

July 30, 1935.

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2,009,383

TRANSFORMER TAP CHANGING APPARATUS

Filed Nov. 1, 1934

Fig. 1.

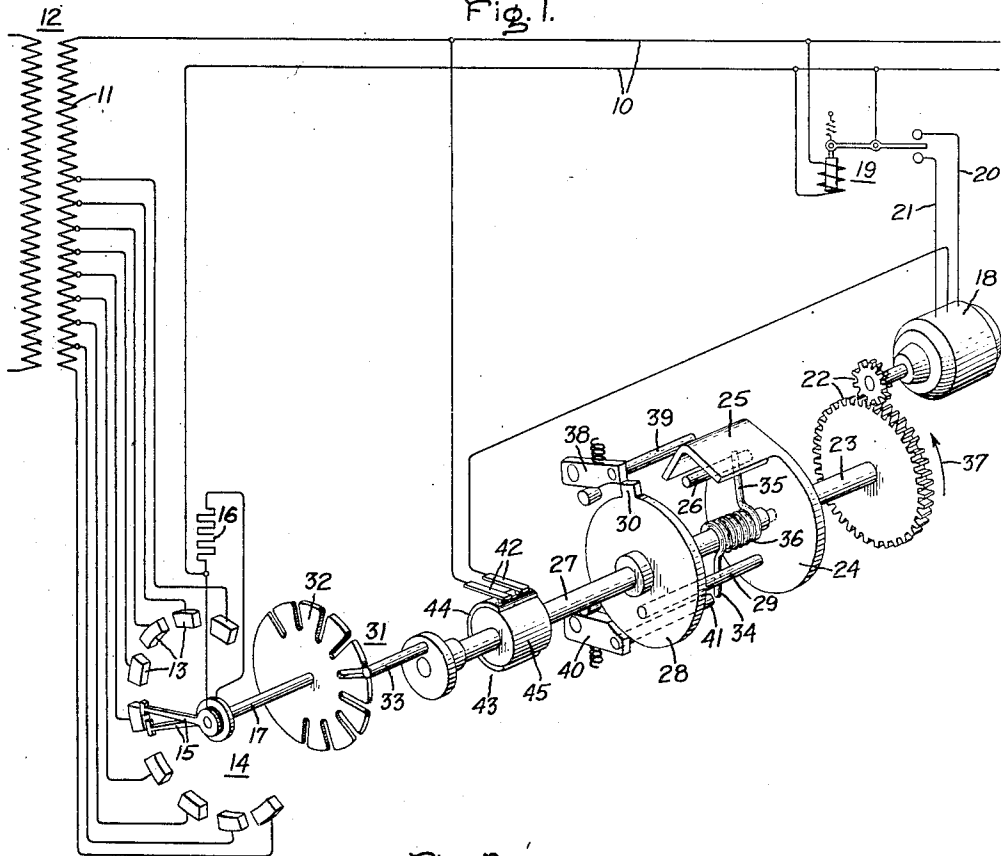
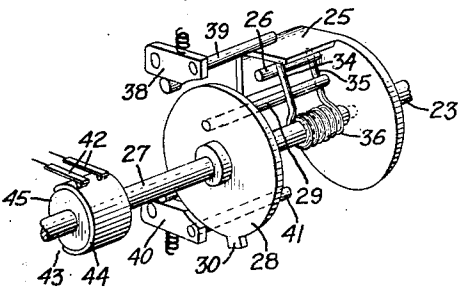


Fig. 2.



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UNITED STATES PATENT OFFICE

2,009,383

TRANSFORMER TAP-CHANGING
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Application November 1, 1934, Serial No. 750,953

4 Claims. (Cl. 171-119)

My invention relates to transformer tap-changing apparatus and more particularly to that type of apparatus in which energy is stored in a spring or equivalent device in response to a variation from a desired normal voltage of a circuit, the energy being subsequently automatically released to change the tap connection of a transformer to restore the circuit voltage to normal. The general object of the invention is to provide means for preventing injury to such apparatus in case it fails to function normally.

The invention will be better understood from the following description taken in connection with the accompanying drawing in which Fig. 1 shows transformer tap-changing apparatus of the type referred to with protective means arranged in accordance with the invention, and Fig. 2 is an explanatory view of a part of the apparatus.

Like reference characters indicate similar parts in both figures of the drawing.

The apparatus shown in the drawing is arranged to maintain substantially constant voltage in a circuit 10 supplied with voltage from the secondary winding 11 of a transformer 12. The transformer winding 11 is provided with taps connected to the fixed contacts 13 of a switch 14. A two-part contact 15 of the switch 14 is movable along the fixed contacts 13. One side of the circuit 10 is connected to one end of the transformer winding 11. The other side of the circuit 10 is connected directly to one part of the switch contact 15 and through an impedance 16 to the other part of the switch contact 15. The two parts of the switch contact 15 are insulated from each other and are angularly displaced about a common shaft 17 to which they are secured. Both parts of the movable switch contact 15 normally rest upon the same fixed contact 13. When they are moved to an adjacent fixed contact 13, each part of the movable contact 15 is momentarily open-circuited while it is between the two fixed contacts, the other part at this time carrying the full load current. Midway of the travel of the movable contact 15, its two parts bridge the two fixed contacts, at which time the impedance 16 prevents excessive circulating current between the two fixed contacts. Thus, the contact 15 may be moved from one fixed contact 13 to another without interrupting the current in the circuit 10.

The switch 14 is controlled by a reversible motor 18 and a contact-making voltmeter 19. The voltmeter 19 is connected across the circuit 10 and is arranged to close one circuit 20 and rotate the motor in one direction if the voltage of the circuit 10 increases above normal and to close

another circuit 21 and rotate the motor 18 in the other direction if the voltage of the circuit 10 decreases below normal. The motor 18 is connected through a set of reducing gears 22 to a shaft 23 which drives a disk 24 provided with a cam 25 and a pin 26. A second shaft 27 in alignment with the shaft 23 is provided with a disk 28 with a pin 29 and a peripheral projection 30. The shaft 27 is arranged to operate the movable contact 15 of the switch 14 through a Geneva type gear 31 having a slotted disk 32 and a driving pin 33. The two pins 26 and 29 project between the two outwardly turned ends 34 and 35 of a spring 36 coiled about the shaft 27. The spring 36 is under tension so that its two ends 34 and 35 tend to hold the pins 26 and 29 together as shown in Fig. 2.

Assume now that the voltage of the circuit 10 increases above its desired normal value. The voltmeter 19 will close the circuit 20 and cause the motor 18 to rotate the shaft 23 in the direction of the arrow 37. The shaft 23 will act through the pin 26, the spring 36 and the pin 29 to rotate the shaft 27 slowly in the direction of the arrow 37 until the projection 30 strikes a spring-pressed stop 38 which will prevent further rotation of the shaft 27 and further movement of the end 34 of the spring 36. The shaft 23, however, will continue to rotate and act through the pin 26 on the end 35 of the spring to increase the tension of the spring and the pressure of its end 34 on the pin 29, thus storing energy in the spring. The cam 25 will finally reach a pin 39 and lift the stop 38 to release the projection 30 and the disk 28. As shown in Fig. 1, the projection 30 and disk 28 are just about to be released. Upon release of the disk 28, the stored energy in the spring 36 is released and the pressure of the end 34 of the spring 36 on the pin 29 will rotate the shaft 27 very rapidly about one-half a revolution until it is stopped when the pin 29 strikes the other end 35 of the spring 36 and the end 34 of the spring 36 is stopped by the pin 26. This motion of the shaft 27 causes the pin 33 of the Geneva gear 31 to drive the shaft 17 one step and transfer the movable contact 15 of the switch 14 very rapidly to the next fixed contact 13 so as to reduce the voltage applied to the circuit 10. If the voltage has been thus reduced to its normal value, the voltmeter 19 will open the circuit 20 and the motor 18 will stop. Otherwise the motor 18 will continue to operate until the normal voltage of the circuit 10 has been restored.

If the voltage of the circuit 10 decreases below

its normal desired value, then the voltmeter 19 will close the circuit 21 and rotate the motor 18 to turn the shaft 23 in the direction opposite to that indicated by the arrow 37. This will rotate both shafts 23 and 27 until the projection 30 of the disk 28 strikes a second spring-pressed stop 40 to prevent further rotation of the shaft 27. The shaft 23 will, however, continue to rotate and act through the pin 26 to tension the spring 36 until the cam 25 reaches a pin 41 on the stop 40. The cam 25 then lifts this stop 40 and releases the projection 30 and the disk 28 to permit the spring 36 to turn the shaft 27 very rapidly about one half a revolution and transfer the movable contacts 15 of the switch 14 very rapidly to the next fixed contact 13, thus increasing the voltage of the circuit 10.

In accordance with the invention the operating circuit of the motor 18 includes two contacts 42 which rest on a commutator 43 mounted on the shaft 27. This commutator 43 includes a conductive section 44 and a non-conductive or insulating section 45, the insulating section 45 being arranged to break the motor circuit while the shaft 27 and the switch 14 are being rotated by the spring 36. Under all other conditions of operation the contacts 42 rest on the conductive section 44 of the commutator and the motor circuit is thus closed between these two contacts. The motor 18, in response to a variation from normal value of the voltage of the circuit 10, will rotate the shaft 23 rather slowly but when the spring 36 has been fully tensioned and the shaft 27 is released the spring will very rapidly rotate the shaft 27 and operate the switch 14 one step. However, the apparatus may not always function as intended because of some excessive friction, breakage of the spring 36 or other abnormal condition. Thus, instead of moving very rapidly from one fixed contact 13 to another, as intended, the movable contact 15 may move slowly or may stop when not in normal position on a fixed contact 13. The motor 18, however, would continue to drive the shaft 23 and this might cause damage to some part of the apparatus or it might cause the movable contact 15 to continue to move slowly so as to result in serious arcing and burning of the contacts. Just as soon, however, as the insulating section 45 of the commutator 43 reaches the contacts 42, the motor driving circuit is broken and the motor stops so that further damage to the apparatus is effectively prevented. This insulating section 45 of course interrupts the operating circuit of the motor each time that the switch 14 is operated by the spring 36 but the interruption

of the motor circuit is so brief as to have substantially no effect upon the motor.

The invention provides very simple and effective protection for automatic transformer tap-changing apparatus. It has been explained by describing and illustrating a particular arrangement and application thereof but it will be obvious that changes may be made without departing from the spirit of the invention and the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States, is,—

1. The combination with a transformer having a winding with taps and a circuit connected thereto, of a switch for changing tap connections to adjust the voltage of said circuit, means responsive to voltage changes in said circuit for storing energy, means for automatically releasing the stored energy to operate said switch, and means for interrupting the operation of said energy storing means during operation of the switch.

2. The combination with a transformer having a winding with taps and a circuit connected thereto, of a switch for changing tap connections to adjust the voltage of said circuit, means responsive to voltage changes in said circuit for storing energy, means including a shaft for operating said switch, means for automatically releasing the stored energy to operate said shaft, and means controlled by said shaft for interrupting the operation of said energy storing means during operation of the switch.

3. The combination with a transformer having a winding with taps and a circuit connected thereto, of a switch for changing tap connections to adjust the voltage of said circuit, means including a motor responsive to voltage changes in said circuit for storing energy, means for releasing the stored energy to operate said switch, and a circuit interrupter controlled by said switch operating means for interrupting the driving circuit of the motor during operation of the switch.

4. The combination with a transformer having a winding with taps and a circuit connected thereto, of a switch for changing tap connections to adjust the voltage of said circuit, means including a motor responsive to voltage changes in said circuit for storing energy, means including a shaft for operating said switch, means for releasing the stored energy to rotate said shaft, contacts in the driving circuit of said motor, and a commutator controlled by said shaft for opening said contacts during the operation of the switch.

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