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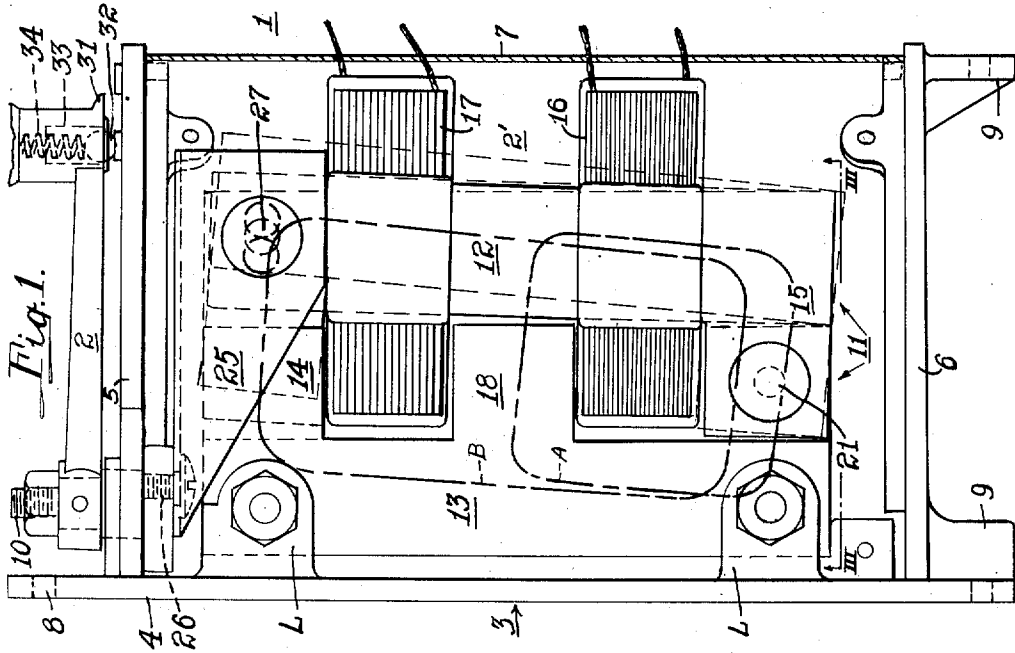
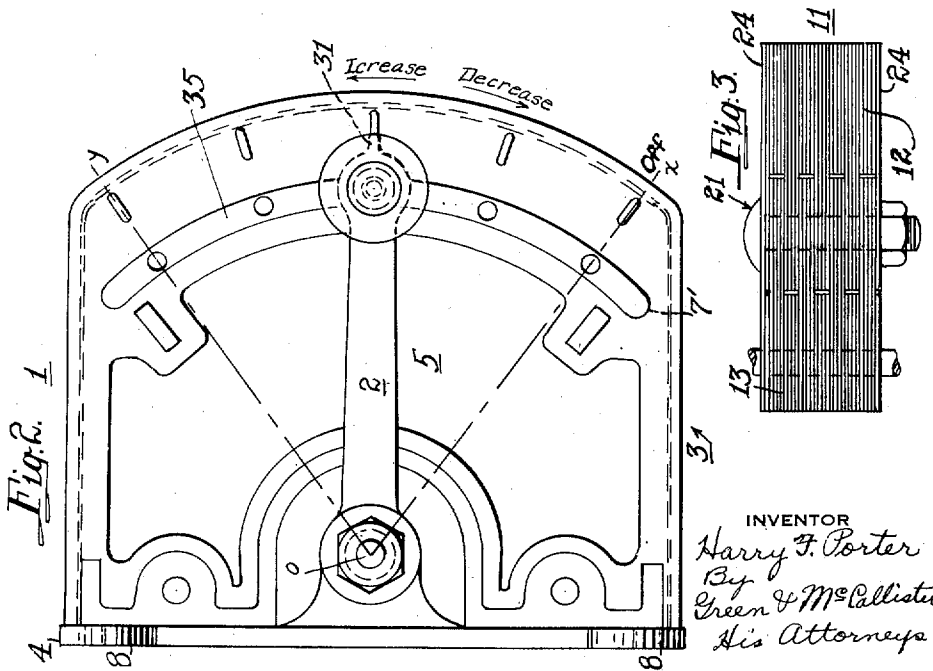
H. F. PORTER

2,031,733

ELECTRIC CONTROLLER OF THE VARIABLE VOLTAGE TYPE

Filed Dec. 4, 1934

2 Sheets-Sheet 1



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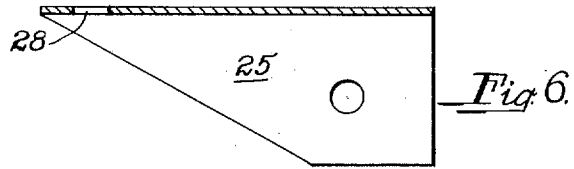
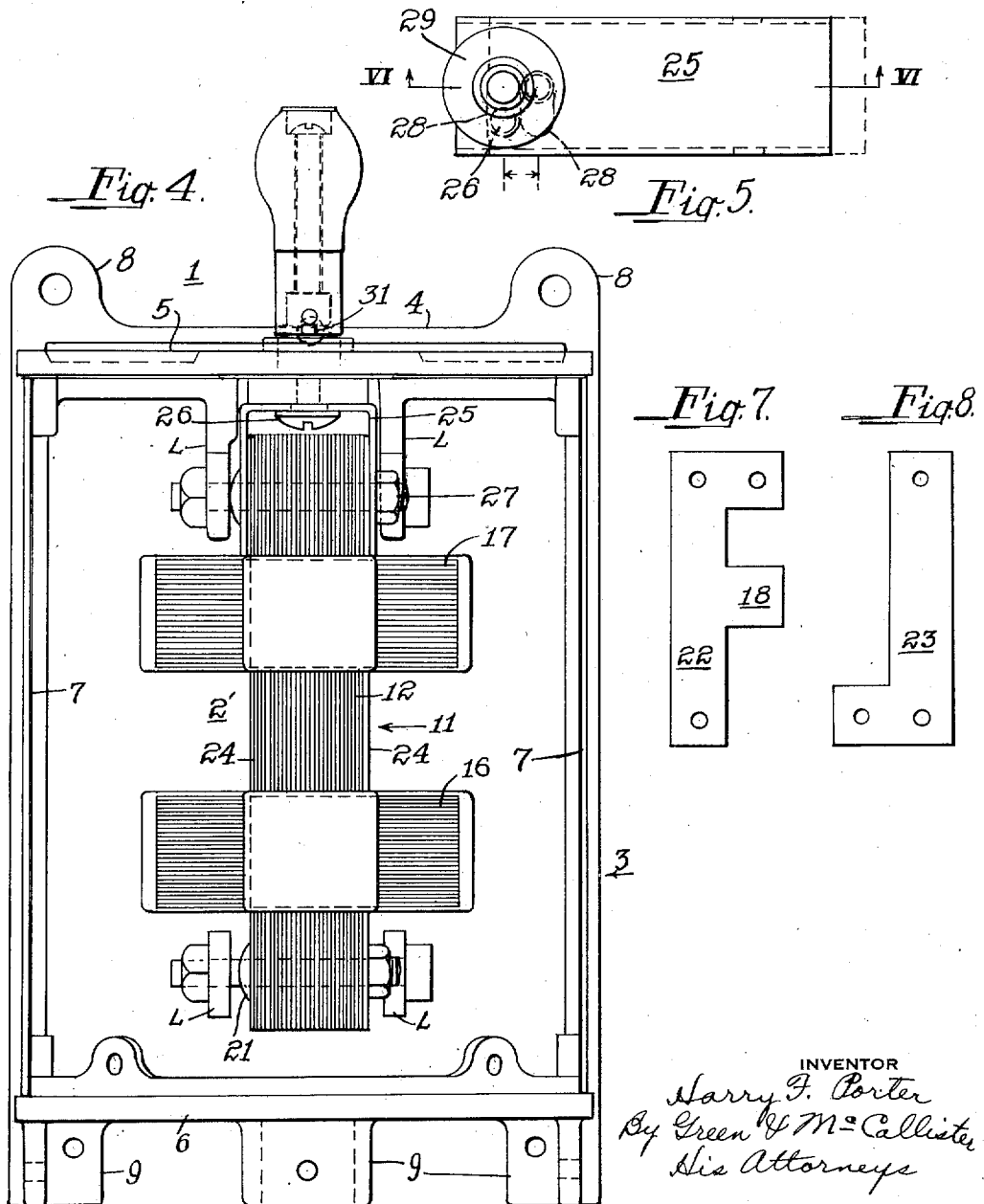
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UNITED STATES PATENT OFFICE

2,031,733

ELECTRIC CONTROLLER OF THE VARIABLE VOLTAGE TYPE

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5 Claims. (Cl. 171-119)

This invention relates to electric controllers and more particularly to transformers of the adjustable voltage type and adapted to provide a source of adjustable voltage for electric toys such as electric trains and the like.

An object of this invention is the provision of a controller provided with a transformer that shall be capable of providing a source of adjustable voltage that may be adjusted in smooth steps from substantially zero value to a maximum value for which apparatus connected to such source is designed to operate on.

Another object of the invention is the provision of a transformer of the character described that shall be designed to provide a source of adjustable alternating current voltage without employing a series of voltage taps on the adjustable voltage winding or adjustable resistors, to produce the voltage range desired.

A further object of the invention is the provision of an adjustable voltage transformer that shall have a low short circuit current at full voltage in order that the transformer shall not be a fire hazard, and a source of danger in the hands of children or inexperienced operators.

Other objects of the invention will, in part, be apparent and, will in part, be obvious from the following description taken in conjunction with the accompanying drawings, in which:

Figs. 1 and 2 are elevational and top plan views, respectively, of a controller provided with a variable voltage transformer embodying one form of the invention;

Fig. 3 is a view of the transformer core as seen when looking in the direction of the arrows taken on line III—III of Fig. 1;

Fig. 4 is a view in front elevation of the controller shown in Figs. 1 and 2;

Fig. 5 is a top plan view of two operating elements of the controller through which motion from the controller handle is transmitted to an element of the transformer to effect the desired adjustments in the voltage output of the transformer;

Fig. 6 is a view in section of one of the elements shown in Fig. 5 taken on line VI—VI thereof; and

Figs. 7 and 8 are views in side elevation of magnetic punchings or laminations employed in making up the transformer core.

Throughout the drawings and the specification like parts are designated by similar reference characters.

In the drawings, and with particular reference to Figs. 1, 2 and 4, a controller 1 is shown repre-

senting what now appears to be a preferred form of the invention. It will be appreciated, however, by those skilled in the art that details of design may be varied in many ways to suit particular requirements without departing from the principle of the invention. Therefore, in the following description, the principle of the invention will be set forth in connection with the description of the specific structure embodying the invention.

The controller illustrated is one designed primarily to supply a source of adjustable voltage for operating toys, powered by electric motors, of the universal or adjustable speed type, such as electric toy trains. Devices of this type may operate on a voltage range varying from zero to 12, 24 or 36 volts, although the maximum voltage most commonly employed is in the neighborhood of 12 volts. The controller comprises a magnetizable core having a primary winding thereon which is wound for use on the usual house lighting circuits, and a secondary winding that supplies the motors of the toys and other electric devices associated therewith.

The core of the transformer is so designed that, when the toy supply circuit is normal and free from grounds or short circuits, the secondary winding will supply maximum voltage, but if a short circuit occurs, the voltage of the secondary winding will be reduced to such a value that the current output will be insufficient to present a fire hazard. This may be accomplished by utilizing a high reactance magnetic circuit in the transformer.

The controller also embodies means for so varying the flux linkage with the secondary winding that when the secondary winding is connected to a load the voltage induced therein may be varied in smooth steps from substantially zero to a maximum value. When the secondary winding is on open circuit, the voltage induced therein will be substantially constant for all positions of the flux linkage varying means, but on closed circuit the induced voltage may be varied in smooth steps over a wide range of voltage values. When voltage adjustment is referred to hereinafter, it is to be understood that the secondary winding is connected to a load and that it is not on open circuit; i. e., closed circuit voltages are contemplated. For convenience, as well as for the purpose of giving the controller the action and appearance of a real or industrial device, a controller handle 2 and appropriate linkages are provided for operating the flux varying means.

As may be seen in Figs. 1, 2 and 4, transformer

2' is mounted in box or housing 3 having a back 4, top and bottom plates 5 and 6 shaped to receive a removable cover 7 (only partially shown), made preferably of pressed sheet metal. The controller may be mounted in a convenient place and secured by lugs or ears 8 to a table, wall, or panel; or it may be set on the floor, bench or table, lugs or feet 9 being provided on the bottom plate 6 for that purpose.

The controller handle 2 is secured to an axle or shaft 10 journaled in the top plate 5, and this shaft, as will appear hereinafter is operatively connected to means for adjusting the voltage supplied by the transformer to the toy circuit.

The transformer embodies a core 11 having sides 12 and 13, and ends 14 and 15, and primary and secondary windings 16 and 17, respectively, that are wound on side 12 of the core. The windings are preferably spaced apart so that a shunt 18 of magnetic core material may be interposed between them. By connecting winding 17 to a load and varying the reluctance of the magnetic path including shunt 18, it will be apparent that the flux linking the secondary winding 17 will be varied and therefore, the voltage induced in that winding may be varied and adjusted at will.

When shunt 18 bridges sides 12 and 13 of the core, that portion of the core on which secondary winding 17 is disposed, is short circuited magnetically; i. e., substantially all of the flux developed in the core by winding 16 permeates that portion of the magnetic circuit indicated by broken-line closed-loop A; consequently the voltage induced in the secondary winding is substantially zero or for practical purposes, nil. As the reluctance of the shunt path is increased, the flux developed by the primary winding 16 will permeate both the circuit indicated by broken-line closed-loop A and the circuit indicated by broken-line closed-loop B, the latter linking with the secondary winding 17. Therefore, as the reluctance of the shunt circuit is gradually increased, the flux permeating circuit A is gradually decreased, while the flux permeating circuit B and the voltage induced in the secondary winding 17 are gradually increased.

A convenient method of varying the reluctance of the shunt path included in circuit A, is illustrated in the drawings and comprises interposing an air gap of adjustable length in series with the shunt magnetic circuit A. This may be accomplished by making shunt 18 integral with either side of the core as side 13, for example, and moving the core sides relative to each other so that an air gap of adjustable length may be interposed between the free end of the shunt and the adjacent core side. In order to provide an air gap of adjustable length, adjacent ends of the core side may be connected by a hinged joint indicated at 21 and the opposite end of core side 12 may be connected to controller handle 2 by appropriate linkage so that on turning the handle in one direction or another, the core sides can be moved towards or away from each other to establish an air gap of adjustable length between the free end of shunt 18 and side 12.

When the air gap is of maximum length, maximum voltage is induced in the secondary winding, because the reluctance of magnetic circuit B is the greatest, and when the air gap is of minimum length, i. e., when shunt 18 and side 12 are in engagement, the voltage induced in the secondary winding 17 is zero or substantially nil. When the air gap length is varied between maximum and

minimum, the voltage in the secondary winding is varied between maximum and minimum.

The core of the controller may conveniently be made of magnetic punchings or laminations 22 and 23 shaped as shown in Figs. 7 and 8, for example, and assembled in certain relationship so that the magnetic circuit represented by broken-line closed-loop B is never broken.

The core may be assembled by grouping a certain number of punchings 22 and 23 in the relative positions shown in Figs. 7 and 8 to form packs and then turning every other pack end for end. By turning every other pack in this fashion, the opposite ends of the packs of laminations interfit in staggered relationship between the ends of contiguous packs (see Fig. 3). Plates 24 may, if desired, be placed on the opposite sides of the core and a bolt or rivet passed through one end to pivotally connect the packs together as indicated at 21. When the core has been assembled with the transformer windings the transformer may be bolted to lugs L formed on the back of the controller box or housing.

Because of the interfitting relationship of the core packs at the ends of the core, it will be observed that the net area of the core at end 14 is greatest when core side 12 abuts shunt 18, but as side 12 is shifted away from the shunt, air gaps of increasing length are formed between the ends of the packs in arms 12 and 13, respectively, tending to gradually decrease the net area of the core at end 14. Therefore, as the reluctance of shunt path A is increased the reluctance of path B is also increased but not as much as the increase in the shunt path. This tends to give finer adjustments in the voltage induced in the secondary winding and at the same time gives sufficient reactance to path B, when maximum voltage is being induced in winding 17, to limit the short circuit current to such a low value that no fire hazard is involved.

The other end of the packs defining side 12 of the core may be connected by a channel shaped link 25 that straddles end 14 of the core, and a crank pin 26 to shaft 10 of the controller handle. The channel shaped link 25 may be secured to side 12 of the core by means of a bolt or rivet 27 and the crank pin may be disposed to operate in an elongated slot 28 in one end of this link.

The crank pin 26 is secured to a disk 29 formed as a part of shaft 10, and eccentrically of the axis of the shaft.

When the controller handle is in the position indicated by line Ox, Fig. 2, crank pin 10 occupies the position shown in full lines in Fig. 5, and arm 12 of the transformer core engages the shunt 18 so that the voltage induced in the secondary winding 17 is zero or substantially nil. As the handle is turned in a counterclockwise direction, an air gap of variable length, depending upon the position of the controller handle, is interposed between arm 12 and the free end of shunt 18, so that for each position of the handle a different voltage will be induced in winding 17. When the handle is in the position Oy, the maximum air gap is interposed between shunt 18 and arm 12 of the core and consequently maximum voltage is induced in the secondary winding.

Plate 5 of the controller housing may be provided with spaced lugs or marks thereon that register with a point or tip 31 on the controller handle to indicate to the operator, approximately what the output voltage of the secondary winding is for any position of the controller handle. Also

the controller handle may be provided with a ball 32 which is disposed in a recess 33 and urged downwardly by means of a compression spring 34 into contact with a segmental rib 35 having spaced 5 recesses or depressions therein into which the ball is urged by the spring to yieldingly lock the handle and give to the operator the operative effect of the controller handle of any industrial or street car controller; that is, the depressions and 10 the spring pressed ball give the impression of notching control action.

Having thus described one form of the invention it is to be understood by those skilled in this art that various modifications and changes may be made in a mechanical construction of the device illustrated and in the assembly arrangement 15 and the combination of the parts therein involved without departing either from the spirit or the scope of the invention. It is desired, therefore, that only such limitations shall be placed on the invention as are imposed by the prior art and the appended claims.

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

25 1. A transformer of the character described comprising a laminated core having arms connected magnetically at their opposite ends by intermeshing fingers to form a closed magnetic circuit, said arms being movable relative to each 30 other, spaced primary and secondary windings on said core in flux linking relationship to said closed magnetic circuit, and a magnetic shunt disposed between said coil windings and engaging said arms when occupying one position relative 35 to each other to divert sufficient magnetic flux from the secondary winding to effectually deenergize the same, said secondary winding having voltage induced therein of increasing value as said arms are moved to provide an air gap of increasing length between the shunt and said arms.

40 2. A controller for adjusting the power input to adjustable speed motors and the like to thereby control the speed thereof, comprising a core de-

fining a closed magnetic circuit and having sections movably mounted relative to each other, spaced primary and secondary coil windings on one of said core sections, a magnetic shunt between said coil windings and core sections and 5 mounted in fixed position relative to one of the core sections so that on moving the movable core section the closed circuit voltage of the secondary winding may be varied, a link connected to the movable core section, and a controller handle 10 having a crank pin connected to the link whereby on turning the handle relative movement between said core sections and the shunt is effected and accompanied by adjustment in the closed circuit voltage of said secondary winding. 15

3. A transformer of the character described comprising a laminated core having arms connected magnetically at their opposite ends by intermeshing fingers to form a closed magnetic circuit, said arms being movable relative to each 20 other, spaced primary and secondary windings on said core in flux linking relationship to said closed magnetic circuit and a magnetic shunt formed integrally with one of said arms and extending between said coil windings and being of a 25 length to substantially engage the other of said arms when said core arms occupy one position relative to each other to divert sufficient magnetic flux from the secondary winding to effectually deenergize the same, said secondary winding 30 having voltage induced therein of increasing value as said arms are moved to provide an air gap of increasing length between the shunt and said arms.

4. A controller according to claim 2 in which 35 the magnetic shunt is integral with one of the core sections.

5. A controller according to claim 2 in which the link is provided with an elongated slot to receive the crank pin which, as the pin revolves, 40 causes the link to move radially to the axis of rotation of the crank pin arm.

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