Sept. 25, 1951 P. A. UNVERZAGT 2,568,888

WRENCH OPERATED TAP CHANGER MECHANISM

Filed Feb. 3, 1950

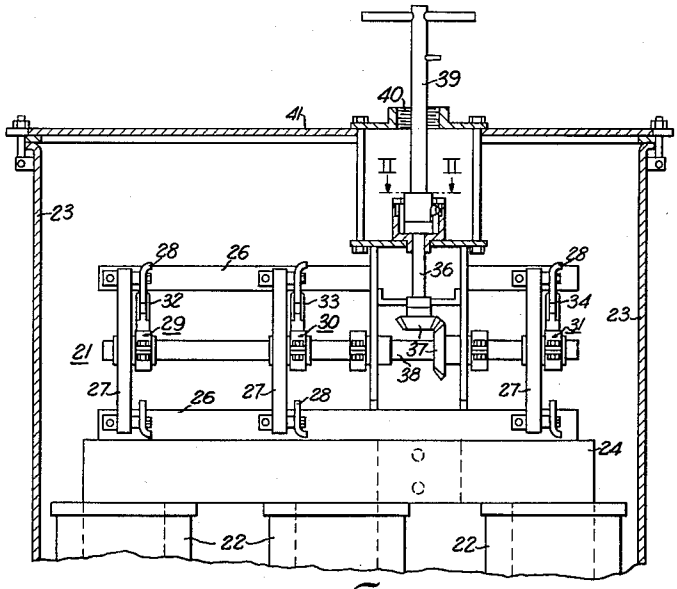


Fig. 1

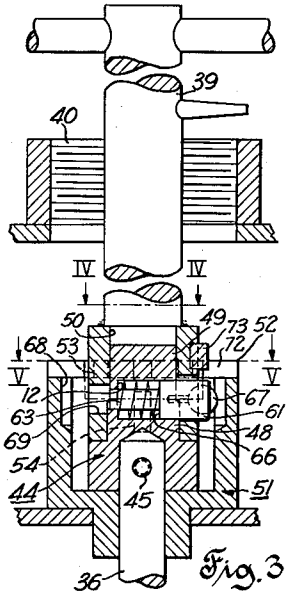


Fig. 3

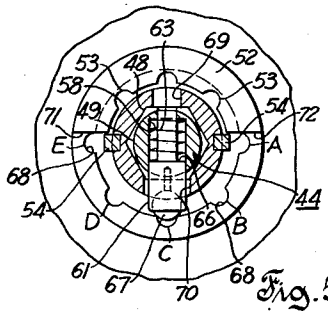


Fig. 5

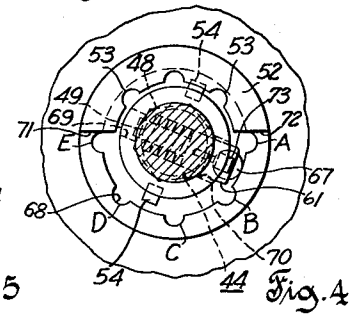


Fig. 4

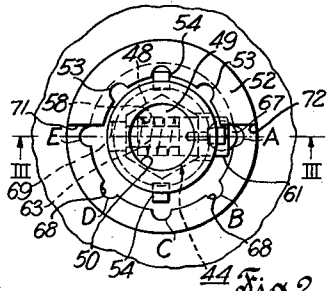


Fig. 2

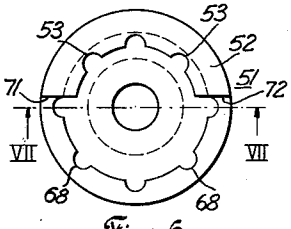


Fig. 6

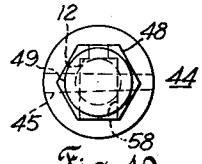


Fig. 10

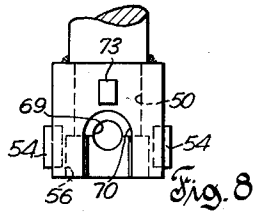


Fig. 8

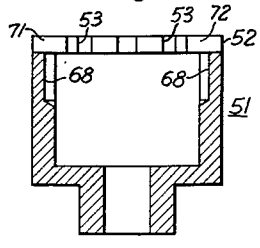


Fig. 7

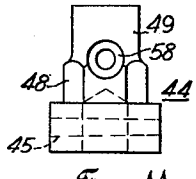


Fig. 11

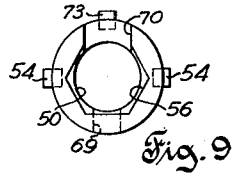


Fig. 9

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WRENCH OPERATED TAP CHANGER MECHANISM

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Application February 3, 1950, Serial No. 142,336

7 Claims. (Cl. 74—548)

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This invention relates generally to operating mechanisms for switch apparatus and in particular relates to means for moving the switch apparatus from one predetermined position to another predetermined position with a snap action preventing movement beyond certain predetermined positions and for preventing separation of the operating elements of the switch apparatus between predetermined positions.

The invention is particularly suitable for use in tap changing equipment associated with induction apparatus. The tap changer being manually operated and located within an enclosing casing is usually wrench operated from outside of the casing. The enclosing casing may have an opening provided with a removable cap or plug through which the wrench can be inserted to operate the switch apparatus of the tap changer.

The use of wrench operated tap changer equipment with electric induction apparatus is disclosed in the prior art. It has been suggested to have a detent associated with the tap changer mechanism for causing a snap action as the tap changer is moved to each predetermined position. It has also been suggested to provide means to insure that the operating wrench of the switch operating mechanism cannot be removed from the enclosing casing unless the wrench is aligned in a particular manner with respect to the opening in the casing; for example, the opening through which the wrench is inserted may include notches with which lugs on the operating wrench must align before the wrench can be removed from the casing. However, the type of apparatus disclosed in the prior art does not provide means to insure that the operating wrench will properly operate the tap changing equipment.

In a preferred embodiment of this invention means are provided for guiding the operating wrench into proper engagement with an operating shaft of the tap changing equipment when the tap changer is in one of selected positions, for interlocking the shaft and wrench at positions intermediate the selected positions, for preventing removal of the wrench from the enclosing casing except when the apparatus is in a selected position, and for preventing movement of the wrench and apparatus beyond the extreme selected positions.

Having in mind the defects of the prior art, an object of this invention is to provide an improved switch apparatus.

Another object of this invention is to provide a wrench operated switch apparatus in which separation of the operating wrench from the switch and from the enclosing casing is prevented when the switch apparatus is not in selected positions.

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Another object is to provide an improved tap changer which insures proper engagement of the elements of the operating mechanism, interlocks the elements, prevents withdrawal of the hand operated element at positions other than predetermined positions, and prevents movement of the operating mechanism except through predetermined positions.

These and other objects will be apparent to those skilled in the art to which this invention relates from the following description when read in connection with the accompanying drawing, in which:

Fig. 1 is an elevation view partially in section of the upper portion of a transformer showing a preferred embodiment of this invention adapted to the tap changing equipment of the transformer;

Fig. 2 is an enlarged sectional view taken along lines II—II of Fig. 1, the mechanism shown in the extreme tap position A;

Fig. 3 is an enlarged view partly in elevation and partly in section of the operating mechanism shown in Fig. 1, the mechanism being assumed to be brought to the extreme tap position A;

Fig. 4 is a sectional view taken along line IV—IV of Fig. 3 assuming the mechanism to be in a position intermediate two tap positions;

Fig. 5 is another view in section taken along stepped line V—V of Fig. 3, the mechanism being assumed to be in a tap position;

Fig. 6 is an enlarged plan view of the flanged fixed member controlling the movement of the wrench used with the operating mechanism;

Fig. 7 is a sectional view taken along line VII—VII of Fig. 6;

Figs. 8 and 9, respectively, are enlarged front and bottom views of the socket portion of the wrench used for changing the taps;

Figs. 10 and 11, respectively, are enlarged plan and front views of the operating nut with which the socket of the wrench cooperates.

A tap changer 21 is shown in Fig. 1 associated with a three phase transformer 22 enclosed in a casing 23. The upper end frame 24 clamps the laminated steel core of the transformer 22 and also may be the supporting structure for the tap changer 21 and frame 26. Three tap changer insulation panels 27 each having six fixed contact blocks 28 are vertically positioned above the upper end frame 24. Movable assemblies 29, 30 and 31 each having double contact shoes 32, 33,

34 are used to change taps by movement of the movable assemblies from one contact block to another. The three movable assemblies 29, 30, 31 are controlled by the operating shaft 36. Movement of the operating shaft 36 is transmitted through bevel gears 37 to shaft 38 to which the movable contacts are attached. Thus all three phases of the transformers are tap changed together, eliminating any chance of one phase being connected differently from another.

The operating shaft 36 is turned by a special wrench 39 which is inserted through a hole 40 in the cover 41 of the transformer casing. When the wrench is not being used to change the tap, it is removed from the hole, and the hole is then sealed tightly by a pipe plug (not shown).

In the preferred embodiment shown, this invention provides effective means to insure that the operator cannot improperly use the operating wrench or improperly move the tap changing equipment even though the wrench is so used that the operator does not see the tap changer.

An operating nut 44 is fixed to the end of the operating shaft 36 in any suitable known manner as by a tapered pin 45. The operating nut being fixed to the operating shaft 36 can be rotated therewith about the longitudinal axis of the operating shaft.

The operating nut is provided with a portion 48 thereof defining driving surfaces preferably having the hexagonal shape shown, with which the driving surfaces of the wrench 39 cooperate to turn the operating shaft.

Above the hexagonal porton 48 the operating nut has a cylindrical shaped extension 49. The cylindrical end corresponds to the cylindrical recess 50 in the socket portion of the wrench. The cylindrical end portion of the nut is made comparatively long with respect to the hexagonal portion of the nut in order to assure proper engagement between the wrench and the operating nut. The cylindrical parts of the wrench and nut cooperate to guide the wrench so that the driving surfaces of the wrench properly align with the hexagonal portion of the nut. Exact axial alignment of the wrench, nut and operating shaft is thereby assured.

It is quite important that proper contact between the operating nut and wrench is assured. And it is generally difficult to be sure of such contact inside of the enclosing casing as the operator cannot see what kind of contact the wrench is making with the operating nut. Improper contact of the wrench with the operating nut may make it possible to improperly operate the tap changing equipment. For example, the wrench might slip off the nut without completing a change from one tap to another.

The fixed hollow guide member 51 is coaxially spaced from the operating shaft and operating nut. This guide member serves in several ways to insure proper operation of the tap changing equipment. As will be apparent from the following description it guides the wrench as it engages the operating shaft, it prevents withdrawal of the wrench at positions intermediate selective positions and it restricts operation of the switch to the range of the selective positions.

The top edge of the guide member has a radially inwardly extending flange 52. The inner edge of the flange has a plurality of spaced recess 53 therein. The external surface of the socket portion of the wrench has two diametrically opposed longitudinally extending ribs or lugs 54 thereon. One of these lugs cooperates with one the recesses in the flange to guide the socket portion 56 of the wrench as it is inserted into contact with the operating nut. The lugs on the socket and the recesses in the flange are positioned so that the socket of the wrench can be engaged with the operating nut only when the operating shaft and tap changing equipment is in one of predetermined selective positions corresponding to tap positions. In moving from one predetermined selective position to the next selective position the wrench moves with respect to the guide member so that one of the lugs of the wrench moves below the flange from alignment with one of the recesses of the flange. Intermediate the two selective positions the wrench cannot be withdrawn as at least one of the lugs of the wrench is beneath the flanged surface.

The guide member also cooperates with a biased pin in the operating nut. The operating nut has a stepped hole 58 bored therein which serves as a retainer and guide means for a biased pin 61. The hole in the operating nut is located transversely to the axis of the operating shaft. The difference in the diameters of the bore defines a shoulder 12. A spring 63 is inserted into the large end of the hole. One end of the spring rests on the shoulder in the bore. The pin has one end larger than the other end and therefore has a shoulder 66 intermediate the ends. The larger of the two ends of the pin defines a socket containing a freely rotatable ball 67. The pin is inserted into the large end of hole 58 with the small end of the pin first until the shoulder of the pin rests against the end of the spring. The large end of the pin with the freely rotatable ball extends out of the hole in the nut and makes contact with the fixed hollow guide member 51 surrounding the operating shaft.

A plurality of circumferentially spaced semicylindrical recesses 68 are cut in the inner surface of the guide member. There are five of these recesses and they correspond to the aforementioned predetermined selective or tap positions of which there are also five. As the operating shaft is rotated about its axis the ball in the pin rides on the inner surface of the guide member, and the spring biased pin and the ball move with a snap action into the recesses. The inner peripheral surface of the guide member acts as a cam surface against which the pin rides so that the pin has a transverse movement in the hole of the operating nut.

When the ball makes contact with the inner surface of the guide member intermediate the recesses the smaller end of the pin will protrude from the small end of the hole and into a hole 69 in the socket portion of the wrench which is in engagement with the operating nut. In this manner the operating nut and wrench are interlocked intermediate selective positions.

The socket portion of the wrench, in addition to the hole in the wall thereof to accommodate the small end of the pin, has in the wall of the socket portion diametrically opposite to the hole an opening forming a notch 70 to accommodate the end portion of the pin containing the freely rotatable ball which snaps into selective or tap positions.

As illustrated there are five selective or tap positions. These are designated as A, B, C, D and E. The corresponding five longitudinally extending semicylindrical recesses in the inner wall of the guide member are all located on one half of the inner peripheral surface of the guide member so that the operating shaft turns through an

angle of 180° as it goes from one extreme selective position, A, to the other extreme selective position, E. The flange of the guide member extends inwardly only from the portion of the guide member opposite the five recesses, and thus the flange is slightly less than semicircular with vertical edge surfaces 72, 71, respectively, adjacent the extreme selective positions A and E. These edge surfaces coact with the wrench to limit the movement of the wrench to a predetermined range including the selective positions.

On the external surface of the socket of the wrench above the notch 70 is a third lug 73. This third lug 73 is positioned higher on the external surface of the socket than the other two lugs, and when the wrench is in engagement with the operating nut, this third lug being directly above the recess will also be above the biased pin. When the biased pin is in extreme position A, the third lug 73 will abut edge surface 72 of the flange. When the operating shaft is turned to position E, the lug 73 will abut the other end of the flange against edge surface 71. Thus it is impossible for the operator to move the operating mechanism beyond the predetermined positions.

Although but one embodiment of the present invention has been illustrated and described, it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims. Features disclosed but not claimed herein are claimed in a copending application Ser. No. 101,877 of Frank E. Grommes, filed June 28, 1949.

It is claimed and desired to secure by Letters Patent:

1. A switch operating mechanism including an operating shaft having a plurality of selective positions, a wrench defining a socket portion cooperative with one end of said shaft for rotating said shaft, said socket portion engageable with and disengageable from said shaft at any of said selective positions, the external surface of said socket portion having a plurality of lugs thereon, and protective means for preventing improper operation of the switch operating mechanism including means to interlock said shaft with said wrench, said interlock means including said lugs and a fixed member cooperable with one of said lugs of said socket portion to provide means for guiding said socket portion into cooperable engagement with said operating shaft when said operating mechanism is in any of said selective positions, said member having a first surface cooperable with another of said lugs of said socket when the operating mechanism is in an extreme said selective position to prevent movement of said operating mechanism beyond said extreme selective position, said member having a second surface cooperable with said one of said lugs of said socket portion when said operating mechanism is in positions intermediate said selective positions to prevent removal of said wrench from engagement with said shaft.

2. A switch operating mechanism including an operating shaft, a wrench, defining a socket portion cooperative with one end of said operating shaft, the external surface of said socket portion having a plurality of lugs, and a fixed guide member coaxially spaced from said shaft, a first portion of the inner periphery of said guide member having a first plurality of circumferentially spaced recesses, a second portion of the inner periphery of said guide member including a flange having a second plurality of circumferentially spaced recesses, said end of said operating shaft including a biased member, said biased member rotatable with said end of said shaft and making contact with said first portion of said guide member, said wrench and said shaft interlocked by said biased member when said biased member contacts said guide member at positions intermediate said first plurality of recesses, said biased member movable with a snap action into contact with said first plurality of recesses to define selective positions for said operating shaft, one of said lugs cooperative with said flange to restrict movement of said shaft by said wrench to a predetermined range including said selective positions, a second one of said lugs cooperative with any of said second plurality of recesses to guide said socket into engagement with said end of said shaft at any selective position and cooperative with portions of said flange intermediate said second plurality of recesses to prevent separation of said socket from engagement with said end of said shaft.

3. A switch operating mechanism including an operating shaft, a wrench defining a socket portion cooperative with one end of said operating shaft, the external surface of said socket portion having a plurality of lugs, and a fixed guide member coaxially spaced from said shaft, a first portion of the inner periphery of said guide member having a first plurality of circumferentially spaced recesses to define selective positions for said operating shaft, a second portion of the inner periphery of said guide member including a flange having a second plurality of circumferentially spaced recesses, said end of said operating shaft including a biased member, said biased member rotatable with said end of said shaft and making contact with said first portion of said guide member and said first plurality of recesses, said wrench and said shaft interlocked by said biased member when said biased member contacts said guide member at positions intermediate said first plurality of recesses, one of said lugs cooperative with said flange to restrict movement of said shaft by said wrench to a predetermined range including said selective positions, a second one of said lugs cooperative with any of said second plurality of recesses to guide said socket into engagement with said end of said shaft at any of said selective positions of said shaft and cooperative with portions of said flange intermediate said second plurality of recesses to prevent separation of said socket from engagement with said end of said shaft.

4. A switch operating mechanism including an operating shaft, a wrench defining a socket portion cooperative with one end of said operating shaft for rotating said shaft into a plurality of selective positions, a fixed flanged hollow member disposed about said operating shaft, and protective means for preventing improper operation of said operating shaft comprising a lug on said wrench and a first recess in said fixed member cooperative with said lug to guide said wrench into engagement with said operating shaft at any of said selective positions, said lug cooperative with a flanged portion of said hollow member to prevent removal of said wrench from engagement with said shaft at positions intermediate said selective positions, a biased member rotatable with said shaft for interlocking said shaft with said wrench, said biased member making contact with the inner peripheral surface of said hollow member, said inner peripheral surface having a cam surface to cause transverse

movement of said biased member relative to said shaft to interlock said shaft and wrench at positions intermediate said selective positions, and a second lug on said wrench cooperative with said flange of said hollow member to prevent rotation of said shaft beyond the extreme selective positions.

5. A switch operating mechanism including an operating shaft having one end thereof comprising a first portion defining driving surfaces and a cylindrical portion extending from said first portion, a wrench defining a socket portion having a cylindrical portion and a portion having driving surfaces cooperative with the corresponding portions of said end of said shaft for rotating said shaft into a plurality of selective positions, said cylindrical cooperative portions of said shaft and said socket portion providing means to guide said socket portion in axial alignment with said shaft and to insure engagement of said driving surfaces of said shaft and said wrench, a fixed hollow member disposed about said operating shaft, said fixed member having a flanged portion, and protective means for preventing improper operation of said operating shaft comprising a lug on said wrench and a recess in said fixed member cooperative with said lug to guide said wrench into engagement with said operating shaft at any of said selective positions, said lug cooperative with said flanged portion to prevent removal of said wrench from engagement with said shaft at positions intermediate said selective positions, a biased member rotatable with said shaft, said biased member making contact with the inner peripheral surface of said fixed member, said inner peripheral surface having a cam surface to cause transverse movement of said biased member relative to said shaft to interlock said shaft and wrench at positions intermediate said selective positions, and a second lug on said wrench cooperative with said flanged portion to prevent rotation of said shaft beyond the extreme said selective positions.

6. A switch operating mechanism including an operating shaft having a portion defining driving surfaces; a wrench having a socket portion defining driving surfaces cooperative with said driving surfaces of said shaft to turn said operating shaft through a plurality of selective positions; and protective means to insure proper operation of said operating shaft through said selective positions comprising a hollow member coaxially spaced from said operating shaft having a radially inwardly extending flange, the external surface of said socket portion having a first lug cooperative with a recess in said flange to guide said wrench into engagement with said shaft at any of said selective positions, said shaft having a cylindrical portion extending axially of said shaft from said driving surfaced portion cooperative with a cylindrical recess in said socket portion to guide said socket axially to bring said driving surfaces of said wrench into proper engagement with said driving surfaced portion of said shaft, interlock means operative when said operating shaft is in positions intermediate said selective positions to prevent separation of said wrench from engagement with said operating shaft, and a second lug on the external surface of said socket cooperative with an edge surface of said flange when said operating shaft is in an extreme said selective position to prevent movement of said operating shaft beyond the said extreme selective position.

7. A switch operating mechanism including an operating shaft having a plurality of selective positions; a wrench defining a socket portion cooperative with an end of said shaft for rotating said shaft through said plurality of selective positions, said wrench engageable with and disengageable from said shaft at any of said selective positions, the external surface of said socket portion having a plurality of lugs thereon; and a fixed guide member coaxially spaced from said shaft, a first portion of the inner periphery of said guide member having a first plurality of circumferentially spaced recesses corresponding to said selective positions, a second portion of the inner periphery of said guide member including a flange having a second plurality of circumferentially spaced recesses, said end of said operating shaft including a biased member, said biased member rotatable with said end of said shaft and making contact with said first portion of said guide member, said wrench and said shaft interlocked by said biased member when said biased member contacts said guide member at positions intermediate any adjacent two of said first plurality of recesses, one of said lugs cooperative with said second plurality of recesses to provide a guide external of said socket for the engagement of said wrench with said end of said shaft at any of said selective positions, said end of said operating shaft comprising a first portion defining driving surfaces and a cylindrical portion extending from said first portion, said socket portion having a cylindrical element and a driving element cooperative with the corresponding portions of said end of said shaft, said cylindrical cooperative portions of said shaft and said wrench providing means internal of said socket portion to guide said socket portion in axial alignment with said shaft to insure engagement of said driving surfaces of said shaft and said wrench, said socket portion having an opening cooperable with said biased member for said socket portion to be engaged with said shaft in the position corresponding to any selective position of said shaft, one of said lugs cooperative with said flange to restrict movement of said shaft by said wrench to a predetermined range including said selective positions, one of said lugs cooperative with portions of said flange intermediate any adjacent two of said second plurality of recesses to prevent separation of said socket portion from engagement with said end of said shaft at positions intermediate said selective positions.

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