REVERSING SWITCH FOR TAP-CHANGING REGULATING TRANSFORMERS

Fig. 4

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This invention relates to tapped regulating transformers, and more particularly to load-tap changers for such transformers which allow to effect tap-changes while the transformer is carrying load currents, or over-load currents.

Such devices include selector switches for selecting the desired tap, and transfer switches for inserting the desired tap into the circuit. Selector switches do not perform any switching operations between contacts that carry currents. This task is performed by the transfer switches. Some load-tap changers include, in addition to selector switches and transfer switches, reversing switches. The function of reversing switches is to change the polarity of the terminals of a portion of a tapped transformer winding. Thus, depending upon the position of the reversing switch, the voltage generated in the particular portion of a tapped transformer winding may be used to boost, or to buck, another voltage, e.g., a voltage generated in a transformer winding which is not tapped.

This invention refers more particularly to load-tap changers including a reversing switch, and it is one object of this invention to provide improved reversing switches for load-tap changers.

Another object of this invention is to provide improved reversing switches for load-tap changers of the particular kind known as Jansen-type load-tap changers. Such tap changers are well-known in the art and are described in many patents, as for instance, Patent No. 1,985,927 to Bernhard Jansen, Jan. 1, 1935, for step-switch arrangement for tapping transformers.

Transformers involving relatively small power are generally provided with reversing switches having one single pole. Such reversing switches are relatively simple and compact, they may readily be arranged adjacent the other units of a load-tap changer, and jointly submersed with such units in the body of oil inside of the oil tank of an oil-insulated transformer.

Reversing switches having but one single pole are subject to the drawback, or limitation, that their operation involves a connection of the tapped regulating winding of the transformer from its principal winding. As a result, the tapped regulating winding assumes an under-determinate potential. Consequently the reversing switch must switch capacitive currents inside the body of a transformer wherein it is immersed. Considering transformers representing relatively large blocks of power, such capacitive currents may be relatively large, and in consequence undesirable.

It is, therefore, another object of this invention to provide reversing switches for load-tap changers which are not subject to the aforementioned drawbacks, and limitations, and are, therefore, readily applicable to transformers involving relatively large blocks of power.

Multipolar reversing switches are capable of reversing the polarity of a portion of a tapped regulating winding without disconnecting the tapped regulating winding from the main or principal winding of the transformer whose voltage is intended to be boosted or bucked, as the case may be.

It is, therefore, another object of this invention to provide improved reversing switches for load-tap changers, i.e., reversing switches not subject to the drawbacks and limitations of multipolar prior art reversing switches.

Some of the prior art multipolar reversing switches do not lend themselves for joint use with rotary selector switches, but are designed to be used only in connection with selector switches whose movable contacts have straight trajectories. This is a serious limitation since selector switches of the first mentioned type are frequently preferable. Other prior-art multipolar reversing switches are not readily acceptable because of their complexity and/or bulk.

It is, therefore, another object of this invention to provide reversing switches for load-tap changers which reversing switches are not subject to the aforementioned drawbacks and limitations.

Still another object of the invention is to provide reversing switches for load-tap changers that do not involve a radial departure from the design principles underlying single pole reversing switches, and are about as compact as single pole reversing switches, and lend themselves to be integrated with the other constituent parts of load-tap changers in the same fashion as single pole reversing switches.

Still another object of the invention is to provide multipolar reversing switches that lend themselves to structural and operational integration with the selector switches of a load-tap changer, or relatively compact structural elements performing both the function of a selector switch and that of a reversing switch.

These and other objects of the invention and advantages thereof will be more apparent from the ensuing description of the invention and of a preferred embodiment thereof when considered jointly with the appended drawings wherein:

FIGS. 1–3 are diagrams of a tap-changing switching mechanism including a reversing switch embodying the present invention, these figures showing the constituent parts of the switching mechanism in consecutive positions assumed during a reversing operation;

FIG. 4 is in part a front elevation and in part a vertical section of the reversing switch of FIGS. 1–3 embodying the present invention;

FIG. 5 is a section along V—V of FIG. 4;

FIG. 6 is a section along VI—VI of FIG. 4 showing the fixed and movable contacts of the reversing switch according to FIG. 4;

FIGS. 7–9 illustrate consecutive positions of the operating mechanism of the reversing switch illustrated in the preceding figures.

Referring now to the drawings, and more particularly FIGS. 1–3 thereof, reference character Tr has been applied to generally indicate a transformer including the main winding T1 and the tapped regulating winding T2. Reference character Sr has been applied to indicate a selector switch for selecting any of the taps of tapped regulating winding T2, and reference character L has been applied to indicate a transfer switch for effecting tap-changing switching operations under load and overload conditions. The transfer switch L is a so-called Jansen-type transfer switch well known in the art. It includes switch-over resistors R which are inserted into the circuit during tap-changing operations.

The selector switch Sr may be of the kind disclosed and claimed in U.S. Patent 3,194,900 to Alexander Bleibtreu, issued July 13, 1965, for Modular Tap-changing Selector Switch for Connecting Selectively Fixed Tap Contacts to a Transfer Switch, assigned to the same assignee as the present invention. As shown in FIGS. 1–3 transformer winding T2 is provided with ten taps 1 … 10. The selector switch Sr comprises ten stationary contacts.
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I, 2, 3 . . . 8,9, K which are arranged in a circular pattern, each being conductively connected to one of the ten taps 1 . . . 10 of transformer winding T₁. Tap K forms a terminal for lead e. The selector switch Sr further comprises two annular fixed contacts r, s arranged in concentric relation to stationary contacts 1, 2, 3, 8, 9, K. Contact or terminal K is conductively connected to annular contact r. Lead t conductively connects annular contact s to the upper two fixed contacts of transfer switch L, and lead u conductively connects annular contact r to the lower fixed contacts of transfer switch L (FIG. 1). Annular contacts r, s are electrically insulated from one another. Selector switch Sr further comprises a radial bridge contact pivotable about the center of annular contacts r, s and adapted to connect conductively any of the fixed contacts 1, 2, 3, . . . and circular contact r. In FIGS. 1–3 the aforementioned radial bridge contact rests on tap contact 9 of selector switch Sr.

Reference character W has been applied to generally indicate a double pole reversing switch. This switch is made up of two switch units U₁ and U₂. Switch units U₁ and U₂ control a pair of parallel circuits or current paths. Each of said circuits or current paths 11, 12 includes three pairs of stationary or fixed contacts. Reference characters A, O, B have been applied to indicate the fixed or stationary contacts of change-over switch U₁, and reference characters B, C, A have been applied to indicate the fixed or stationary contacts of change-over switch U₂. As shown in FIG. 1, contacts AO and OB, respectively, are conductively interconnected by change-over contacts 13 formed by contact bridges moveable between two limit positions. In a similar fashion, contacts BC and CA, respectively, are conductively interconnected by change-over contacts 14 formed by contact bridges moveable between two limit positions. Change-over contacts 13 of change-over switches U₁, U₂ are operated by a pair of contact-operating arms or levers 15, and contact bridges 14 of change-over switches U₁, U₂ are operated by a pair of contact-operating arms or levers 16. The ends of contact-operating arms 15 are tied together by insulating rod 17 to which change-over contacts 13, of change-over switches U₁, U₂ are affixed, or otherwise operatively related. Similarly, the ends of contact-operating arms 16 are tied together by insulating rod 18 to which change-over contacts 14 of change-over switch U₁, U₂ are affixed, or otherwise operatively related.

The fixed contacts A of the reversing switch W are conductively connected by leads a to one end of main transformer winding T₁. The fixed contacts B of reversing switch W are conductively connected to the outgoing lead b indicated by an arrow. The fixed contacts C of reversing switch W are conductively connected by leads c to the terminal d of transfer switch L, i.e., to the movable contacts thereof. The latter have been indicated diagrammatically by a contact arm pivotally mounted at d. The fixed contacts O of reversing switch W are conductively connected to terminal K of selector switch Sr by means of leads e. Lead c conductively connects the last tap 10 of tapped transformer winding T₂ with terminal K of selector switch Sr.

Operation of selector switch Sr in successive steps 1 to 10 and corresponding operation of transfer switch L between its two limit positions results in successive disconnection of portions of the connections of said transformer winding T₂. Upon disconnection of all the portions or sections of tapped transformer winding T₂ the current path of the transformer extends from the left end of winding T₁ along lead a to reversing switch W and through the latter to outgoing lead b (FIG. 1). The next operating step of the switch Sr initiates the reversing operation of the system.

This reversing operation involves a change-over of the change-over contacts 13 of change-over switches U₁, U₂ from fixed contacts AO and BC to fixed contact OB and CA (FIG. 2). This operating step maintains the conductive connection between transformer winding T₁ and outgoing lead b, this connection being maintained by the intermediary of both change-over switches U₁, U₂. At this point of time the polarity of tapped winding Tr is maintained by leads f and e and terminal K and contact O. This has been indicated in FIG. 2 by a dotted line extending along leads f and e.

Subsequent to, and shortly after, the afore-described first operating step of reversing switch W the latter performs its second operating step. This second operating step involves a change-over of the change-over contacts 14 of change-over switches U₁ and U₂ from fixed contacts AO to OB and from fixed contacts BC to CA (FIG. 3). During this second operating step the circuit of winding T₁ includes leads a, fixed contacts A, fixed contacts C, lead c, terminal d of transfer switch L, the contact arm of transfer switch L in the position shown in FIG. 3 in dotted lines, terminal K of selector switch Sr, fixed contacts O and B of reversing switch W and outgoing lead b. At this point of time the cycle of tapped winding Tr is still maintained, the afore-mentioned conductive connection from winding Tr including terminal K and fixed contact O not having as yet been interrupted.

Following the second operating step of the reversing switch W which has been described above, the transfer switch L is operated in such a way that its pivoting contact arm is moved from its limit position shown in FIG. 3 in dotted lines to its limit position shown in FIG. 3 in solid lines. Now the voltage generated in the last section of tapped winding T₂ bucks the voltage of winding T₁, as is apparent from that portion of the circuitry shown in heavy lines in FIG. 3.

The sequence in which the switching circuits 11, 12 of changeover switches U₁, U₂ are switched is a very rapid one and therefore the position of parts shown in FIG. 2 is maintained but for a very short period of time. The fact that the current is carried during this short period of time only by one of the two parallel current paths of the reversing switch W has no adverse effects on the contacts thereof.

It will be apparent from FIGS. 1–3 that these figures refer to identical circuitry and structure, but slight representational changes have been made in the three figures in the interest of increased clarity. Thus lead e conductively connecting fixed contacts O of change-over switch U₁ to terminal K has been represented in a different fashion in FIGS. 1 and 2, on the one hand, and in FIG. 3, on the other hand.

Referring now to FIGS. 4, 5 and 6 showing a preferred embodiment of the reversing switch W of FIGS. 1–3, inclusive, reference character Sr has been applied to indicate a portion of the selector switch of the type illustrated in FIG. 1 and including an upper cover plate 21 and a base plate 22. A plurality of insulating rods 23 of which but one is shown in FIG. 4 are arranged in a cylindrical pattern and form a squire-cage-like structure, their upper ends being secured. Lead plate 21, and their lower ends being secured to plate 22. Rods 23 are supports for the fixed contacts of the selector switch Sr which are arranged in a circular pattern as shown in FIGS. 1–3. These contacts include fixed contacts numbered 1–9 and fixed contact or terminal K. FIG. 4 shows the particular insulating rod 23 with its contact K. Contact K is in the form a pair of spaced contacts to increase the current-carrying capacity of the resulting composite contact. The upper plate 21 and the lower plate 22 each support a substantially semi-circular cantilever 24 and 25, respectively. Three tie rods 26 of insulating material extend between and space cantilevers 24 and 25 also FIGS. 5 and 6. Tie rods 26 support the fixed contacts A, B, C and D of reversing switch W. Reference numeral 27 has been applied to indicate the centers of semi-circular cantilevers 24, 25.
Each center or fulcrum 27 supports pivotally a pair of levers 15, 16. Levers 15, 16 support on the radially outer ends thereof, respectively, a pair of insulating rods 17, 18. Each insulating rod 17, 18, in turn, supports a pair of change-over contacts 13, 14 for change-over switches U₁ and U₂. In the structure of FIGS. 4–6 change-over contacts 13, 14 are formed by pivotable arcuate bridge members 13, 14. As shown in FIGS. 5 and 6 each bridge-member 13, 14 includes a first contact, or bridge-member contact, 28 having an annular support 29 by means of which it is secured to insulating rod 17 and each bridge member 14 includes an annular support 29 by which it is secured to insulating rod 18. Each bridge-member 13, 14 further includes a second contact, or bridge-member contact, 30 which is angularly displaced from its first contact 28. The second bridge-member contact 30 is supported by an arcuate supporting member 31 integral with annular support 29 and projects laterally therefrom. The first and second bridge-member contacts 28, 30 of arcuate supporting members 31 of change-over switches U₁, U₂ are symmetrical in the way in which an object and its image formed in a mirror are symmetrical, i.e., in a top plan view the supporting member 31 of annular support 29 of the first bridge-member contact 28 once appears to the left (FIG. 5), and then to the right (FIG. 6), of annular support 29 of contact 28. As a result of this geometry, a second bridge-member contact 30 is always aligned with and below a first bridge-member contact 28 when the superimposed arcuate bridge members 13, 14 (FIG. 4) are in their limit positions (shown in FIGS. 1 and 3). This will be apparent when keeping in mind that the second bridge-member contact 30 is secured to the end of the arcuate supporting member 31, and is not provided with its own annular support 29 as the first bridge-member contact 28.

The structure which has been described above and which is shown in FIGS. 5 and 6 makes it possible to move first bridge-member contact 28 of part 13 in clockwise direction as seen in FIGS. 5 and 6 from insulating rods 17 and 18 to move contact 30 of part 14 subsequently to contact 30 of part 13. The pivotal movement of arcuate bridge members 13, 14 is limited by abutments 32 integral with arcuate supporting members 31 engaging insulating rods 17 and 18, respectively. Abutments 32 are also an effective interlock between bridge-members 13, 14. In other words, bridge-member 14 can only be pivoted in one direction (clockwise as shown in FIGS. 5 and 6), following a pivotal movement of bridge-member 13 in the same direction. This sequence is reversed when the sense of pivotal motion is reversed. This function of abutments 32 is immediately apparent from an inspection of FIGS. 5 and 6. Considering FIG. 5, it is apparent that the abutment 32 of bridge-member 13 rests against insulating rod 18 integral with bridge-member 14 and thus precludes bridge-member 14 from pivoting in clockwise direction as seen in FIGS. 5 and 6 as long as bridge-member 13 has not performed its pivotal motion in clockwise direction.

As best shown in FIG. 4 the contacts 28, 30 of bridge members 13, 14 are in the form of spring-loaded finger contacts 33. Each movable contact 28, 30 of bridge members 13, 14 comprises an upper set of contact fingers 33 and a lower set of contact fingers 33. One of these two sets of contact fingers, or contact laminations, engages the upper surfaces of fixed contacts A, B, C, O. The requisite contact pressure is established by small helical springs 34 having one end resting against contact fingers 33. Bridge members 13 and 14 are provided with the aforementioned pads and lower cover plates 35, and the ends of contact-finger-biasing springs 34 remote from fingers 33 rest against these cover plates. The fingers 33 of contacts 28 (see FIGS. 5 and 6) are pivotally supported by the aforementioned annular support 29.

Referring now to FIGS. 7–9, illustrating the preferred operating mechanism for bridge-members 13 and 14, reference numerals 15 and 16 have been applied to indicate a pair of levers pivotably on fulcrum 27. Lever 15 operates insulating rod 17 and bridge-member 13 (see FIG. 4). Lever 16 operates insulating rod 18 and bridge-member 14. Levers 15, 16 are provided with oblong apertures or holes 36, 37 engaged by cams or rollers supported by levers 40, 41. Levers 40, 41 are pivotable about fulcrums 42 and 43, respectively. Fulcrums 42 and 43 are integral with the upper cover plate 21 of selector switch Sr (see FIG. 4). Each lever 40, 41 includes a relatively long arm and a relatively short arm. The shorter arms of levers 40, 41 are provided with substantially semi-circular grooves 44 and 45, respectively, which may be engaged by a cam or roller 46 forming part of the rotary operating mechanism of the switch.

When the aforementioned cam or roller 46 is moved in counterclockwise direction as seen in FIGS. 7–9, and as indicated therein by an arrow, part 46 engages the semi-circular groove 44 of lever 40 and pivots the same, thus moving bridge-member 13, in engagement with fixed contacts AO and into engagement with the fixed contacts OB (FIG. 8). In this position there occurs a partial overlap of the relatively short arms of levers 40 and 41, as a result of which part 46 moves from semi-circular groove 44 into semi-circular groove 45. This causes a pivotal motion of lever 41 about fulcrum 43. As a result, bridge-member 14 is moved out of engagement with the fixed contacts AO and into engagement with the fixed contacts OB (FIG. 9). The instant at which this switching operation occurs follows shortly the instant at which the above described switching operation of bridge-member 13 occurs. The movement of bridge-member 14 into engagement with fixed contacts OB terminates the operating cycle of reversing switch W.

FIGS. 7 to 9 show but the operation of the bridge-members 13, 14 of one of the change-over switch U₁. They do not show the operation of the bridge-members 13, 14 of the other change-over switch U₂. The bridge-members 13, 14 of the second change-over switch U₂ operate simultaneously with and in the same sense as the corresponding bridge-members of the first change-over switch U₁. This is due to the fact that the bridge-members 13 of both change-over switches U₁, U₂ are mounted on the same insulating rod 17 and both operated by the same lever 40, and that the bridge-members 14 of both change-over switches U₁, U₂ are mounted on the same insulating rod 18 and both operated by the same lever 41.

Since the relatively long arms of levers 40, 41 operate bridge-members 13, 14 and the relatively short arms of levers 40, 41 are driven by the operating mechanism of the switch, the transmission ratio of levers 40, 41 makes it possible to move bridge-members 13, 14 at high speeds between the limit positions thereof.

It will be apparent from the foregoing that reversing switches embodying the present invention includes a first double pole change-over switch U₁ and a second double pole change-over switch U₂. Each change-over switch U₁, U₂ includes three parallel connected pairs of fixed contacts ABO and ABC, respectively. Each change-over switch U₁, U₂ includes a first reciprocating change-over contact or bridge-member 13 and a second reciprocating change-over contact or bridge-member 14 operable independently from said first change-over contact or bridge-member 13. Change-over contacts or bridge-members 13, 14 have two limit positions and interconnect conductively in either of said two limit positions two fixed contacts AO, AO, BC and OB, OB, CA, CA, respectively, of the respective fixed connected pairs of contacts. The reversing switch embodying this invention includes a common operating mechanism for the first change-over contact, or bridge-member, 13 and for the second change-over contact, or bridge-member, 14 of the first change-over switch U₁ and the second change-over
The aforementioned common operating mechanism includes means effecting sequential change-over of the first change-over contact, or bridge-member, 13 and of the second change-over contact, or bridge-member, 14 of the first change-over switch U1 and sequential change-over of the first change-over contact, or bridge-member, 13 of the second change-over switch U2 and the second change-over contact, or bridge-member, 14 of the second change-over switch U2. The aforementioned common operating mechanism further includes means effecting simultaneous change-over of the first change-over contact, or bridge-member, 13 of the first switch U1 and the second change-over contact, or bridge-member, 14 of the second change-over switch U2 and means for effecting simultaneous change-over of the second change-over contact, or bridge-member, 14 of the first switch U1 and of the second change-over contact, or bridge-member, 14 of the second switch U2.

The aforementioned common operating mechanism includes a continuously moving or continuously movable contact drive 46 (FIGS. 7-9), a pair of intermediate levers 40, 41 sequentially operated by said drive, and a pair of change-over contact or bridge-member operating levers 15, 16 sequentially operated by said pair of intermediate levers.

One of the pair of change-over contact operating levers 15 is operatively related to the first change-over contact, or bridge-member, 13 of the first switch U1 and to the first change-over contact, or bridge-member, 14 of the second switch U2. The other of the pair of change-over contact operating or bridge-member operating levers 16 is operatively related to the second change-over contact, or bridge-member, 14 of the first switch U1 and to the second change-over contact, or bridge-member, 14 of the second switch U2. Each of said pair of change-over contact operating levers or bridge-member operating levers 15, 16 is provided with an oblong hole 36, 37 and each of said pair of intermediate levers 40, 41 has a projection 38, 39 engaging said oblong hole 36, 37 in one of said pair of change-over contact operating levers or bridge-member operating levers 15, 16. Each of the pair of intermediate levers 40, 41 has a substantially semi-circular groove 44, 45 at one end thereof. The rotatable contact drive has a groove-engaging means such as, for instance, a rotatable pin 46 sequentially engaging grooves 44 and 45 in intermediate levers 40, 41.

In the specific embodiment of this invention shown in FIGS. 7-9, each parallel connected pair of contacts A A; O O; B B of the first change-over switch U1 and of the second change-over switch U2 is supported by one of three angularly displaced insulating rods 26 defining generatrices of a cylindrical surface. The first change-over contact 13 and the second change-over contact 14 of the change-over switch U1 and the second change-over switches U2 are integrated into a unitary pivot-pivotal about the longitudinal axis of the cylindrical surface defined by insulating rods 26.

In the structure of FIGS. 4-6, inclusive, both change-over switches U1, U2 are integrated into a unitary pivotal reversing switch. To this end switches U1, U2 are superimposed and the arcuate bridge-members 13, 14 of switches U1, U2 are reciprocating in horizontal planes. Each of the three angular displaced insulating rods 26 supports two parallel connected pairs of fixed contacts, i.e., A, A; B, B; O, O; C, C; B, B; A, A. One of said parallel connected pairs of contacts A, O; B, C; A, A operates with the arcuate bridge-members 13, 14 of the first switch U1 and the other of said parallel connected pair of contacts B, C; A, A cooperates with the arcuate bridge-members 13, 14 of the second switch U2. As particularly shown in FIGS. 5 and 6 the arcuate bridge-members 13, 14 of the first change-over switch U1 and of the second change-over switch U2 each include a first bridge-member contact 28 and an annular support 29 thereon mounted on an insulating rod 17 and 18, respectively. The arcuate bridge-members 13, 14 of the first change-over switch U1 and the second change-over switch U2 each include also a second bridge-member contact 30 angularly displaced relative to said first bridge-member contact 28 and supported by an arcuate supporting member 31 integral with annular member 29 of the second bridge-member contact 28 and projecting laterally therewith.

In the structure shown in FIGS. 4-6 the first arcuate bridge-member 13 of the first change-over switch U1 and the first arcuate bridge-member 13 of the second change-over switch U2 are arranged in registry in the two limit positions thereof. The second arcuate bridge-member 14 of the first change-over switch U1 and the second arcuate bridge-member 14 of the second change-over switch U2 are arranged in registry in the two limit positions thereof. This is also apparent from FIG. 1 wherein the straight change-over contacts 13, 14 take the place of the arcuate bridge-members 13, 14 in the structure of FIGS. 4-6. The first arcuate bridge-member 13 and the second arcuate bridge-member 14 of the first change-over switch U1 are symmetrical relative to a plane of symmetry including the longitudinal axis of the cylindrical surface defined by vertical insulating rods 26. In a similar fashion, the first and the second arcuate bridge-members 13, 14, respectively, of said switch U2 are symmetrical relative to a plane of symmetry including the longitudinal axis of the cylindrical surface defined by vertical insulating rods 26. The first arcuate bridge-member 13 of the first change-over switch U1 and the first arcuate bridge-member 13 of the second change-over switch U2 are tied together by a first insulating rod 17 parallel to the longitudinal axis of the cylindrical surface defined by vertical insulating rods 26. Similarly, the second arcuate bridge-member 14 of the first change-over switch U1 and the second arcuate bridge-member 14 of the second change-over switch U2 are tied together by an insulating rod 18 parallel to the longitudinal axis of the cylindrical surface defined by insulating rods 26.

The structure of FIGS. 4-6 further comprises interlocking means for compounding a proper sequence of change-over. These interlocking means include abutments 32 integral with the arcuate supporting members 31 for said second bridge-member contacts 30 of each of said arcuate bridge-members 13, 14 of said first change-over switch U1 and said second change-over switch U2, each engaging said insulating rods 17 and 18, respectively, on which one of said annular supports 29 for said first bridge-member contacts 28 of said arcuate bridge-members 13, 14 of said first change-over switch U1 and said second change-over switch U2 is mounted. While FIGS. 5 and 6 refer to change-over switch U1 (see section lines of FIG. 4), it will be apparent from the foregoing that change-over switches U1 and U2 are substantially identical.

The structure shown in FIGS. 4-6 comprises a pair of parallel plates 21, 22 having substantially semi-circular cantilever-like projections 24, 25. These projections 24, 25 are spaced by the three angularly displaced insulating rods 26. Each arcuate bridge-member 13, 14 is pivotable about an axis defined by the straight line interconnecting the center of cantilever-like projections 24, 25.

From the foregoing description of the invention, it will be apparent that the reversing switch constructed in accordance with the principles of this invention provides a novel reversing means for boosting or bucking a voltage in a regulating transformer, particularly a large distribution transformer, which makes it possible to reverse series windings without opening the circuit of the transformer, the reversing means being more compact than any comparable prior art reversing switch and lending itself particularly well to be used with rotary selector switches for selecting any desired tap of the tapped series winding.

While there has been described what is at present considered to be the preferred embodiment of the invention,
it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and it is, therefore, aimed to cover all such changes and modifications as fall within the true spirit and scope of the invention.

We claim as our invention:

1. A multipolar reversing switch for load-tap changers for regulating transformers comprising for reversing the connection of a tapped regulating winding and said principal winding without disconnecting the regulating winding from the principal winding, said reversing switch comprising in combination:

(a) a first double-pole change-over switch and a second double-pole change-over switch each including three parallel connected pairs of fixed contacts and each including a first reciprocating change-over contact and a second reciprocating change-over contact operable independently from said first change-over contact, said first change-over contact and said second change-over contact of each said first switch and said second switch having two limit positions and conductively interconnecting in either of said two limit positions two fixed contacts of said parallel connected pairs of contacts; and

(b) a common operating mechanism for said first change-over contact of said second change-over contact of said first switch and said second switch including means effecting sequential change-over of said first change-over contact and of said second change-over contact of said first switch and sequential change-over of said first change-over contact and of said second change-over contact of said second switch, effecting simultaneous change-over of said first change-over contact of said first switch and of said first change-over contact of said second switch and effecting simultaneous change-over of said second change-over contact of said first switch and of said second change-over contact of said second switch.

2. A reversing switch as specified in claim 1 wherein said common operating mechanism includes a continuously movable contact drive, a pair of intermediate levers sequentially operated by said drive, and a pair of pivotable change-over contact-operating levers sequentially operated by said pair of intermediate levers.

3. A reversing switch as specified in claim 1 wherein each of said parallel-connected pairs of fixed contacts of said first switch and of said second switch is supported by one of three angularly displaced insulating rods defining generatrices of a cylindrical surface and wherein each said first change-over contact and said second change-over contact of said first switch and of said second switch are formed by an arcuate bridge-member pivotable about the longitudinal axis of said cylindrical surface.

4. A reversing switch as specified in claim 3 wherein said first switch and said second switch are superimposed and the arcuate bridge members of said first switch and of said second switch are reciprocating in horizontal parallel planes, and wherein each of said three angularly displaced insulating rods supports two parallel connected pairs of fixed contacts, one of said two parallel connected pairs of fixed contacts on each of said insulating rods cooperating with the arcuate bridge-members of said first switch and the other of said two parallel connected pairs of fixed contacts on each of said insulating rods cooperating with the arcuate bridge members of said second switch.

5. A reversing switch as specified in claim 3 wherein each arcuate bridge-member of said first switch and of said second switch includes a first bridge-member contact, an annular support thereof mounted on an insulating rod, and a second bridge-member contact angularly displaced relative to said first bridge-member contact and supported by an arcuate supporting member integral with said arcuate support of said first bridge-member contact and projecting laterally from said support.

6. A reversing switch as specified in claim 5 wherein the first arcuate bridge-member of said first switch and the arcuate bridge-member of said second switch are arranged in registry in the two limit positions thereof, wherein the second arcuate bridge-member of said first switch and the second arcuate bridge-member of said second switch are arranged in registry in the two limit positions thereof, wherein the first and the second arcuate bridge-members of said first switch are symmetrical relative to a plane of symmetry including said longitudinal axis of said cylindrical surface, wherein the first and the second arcuate bridge-members of said second switch are symmetrical relative to a plane of symmetry including the longitudinal axis of said cylindrical surface, wherein the first arcuate bridge-member of said first switch and the first arcuate bridge-member of said second switch are tied together by a first insulating rod parallel to said longitudinal axis of said cylindrical surface, and wherein the second arcuate bridge-member of said first switch and the second arcuate bridge-member of said second switch are tied together by a second insulating rod parallel to said longitudinal axis of said cylindrical surface.

7. A reversing switch as specified in claim 5 comprising interlocking means for compelling the proper sequence of change-over, said interlocking means including abutments integral with the arcuate supporting members for said second arcuate bridge-member contact of said arcuate bridge-members of said first switch and said second switch, said abutments engaging said insulating rods on which said annular supports for said first bridge-member contacts of said arcuate bridge-members of said first switch and said second switch are mounted.

8. A reversing switch as specified in claim 2 wherein one of said pair of change-over contact-operating levers is operatively related to said first change-over contact of said first switch and to said first change-over contact of said second switch, wherein the other of said pair of contact-operating levers is operatively related to said second change-over contact of said first switch and to said second change-over contact of said second switch, wherein each of said pair of change-over contact-operating levers is provided with an oblong hole, wherein each of said pair of intermediate levers has a groove-engaging said oblong hole in one of said pair of change-over contact-operating levers, wherein each of said pair of intermediate levers has a substantially semi-circular groove at one end thereof, and wherein said contact drive has a groove-engaging means sequentially engaging said groove in each of said pair of intermediate levers when said contact drive is rotating.

9. A reversing switch as specified in claim 8 wherein the arms of said pair of intermediate levers adjacent said pair of contact-operating levers are longer than the arms of said pair of intermediate levers adjacent said groove-engaging means.

10. A reversing switch as specified in claim 3 comprising a pair of parallel plates having substantially semi-circular cantilever-like projections, said projections being spaced by said three angularly displaced insulating rods and each arcuate bridge-member being pivotable about an axis defined by the straight line interconnecting the centers of said cantilever-like projections.

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