprises a portion bent upon itself and straddling the end of the insulating means 33 and 37. Also positioned under the current connecting strip 40 and insulating it from the magnetic core means is an insulating strip 41. The left hand end of the current conducting strip 40 is connected to the upper end of the outside winding 36 by means of a conductor 42 and the right hand end portion of the current conducting strip 40 is connected to the upper end of the outside winding 32 by means of a conductor 43. The upper surface of the outside windings 32 and 36 and the upper surface of the current conducting strip 40 is adapted to be engaged by a suitable rotating engaging means to vary the ratio of the turns of the windings. This rotatable engaging means is operated by the rotating shaft 31 and may comprise a rotating arm 44 having a contact 55 which slidably engages the upper surface of the outside windings 32 and 36 and the current conducting strip 40. A cross sectional view of the contact engaging member 55 is shown in Figure 5 and may be provided with a high resistance carbon contact 56. The purpose of using a high resistance carbon contact is to reduce the amount of short-circuited current which flows through the adjacent turns of the windings that are bridged by the carbon contact 56. In order to dissipate the heat that is generated at the slidable contact, we utilize a mass of good heat conducting material 47 which may be copper or any other suitable material. This mass 47 is connected to the end of the rotating arm 44 by means of screws 48. Preferably, the heat conducting mass 47 is spaced slightly upon the end of the rotating arm 44 in order to dissipate as much heat as possible. As illustrated, the upper threaded end of the slidable contact member 55 extends through both the heat conducting mass 47 and the end of the rotating arm 44 and is held firmly in position by means of a suitable nut. The rotating arm 44 is preferably constructed of resilient material so as to cause the contact to engage resiliently the outside surface of the windings 32 and 36 and the current conducting strip 40. The rotating arm 44 is provided with a suitable collar 45 that is non-rotatively connected to the rotating shaft 31 by means of screws 46. The upper side of the rotating arm 44 is insulated from the upper shaft bearing bracket 28 by means of insulating washers 49. A collar 50 is mounted about the rotating shaft 31 above the upper shaft bearing bracket 28 so as to hold the rotating shaft 31 against longitudinal movement. In the event that the carbon contact 56 wears down and does not make very firm contact with the two outside windings 32 and 36 and the current connecting strip 40, the rotating arm 44 may be lowered slightly by unloosening the screw 46 and re-setting the collar 45 at a lower position. The rotating arm swings from the lower edge of the outside winding 36, up across the outer surface of the outside winding 36, thence across the current connecting strip 40 and then downwardly across the outside winding 32, until it substantially reaches the end of the outside winding 32, and vice versa. An adjustable stop 51 is provided in order to keep the slidable contact from sliding off of the lower ends of the outside windings 32 and 36. This adjustable stop 51 is mounted within a slotted opening 52 and may be adjusted longitudinally by a nut 53 so as to make the lower range of the voltage read substantially zero. The upper end of the rotating shaft extends through the cover 66 of the container 65 and is actuated by a suitable knob 54 having a pointer 57 that is movable relative to an indicating dial 58. The container 65 may be of the perforated type so as to provide suitable ventilation for the transformer. As illustrated, best in Figure 3, the entire magnetic core means and the windings are suspended from the cover 66 by means of suitable cap screws 68 engaging the upper end of the longitudinal nuts 19 and 20. Therefore, by removing the cover 66, the entire assembly is removed from the container 65. On top of the cover 66, there is mounted a line toggle switch 63, a toggle transfer switch 64, a volt meter 70, and an outlet plug 71 into which a suitable detachable plug may be inserted. The supply conductors 61 and 62 which are enclosed in a suitable cable enters the container through the top having an opening 67.

The operation of our variable voltage transformer may be best explained by referring to the diagrammatic view in Figure 4, keeping in mind that the purpose of our transformer is to give any suitable output voltage at the outlet plug 71 when the windings are energized from a suitable source of supply current. Upon the closing of the toggle line switch 63, all of the windings 32, 34, and 36 and 38 are energized. The path of the current flow may be traced beginning with the supply conductor 61 through the toggle line switch 63, the conductor 73, the inside winding 38, the conductor 80, the inside winding 34, the conductor 81, the outside winding 36, the current connecting strip 40, the right hand end portion of the outside winding 32 to the tap 79 which is connected to the other supply conductor 62. Inasmuch as the supply conductor 62 is connected to the tap 79, the over all voltage of the entire windings is higher than the line voltage. Thus, for instance, if the line voltage is 110 volts, the voltage across all of the windings may be made to be 140 volts, or any other suitable value to take care of the demands for our transformer. For the purpose of clarity, we have selected 140 volts for the upper limit. The voltage impressed upon the output plug 71 is the drop between the slidable contact 56 and the toggle transfer switch 64. In the position as shown, the toggle transfer switch 64 is thrown to its low position and is connected to the switch contact 77. Therefore, with the rotating arm 44 upon point A of the winding 32, the voltage drop across the output plug 70 is zero. This is because there are no turns enclosed by the circuit which extends from the point A through the rotating arm 44, the conductor 78, the outlet plug 71, the toggle transfer switch 64, and the conductor 75. If the rotating arm 44 is turned in a counterclockwise direction, there are progressively a relative number of turns enclosed by the circuit

above traced through the outlet plug 71 and an increasingly higher voltage is impressed across the two spaced contacts of the outlet plug 71. According to the arbitrary factors mentioned above, there is substantially 35 volts impressed across the spaced contacts of the outlet plug 71 when the slidable contact 56 reaches the point B of the outside winding 32. Then as the sliding contact 56 slides across the current conducting strip 40, there is no change in the voltage output, but when the sliding contact 56 reaches the point C and begins to slide across the outside winding 36, there is impressed a higher voltage across the spaced contacts of the output plug 71. When the slidable contact 56 reaches the point D, there is impressed substantially 70 volts across the spaced contacts of the output plug 71. At this point, the toggle transfer switch 64 is reversed and now the swinging arm of the switch is connected to the switch contact 76, which means that the point H of the inside winding 38 is connected to the rotating arm 44 through a circuit which may be traced as follows: Through a conductor 73 and 74, the transfer toggle switch 64, the output plug 71, and a conductor 78 to the rotating arm 44. This means that when the toggle transfer switch 64 is making contact with the switch contact 76, the inside windings 38 and 34 are included between the rotating arm 44 and the transfer toggle switch 64. Under this condition, there is impressed substantially 70 volts across the spaced contacts of the output plug 71. If the rotating arm 44 is turned in a clockwise direction, the volts impressed across the spaced contacts of the output plug 71 increases. When the slidable contact 56 reaches the point C, there is substantially 105 volts impressed across the spaced contacts of the output plug 71. Then as the slidable contact 56 moves across the current connecting strip 40, there is no change in the output voltage, but when the slidable contact 56 engages the point B, the voltage again begins to rise. When the slidable contact 56 reaches the point A, there is impressed substantially 140 volts across the spaced contacts of the output plug 71. Therefore, with the arrangement of the transfer toggle switch 64 and the slidable contact 56, it is possible to get a voltage range from zero to 140 volts without the slidable contact engaging the inside windings 34 and 38. The volt meter 70 is connected directly across the two spaced contacts of the outlet plug 71 and gives an indication of the voltage output impressed upon the spaced contacts of the outlet plug 71. Instead of using a slidable contact 56, we have illustrated a rolling contact means 82 in Figure 6. This rolling contact means 82 comprises a heavy roller 83 which rotates about an axis 84. The mass of the roller 83 is quite large so that it may dissipate the heat generated.

Therefore, with the embodiment of our variable voltage transformer, it is possible to obtain an output voltage ranging from substantially zero to a high value without the slidable contact 56 engaging the inner windings 34 and 38.

Although we have described our invention with a certain degree of particularity, it is understood that the present disclosure has been made only by way of example and that numerous changes in the details of the combination and arrangement of substances may be resorted to without departing from the spirit and scope of the invention as hereinafter claimed.

We claim as our invention:

1. A variable voltage transformer comprising, in combination, magnetic core means, a winding having two portions connected in series mounted upon the magnetic core means, supply conductors connected to and adapted to energize the said winding, two spaced output means, selectable switch means for connecting one of the said spaced output means to either end of said winding, movable contacting means adapted to engage electrically one portion of said winding, and means for connecting the movable contacting means to the other of said spaced output means.

2. A variable voltage transformer comprising, in combination, magnetic core means, a winding mounted upon the magnetic core means, supply conductors connected to and adapted to energize the said winding, two spaced output means, means for selectively connecting one of the said spaced output means to either end of said winding, movable contacting means adapted to engage electrically a portion of said winding, and means for connecting the movable contacting means to the other of said spaced output means.

3. A variable voltage transformer comprising, in combination, magnetic core means, a winding mounted upon the magnetic core means, a second winding mounted upon the magnetic core means and on the inside of the first winding, means for connecting the two windings in series, supply conductors connected to and adapted to energize the said windings, two spaced output means, switch means for selectively connecting one of the said spaced output means to the end of either of said windings, movable contacting means adapted to engage electrically the outer surface of the first winding, and means for connecting the movable contacting means to the other of said spaced output means.

4. A variable voltage transformer comprising, in combination, magnetic core means having two spaced portions, a first winding mounted upon one of the said portions, a second winding mounted upon the same portion as the first winding is mounted and on the inside of the first winding, a third winding mounted upon the other of said portions, a fourth winding mounted upon the same portion as the third winding is mounted and on the inside of the third winding, means for connecting the said windings in series, supply conductors connected to and adapted to engage the said winding, two spaced output means, means for selectively connecting one of the said spaced output means to the outer end of the second and of the third winding, movable contacting means for electrically engaging the outside surface of the first and third windings, and means for connecting the movable contacting means to the other of said spaced output means.

5. A variable voltage transformer comprising, in combination, magnetic core means having two spaced portions, a first winding mounted upon one of the said portions, a second winding mounted upon the same portion as the first winding is mounted and on the inside of the first winding, a third winding mounted upon the other of said portions, a fourth winding mounted upon the same portion as the third winding is mounted and on the inside of the third winding, means for connecting the second and fourth windings in series, an engaging member having a flat surface for connecting the first and third windings in series, means for connecting the second and fourth windings in series with the first and third windings, the outer surface of the first and third windings and the flat surface of the engaging

member being in substantially the same plane, supply conductors connected to and adapted to engage the said winding, two spaced output means, means for selectively connecting one of the said spaced output means to the outer end of the second and of the third winding, movable contacting means for electrically engaging the outside surface of the first and third windings, and the flat surface of the engaging means, and means for connecting the movable contacting means to the other of said spaced output means.

6. A variable voltage transformer comprising, in combination, magnetic core means, a winding mounted upon the magnetic core means, a second winding mounted upon the magnetic core means and on the inside of the first winding, means for connecting the two windings in series, supply conductors connected to and adapted to energize the said windings, two spaced output means, means for connecting one of the said spaced output means to the end of either of said windings, movable contacting means adapted to engage electrically the outer surface of the first winding, and means for connecting the movable contacting means to the other of said spaced output means.

7. A variable voltage transformer comprising, in combination, magnetic core means, a winding mounted upon the magnetic core means, supply conductors connected to and adapted to energize the said winding, two spaced output means, means for connecting one of the said spaced output means to either end of said winding, movable contacting means including a high resistance material adapted to slidably engage electrically a portion of the said winding, and means for connecting the movable contacting means to the other of said spaced output means.

8. A variable voltage transformer comprising, in combination, magnetic core means, a winding mounted upon the magnetic core means, supply conductors connected to and adapted to energize the said winding, two spaced output means, means for connecting one of the said spaced output means to either end of said winding, movable contacting means including a rotatively mounted element adapted to rotatively engage electrically a portion of the said winding, and means for connecting the movable contacting means to the other of said spaced output means.

9. A variable voltage transformer comprising, in combination, magnetic core means, a winding mounted upon the magnetic core means, said winding having a plurality of layers electrically connected together, supply conductors for energizing the said winding, two output conductors energized by said winding, means for connecting one of the output conductors to an inner layer of the winding, movable contacting means adapted to engage electrically the outer layer of the winding, and means for connecting the movable contacting means to the other of said output conductors.

10. A variable voltage transformer comprising, in combination, magnetic core means, a winding having an outer layer exposed for external and continuous electrical contact and having an inner layer wound inside of the outer layer and mounted upon the magnetic core means, a housing for the magnetic core means and the winding, a detachable cover for the housing, means for supporting the magnetic core means and the winding by the said detachable cover, movable contacting means adapted to engage electrically and continuously the exposed layer of the said winding, an operating member extending through the cover for actuating the movable contacting means, means carried by the detachable cover for guiding the movable contacting means, two output terminals carried by the detachable cover, supply conductors passing through the detachable cover for energizing the said winding, conductor means for connecting one end of the winding to one of the output terminals, and conductor means for connecting the movable contacting means to the other output terminal.

11. A variable voltage transformer comprising, in combination, magnetic core means, a winding mounted upon the magnetic core means, a housing for the magnetic core means and the winding, a detachable cover for the housing, means for supporting the magnetic core means and the winding by the said detachable cover, movable contacting means adapted to engage electrically the said winding, an operating member extending through the cover for actuating the movable contacting means, means carried by the detachable cover for guiding the movable contacting means, two output terminals carried by the detachable cover, supply conductors passing through the detachable cover for energizing the said winding, a selectable switch mounted on the detachable cover for connecting one of the output terminals to either end of the winding, and conductor means for connecting the movable contacting means to the other output terminal.

12. A variable voltage transformer adapted to be energized by a source of current comprising, in combination, magnetic core means, a winding mounted upon the magnetic core means and arranged to be energized by the source of current, two spaced means, means for connecting one of said spaced means to either end of said winding, movable contacting means adapted to engage electrically the winding, and means for connecting the movable contacting means to the other of said spaced means.

13. A variable voltage transformer adapted to be energized by a source of current comprising, in combination, magnetic core means, a winding mounted upon the magnetic core means and arranged to be energized by the source of current, said winding having an outer layer exposed for external electrical contact and an inner layer wound inside of the outer layer, two spaced means, means for connecting one of the said spaced means to the inner layer of the winding, movable contacting means adapted to engage electrically the outer layer of the winding, and means for connecting the movable contacting means to the other of said spaced means.

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