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TAP CHANGERS

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2 Sheets-Sheet 1

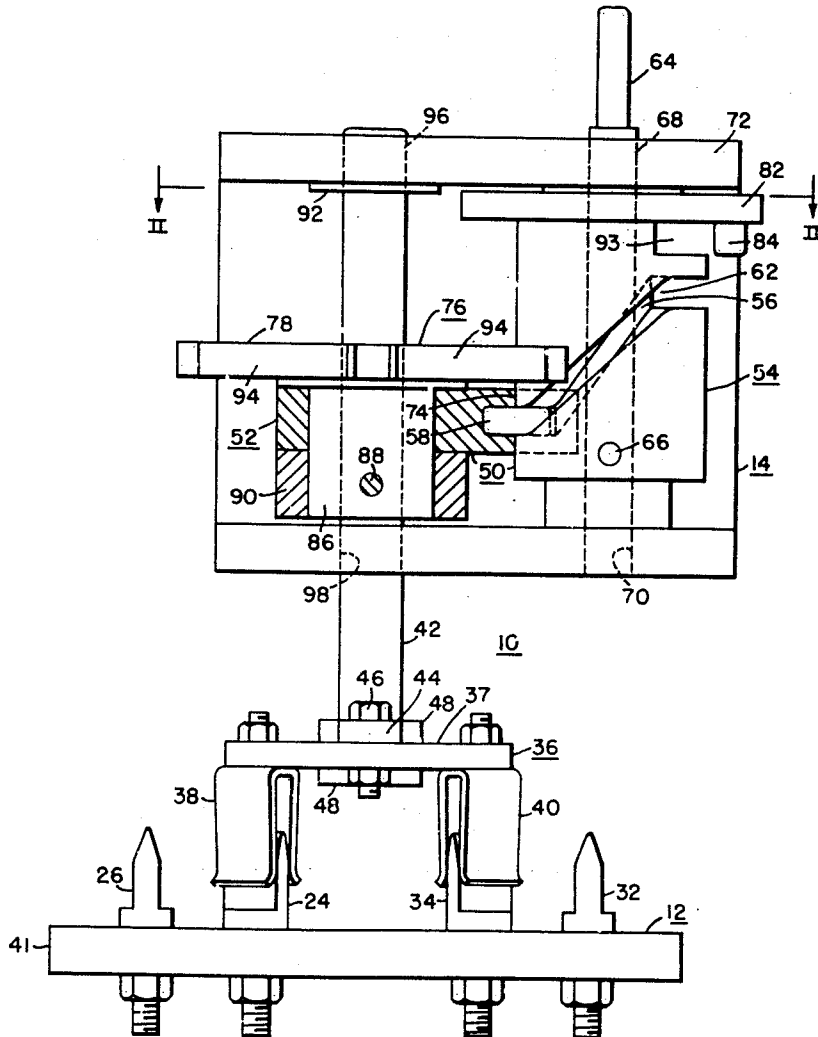


Fig. I.

WITNESSES

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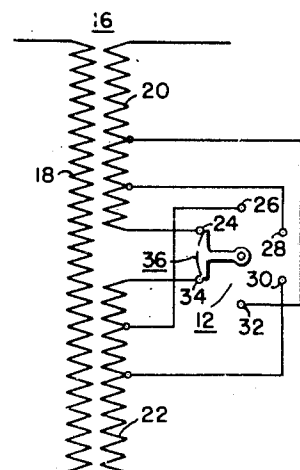
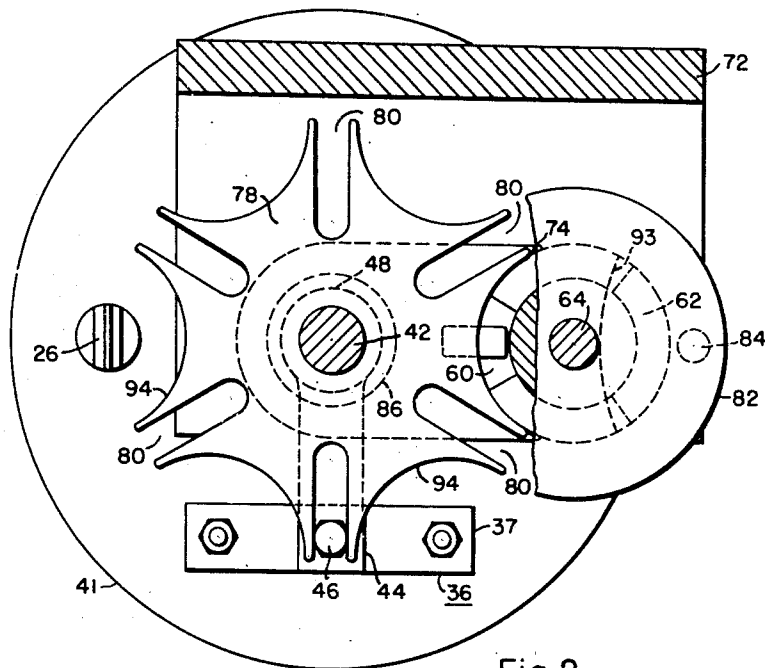
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TAP CHANGERS

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6 Claims. (Cl. 200—17)

This invention relates to tap changers, such as are used in transformers, for changing the ratio between the primary and secondary voltages.

Many transformers are operated under conditions which require that the voltage ratio between the primary and secondary windings be adjusted at intervals. This may be done by providing one of the transformer windings with a plurality of tap connections connected between suitable tap points on the winding and switch contact members so that by operation of the tap-changer switch a selected number of turns of the winding may be excluded from or included in the winding circuit, as desired, thus varying the effective number of turns in the winding.

In order to effect an operation of the tap-changer switch, a switch operating mechanism is provided. In practice, the switch operating mechanism should have a minimum of back-lash so that as the tap-changer switch is actuated to the closed position its movable contact members will be in proper alignment with the oppositely disposed stationary contact members. By maintaining such alignment, the movable contact member or members will always properly engage the oppositely disposed stationary contact members.

In practice, it is also desirable that the switch operating mechanism occupy a minimum of space. For instance, one prior art switch operating mechanism comprises an operating shaft which is disposed at right angles to the switch actuating shaft. Such a prior art arrangement consumes considerable needed space.

A broad object of this invention is to provide for operating a tap-changer switch from one tap position to another by first effecting a longitudinal movement of a movable switch contact member to thereby effect a disengagement of the movable switch contact member from the stationary switch contact members, then effecting a rotary movement of the movable switch contact member so as to align it with another stationary switch contact member in the sequence of operation, and then effecting another longitudinal movement of the movable switch contact member so as to bring the movable switch contact member into engagement with the last-mentioned stationary switch contact member.

A specific object of this invention is to provide for obtaining a minimum of back-lash in a tap-changer operating mechanism to thereby obtain a proper alignment of a movable contact member of a tap-changer switch with an oppositely disposed stationary contact member before actuating it into engagement with the stationary contact member.

A more specific object of this invention is to provide for obtaining a proper alignment of a movable contact member of a tap-changer switch with an oppositely disposed stationary contact member before actuating it into the closed position with respect to the stationary contact member, by coordinating a Geneva gear mechanism, disposed for longitudinal movement with an actuating shaft carry-

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ing the movable contact member, with a drum cam disposed for rotary movement with an operating shaft.

Another object of this invention is to provide a tap-changer switch operating mechanism whose operating shaft is substantially parallel to the switch actuating shaft, to thus provide a compact tap-changer switch operating mechanism.

Other objects of this invention will become apparent from the following description when taken in conjunction with the accompanying drawings, in which:

Figure 1 is a side elevational view, partly in section, of a tap-changer switch and associated tap-changer operating mechanism illustrating the teachings of this invention;

Fig. 2 is a view in section taken along the lines II—II of Fig. 1; and

Fig. 3 is a diagrammatical view showing the tap connections between the tap-changer switch and the transformer winding.

Referring to the drawings, and in particular to Fig. 1, there is illustrated a tap-changer switch 10 comprising a multiple position tap-changer switch 12 and a tap-changer operating mechanism 14 for selectively actuating the tap-changer switch 12 from one position to the next.

Referring to Fig. 3, the tap connections between the tap-changing switch 12 and a transformer 16, having a primary winding 18 and secondary winding sections 20 and 22, are illustrated. In this instance, the tap-changer switch 12 comprises a plurality of circumferentially spaced stationary contact members 24, 26, 28, 30, 32 and 34, and a movable contact bridging device 36 that is capable of bridging any two adjacent stationary contact members. With the movable bridging device 36 positioned as shown: the tap-changer switch 12 is in the neutral position, that is, all of the turns of the secondary winding sections 20 and 22 are included in the secondary winding circuit. As will be explained more fully hereinafter, by rotating the movable bridging device 36 clockwise, turns of the secondary winding sections 20 and 22 are excluded from the secondary winding circuit, to thereby decrease the output voltage of the transformer 16.

As illustrated, the bridging device 36 comprises an electrical conducting bar 37 and two movable contact members 38 and 40, which are suitably secured to either end of the bar 37 and spaced from one another a distance equal to the spacing between adjacent stationary contact members 24, 26, 28, 30, 32 and 34 which are suitably secured to an electrical insulating disc 41. The bridging device 36 is suitably secured to a switch or contact actuating shaft 42 for longitudinal and rotary movement therewith. In particular, an electrical insulating support member 44 is suitably secured to the bar 37 by means of a bolt and nut 46 and suitably secured to the switch actuating shaft 42 by means of a collar 48.

In order to effect a reciprocal longitudinal movement of the switch actuating shaft 42 to thus open and close the multiple position switch 12, cam means 50 is provided. The cam means 50 includes a cam follower member 52 operable to effect a reciprocal longitudinal movement of the switch actuating shaft 42, and a drum cam 54 disposed to coact with the cam follower member 52 to effect the reciprocal longitudinal movement of the switch actuating shaft 42. In particular, the drum cam 54 has a vertically inclined slot 56 the defining surfaces of which coact with a cam follower pin 58 which in turn forms a part of the cam follower member 52. The vertically inclined slot 56 extends upwardly on both sides of the drum cam 54 from a lower land 60 to an upper land 62.

In operation, the drum cam 54 is carried by an operating shaft 64 for rotary movement therewith, the drum cam 54 being suitably secured to the operating shaft 64

by means of a pin 66. The operating shaft 64 is parallel with the switch actuating shaft 42 and is disposed in suitable openings 68 and 70 in a U-shaped support member 72, the openings being sufficiently large to permit rotation of the operating shaft 64 relative to the U-shaped support member 72. As can be seen from Fig. 1, the support member 72 functions to hold the assembly including the drum cam 54 and its associated operating shaft 64 in operating position in both the vertical and horizontal direction.

In order to maintain alignment of the cam follower member 52 with the drum cam 54 and thus prevent binding of the cam follower pin 58 in the slot 56 of the drum cam 54, the cam follower member 52 is provided with an outer arcuate surface 74 which cooperates with the peripheral surface of the drum cam 54 in obtaining such alignment. Thus, as the cam follower member 52 moves up and down vertically in operation, the arcuate surface 74 is in sliding engagement with the peripheral surface of the drum cam 54.

For the purpose of effecting a rotary movement of the switch actuating shaft 42 only when the tap-changer switch 12 is in the open position to thus effect an advancement of the bridging device 36 to a position directly above the next pair of stationary contact members of the tap-changer switch 12, a Geneva mechanism 76 is provided. The Geneva mechanism 76 comprises a Geneva gear or star-shaped wheel 78, having a plurality of slots 80, and a pin wheel 82 having a pin 84 thereon for engagement with the surfaces defining the slots 80. As illustrated, the pin wheel 82 is integral with the drum cam 54, however, it is to be understood that it could separate therefrom provided it were carried by the operating shaft 64 for rotary movement therewith. In this instance, the Geneva gear or star-shaped wheel 78 is provided with a hub 86 which is in integral part of the Geneva gear or star-shaped wheel 78 and which is suitably secured to the switch actuating shaft 42 for longitudinal and rotary movement therewith by means of a pin 88.

The cam follower member 52 is disposed on the hub 86 and is held in assembled relationship with respect to the Geneva gear or star-shaped wheel 78 on downward movement of the switch actuating shaft 42 by means of a collar 90 which is likewise disposed on the hub 86 and held in fixed position relative thereto by the pin 88. However, the Geneva gear or star-shaped wheel 78 and the switch actuating shaft 42 are free to rotate relative to the cam follower member 52 when the cam means 50 has actuated the Geneva gear or star-shaped wheel 78 up against a bearing washer 92, in which position the pin wheel 82 is disposed to coast with the Geneva gear or star-shaped wheel 78 to thereby effect a rotary movement of the switch actuating shaft 42. A cut-away portion 93 of the drum cam 54 permits rotation of the Geneva gear or star-shaped wheel 78 when so positioned.

In order to prevent rotation of the switch actuating shaft 42 as it is actuated longitudinally by the cam means 50 in a downward direction the outer arcuate surfaces 94 of the Geneva gear or star-shaped wheel 78 cooperate with the peripheral surface of the drum cam 54 to prevent such rotation. By preventing rotation of the switch actuating shaft 42 during this portion of the operation proper vertical alignment of the movable contact members 38 and 40 with the oppositely disposed stationary contact members of the tap-changer switch 12 is obtained. In other words, the tap-changer operating mechanism has a minimum of back-lash. Vertical alignment of the switch actuating shaft 42 is obtained by aligning the shaft 42 in openings 96 and 98 in the U-shaped support member 72.

The operation of the tap-changer will now be described. As shown in the drawings the tap-changer 10 is in the neutral position, that is all of the turns of the secondary winding sections 20 and 22 are connected in the sec-

ondary winding circuit. When the operating shaft 64 is rotated in a counterclockwise direction, the cam follower pin 58 slides in the slot 56 and the drum cam 54 effects a longitudinal movement of the switch actuating shaft 42 in the upward direction. However, when the operating shaft 64 has been rotated a predetermined amount in the counterclockwise direction, the movable contact members 38 and 40 become disengaged from their respective stationary contact members 24 and 34 of the multiple position switch 12.

On further rotation of the operating shaft 64 in the counterclockwise direction, the cam follower pin 58 reaches the upper land 62 of the drum cam 54 and when so positioned the pin 84 of the pin wheel 82 engages the surface defining one of the slots 80 of the Geneva gear or star-shaped wheel 78. Further rotation of the operating shaft 64 in the counterclockwise direction effects a rotary movement of the Geneva gear or star-shaped wheel 78 in the clockwise direction to thus effect a rotary movement of the switch operating shaft 42 and the bridging device 36 in a clockwise direction to thereby align the movable contact members 38 and 40 vertically above the stationary contact members 26 and 24, respectively. During this latter rotary movement of the operating shaft 64 the cam follower pin 58 moves along the upper land 62 of the drum cam 54.

Further rotary movement of the operating shaft 64 in the counterclockwise direction effects a longitudinal movement of the switch actuating shaft 42 in a downward direction and thus a longitudinal downward movement of the bridging device 36. During this latter rotary movement of the operating shaft 64, the cam follower pin 58 slides along the slot 56 until the drum cam 54 forces the cam follower pin 58 down to the lower land 60 of the drum cam 54 thus forcing the movable contact members 38 and 40 into engagement with the stationary contact members 26 and 24, respectively. With the tap-changer switch 12 so positioned a number of turns of the secondary winding section 22 are excluded from the secondary circuit of the transformer 16.

When the operating shaft 64 is rotated another 360 degrees in the counterclockwise direction, the bridging device 36 bridges the stationary contact members 26 and 28, thus excluding a number of turns from each of the secondary winding sections 20 and 22 from the secondary winding circuit of the transformer 16. Of course, a rotary movement of the operating shaft 64 in the clockwise direction effects a rotary movement of the bridging device 36 in the counterclockwise direction. Since such operation is substantially the same as that hereinbefore described for counterclockwise movement of the operating shaft 64 a further description of such operation is deemed unnecessary.

The apparatus embodying the teachings of the invention has several advantages. For instance, the tap-changer operating mechanism 14 has a minimum of backlash and thus proper vertical alignment between the movable contact members 38 and 40 and the particular stationary contact members of the switch 12 is obtained before the switch 12 is actuated to the closed position. In addition, the tap-changer illustrated is compact and thus takes up a minimum of space.

Since numerous changes may be made in the above described construction, and different embodiments of the invention may be made without departing from the spirit and scope thereof, it is intended that all matter contained in the foregoing description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

We claim as our invention:

1. In a transformer tap-changer having a multiple position switch, the combination comprising, a switch actuating shaft, operating means comprising cam means operable to effect a reciprocal longitudinal movement of the switch actuating shaft to thus open and close the multiple

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position switch, and an anti-back lash mechanism comprising a star-shaped wheel having slots therein and a wheel having a pin thereon for engaging the slots in said star-shaped wheel when the multiple position switch is in the open position to effect a rotary movement of the switch actuating shaft to thereby actuate the multiple position switch from one position to the next.

2. In a transformer tap-changer having a multiple position switch, the combination comprising, a switch actuating shaft, operating means comprising a cam follower member operable to effect a reciprocal longitudinal movement of the switch actuating shaft to thus open and close the multiple position switch, an operating shaft, said switch actuating shaft and said operating shaft being substantially parallel to each other, a cam member carried by the operating shaft for rotary movement therewith, the cam member being disposed to coact with the cam follower member to effect said reciprocal longitudinal movement, a star-shaped wheel carried by said switch actuating shaft, said star-shaped wheel having a plurality of slots therein, and a wheel having a pin thereon carried by said operating shaft, said pin being engageable with the slots in said star-shaped wheel when the multiple position switch is in the open position to effect a rotary movement of the switch actuating shaft to thereby actuate the multiple position switch from one position to the next.

3. In a transformer tap-changer having a multiple position switch, the combination comprising, a switch actuating shaft, operating means comprising a cam follower member operable to effect a reciprocal longitudinal movement of the switch actuating shaft to thus open and close the multiple position switch, an operating shaft, said switch actuating shaft and said operating shaft being substantially parallel to each other, a cam member carried by the operating shaft for rotary movement therewith, the cam member being disposed to coact with the cam follower member to effect said reciprocal longitudinal movement, a star-shaped wheel carried by the switch actuating shaft for longitudinal and rotary movement therewith, and a pin wheel carried by the operating shaft for rotary movement therewith, the pin wheel being disposed to coact with the star-shaped wheel when the multiple position switch is in the open position to thereby effect a rotary movement of the switch actuating shaft, to thus actuate the multiple position switch from one position to the next.

4. In a transformer tap-changer having a multiple position switch, the combination comprising, a switch actuating shaft, operating means comprising a cam follower member operable to effect a reciprocal longitudinal movement of the switch actuating shaft to thus open and close the multiple position switch, an operating shaft, a drum cam carried by the operating shaft for rotary movement therewith, the drum cam being disposed to coact with the cam follower member to effect said reciprocal longitudinal movement, a Geneva gear carried by the switch

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actuating shaft for longitudinal and rotary movement therewith, the Geneva gear having a plurality of arcuate surfaces which cooperate with the peripheral surface of the drum cam to prevent rotation of the switch actuating shaft as it is actuated longitudinally in closing the multiple position switch, and a pin wheel carried by the operating shaft for rotary movement therewith, the pin wheel being disposed to coact with the Geneva gear only when the multiple position switch is in the open position to thereby effect a rotary movement of the switch actuating shaft and thus actuate the multiple position switch from one position to the next.

5. In a transformer tap-changer having a multiple position switch, the combination comprising, a switch actuating shaft, operating means comprising a cam follower member operable to effect a reciprocal longitudinal movement of the switch actuating shaft to thus open and close the multiple position switch, an operating shaft, a drum cam carried by the operating shaft for rotary movement therewith, the drum cam being disposed to coact with the cam follower member to effect said reciprocal longitudinal movement and the cam follower member having a surface for cooperating with the peripheral surface of the drum cam to effect alignment of the cam follower member with the drum cam during the said reciprocal movement, a Geneva gear carried by the switch actuating shaft for longitudinal and rotary movement therewith, the Geneva gear having a plurality of arcuate surfaces which cooperate with the peripheral surface of the drum cam to prevent rotation of the switch actuating shaft as it is actuated longitudinally in closing the multiple position switch, and a pin wheel carried by the operating shaft for rotary movement therewith, the pin wheel being disposed to coact with the Geneva gear only when the multiple position switch is in the open position to thereby effect a rotary movement of the switch actuating shaft and thus actuate the multiple position switch from one position to the next.

6. In a transformer tap-changer having a multiple position switch, the combination comprising, contact means including a longitudinally movable contact structure, cam means operable to effect a longitudinal movement of said movable contact structure to open and closed positions, and a mechanism comprising a star-shaped wheel having slots therein and a wheel having a pin thereon for engaging the slots in said star-shaped wheel to effect rotation of said movable contacts structure when said movable contact structure is in open position.

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