TAP-CHANGING TRANSFORMER INCLUDING A SELECTOR SWITCH AND A TRANSFER SWITCH
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10 Claims

ABSTRACT OF THE DISCLOSURE

Tap-changing transformers which include selector
switches for selecting any desired tap of tapped
transformer windings and which include transfer switches for
switching a load to any particular tap preselected by the
selector switches further include a pair of auxiliary
switches each arranged in one of a pair of leads con-
ductively connecting the selector switches to the trans-
fer switches. Each of this pair of auxiliary switches has
a closed position establishing a current path through
one of the aforementioned pair of leads between
selector switch and the transfer switch; and each of this
pair of auxiliary switches has an open position wherein
the current path through one of the aforementioned leads
between selector switch and transfer switch is interrupted.

The pair of auxiliary switches is interconnected by addi-
tional leads in such a way that whenever one of the pair
of auxiliary switches is in the closed position thereof,
a conductive connection is established between the closed
auxiliary switch and a contact of the other auxiliary
switch which is then in its open position. As a result of the
presence of the aforementioned pair of auxiliary switches
and the aforementioned conductive interconnection thereof
both main contacts of the transfer switch are at the same
potential at the end of every tap-changing operation per-
formed by the transfer switch.

BACKGROUND OF INVENTION

Tap-changing regulating transformers include, in ad-
dition to tapped transformer windings, selector switches
and transfer switches. The former serve the purpose of se-
lecting a particular tap of a tapped transformer winding
intended to be connected into an electric circuit. Selector
switches are not intended to open current-carrying cir-
cuits, nor to close on current-carrying circuits. These tasks
are left to transfer switches. The latter perform all switching
operations under load. Hence arcing is kept away from the
cooperating contacts of the selector switches, but oc-
curs at the cooperating contacts of the transfer switches.

This invention relates more particularly to regulating transformers including so-called Jansen type transfer
switches. Such transfer switches are well known in the art and are described in many printed publications and
patents as, for instance, in the text book by H. P. Young, Electric Power Systems, London, England, Clap-
man & Hall Ltd.; 1942 (see page 247), or in U.S. Patent
2,680,790 to B. Jansen: June 8, 1954; Load Changeover
Switch for Tapped Transformers Using a Combination of Contact Movements, or in U.S. Patent
2,833,873 to B. Jansen; May 6, 1958, for Multi-Pole Tap Switch Construc-
tion for Changing Transformer Taps Under Load.

Transfer switches include a pair of fixed main contacts
of which each is generally conductively connected to one
of a pair of contiguous taps of a tapped transformer wind-
ing. As a result, the voltage that prevails between contigu-
ous taps of a tapped transformer winding prevails also be-
tween the fixed main contacts of the transfer switch which

is operatively related to the particular tapped transformer
winding. In some instances the voltage between the fixed
main contacts of a transfer switch may by far exceed the
voltage normally prevailing between contiguous taps of
a tapped transformer winding and amount to a dangerous
voltage surge. This calls for surge-voltage-proof designs
of transfer switches in tap-changing transformers, greatly
increasing the cost thereof.

Because of the aforementioned circumstances special selector switch designs have been evolved making it po-
sible to avoid differences in potential between the fixed
main contacts of the transfer switch when the latter is
in one of its two limit positions carrying current from a
selected tap of a tapped transformer winding to a load
circuit. While such special selector switches achieve the
purpose for which they are intended, their use is sub-
ject to serious drawbacks. This invention, therefore, aims to
avoid potential differences between the contacts of trans-
fer switches when the latter are in one of the two limit
positions thereof without resorting to any special selector
switch design, and in spite of retaining the conventional
desirable design of the selector switch.

SUMMARY OF THE INVENTION

A tap-changing transformer embodying this invention
comprises in combination a transformer winding includ-
ing a plurality of taps and a selector switch including a
plurality of fixed contacts each conductively connected
to one of said plurality of taps. The aforementioned selector
switch includes a pair of movable contact means each
adapted to cooperatively engage different contacts of said
plurality of contacts. The tap-changing transformer fur-
ther includes a transfer switch having a pair of fixed main
contacts, fixed auxiliary contacts arranged between said
pair of fixed main contacts, resistor means conductively
connecting each of said pair of fixed main contacts to
fixed auxiliary contacts immediately adjacent thereto, a
pair of movable main contacts and movable auxiliary con-
acts selectively engaging and disengaging said pair of
fixed main contacts and said fixed auxiliary contacts in a
predetermined sequence. The tap-changing transformer
further includes a pair of leads each for conductively con-
necting one of said pair of movable contact means of said
selector switch to one of said pair of fixed main contacts
of said transfer switch. One of a pair of auxiliary switches
is inserted into each of said pair of leads. Each of said
pair of auxiliary switches has a closed position and an
open position. The circuitry further includes lead means
for conductively interconnecting said pair of main con-
acts of said transfer switch when one of said pair of
auxiliary switches is in said open position thereof; and
the other of said pair of auxiliary switches is in said closed
position thereof.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a circuit diagram of a single phase tap-chang-
ing transformer embodying the present invention;
FIG. 2 is a diagrammatic representation of the se-
quence of steps involved in the operation of the struc-
ture of FIG. 1;
FIG. 3 is in part a side elevation and in part a vertical
section of three pairs of auxiliary switches for a three
phase transformer embodying the present invention, the
aforementioned three pairs of auxiliary switches being
integrated to form a unitary switch structure;
FIG. 4 is a section along IV—IV of FIG. 3; and
FIG. 5 is a section along V—V of FIG. 3.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring now to the drawings, and more particularly to FIGS. 1 and 2 thereof, reference character Tr has
been applied to generally indicate a tapped transformer,
reference character W has been applied to generally indicate the tapped winding of transformer Tr, reference character H has been applied to generally indicate the selector switch of the system, and reference character T has been applied to generally indicate the transfer switch of the system. Tapped winding W is provided with twelve taps indicated by numerals 1, 2, 3, 4, 9, 10, 11, 12. Selector switch Sr includes twelve fixed contacts which are circularly arranged. The even numbered contacts 2, 4, 6, . . . are arranged in a circular pattern in a first plane and the odd numbered contacts 1, 3, 5, . . . are arranged in a circular pattern situated in a plane spaced from the plane defined by the first mentioned circular pattern. Both circular patterns are coaxial. The fixed contacts of selector switch Sr may be supported by a squirrel-cage-like structure formed by vertical insulating rods 41, 42 pivotable about the common axis of the aforementioned circular patterns of fixed contacts 1, 2, 3, 4, . . . 9, 10, 11, 12. The radially inner end of contact arm 41 engages and rests upon a slip ring 43 and its radially outer end is adapted to cooperatively engage the odd numbered fixed contacts of selector switch Sr. In like fashion the radially inner end of contact arm 42 engages and rests upon a slip ring 44 and its radially outer end is adapted to cooperatively engage the even numbered fixed contacts of selector switch Sr. Each tap 1, 2, 3, 4, . . . of tapped winding W is conductively connected with a corresponding fixed contact of selector switch Sr. Thus tap 1 is connected by lead 101 to fixed contact 1, tap 2 is connected by lead 102 to fixed contact 2, tap 3 is connected by lead 103 to fixed contact 3 and tap 4 is connected to fixed contact 4 by lead 104. In order not to clutter FIG. 1 by a large number of tap and fixed selector switch contact interconnecting leads the leads between taps 5–12 and contacts 5–12 have been deleted in FIG. 1. Lead 51 is conductively connected to slip ring 43 and lead 52 is conductively connected to slip ring 44.

It should be understood that the illustration of selector switch Sr of FIG. 1 is diagrammatic. Selector switches of the kind under consideration are disclosed in considerable structural detail in U.S. Patent 3,176,089 to A. Bleibtreu et al., Mar. 30, 1965, for Load Tap Changers for Transformers; U.S. Patent 3,233,049 to A. Bleibtreu, Feb. 1, 1966, for Integral Selector Switch and Transfer Switch Unit with Tap Regulating Transformers; and U.S. Patent 3,250,864 to A. Bleibtreu et al., May 10, 1966, for Regulating Transformers Having a Large Number of Taps.

The transfer switch L includes a cylindrical support 27 of insulating material for supporting the fixed contacts thereof. Reference numerals 21 and 22 have been applied to indicate the fixed main contacts of transfer switch L and reference numerals 23, 24, 25, 26 have been applied to indicate the fixed auxiliary contacts of transfer switch L. Fixed auxiliary contacts 23, 24, 25, 26 are arranged between fixed main contacts 21, 22. Fixed auxiliary contact 23 is conductively connected to a switch-over resistor R1 and fixed auxiliary contact 24 is conductively connected to a switch-over resistor R2. In a like fashion fixed auxiliary contact 26 is conductively connected to a switch-over resistor R1 and fixed auxiliary contact 25 is conductively connected to a switch-over resistor R3. The two resistors R1, R2 shown at the left hand side of FIG. 1 are conductively connected by leads including lead 51 to fixed main contact 21, and the two resistors R1, R2 shown at the right side of FIG. 1 are conductively connected by leads including lead 52 to fixed main contact 22. Fixed main contact 21 may be engaged by the externally supported movable main contact 31 and the latter may be separated from the former. In like fashion fixed main contact 22 may be engaged by linkage-supported movable main contact 32 and the latter may be separated from the former as shown to the right of FIG. 1. Each of linkage-operated movable auxiliary contacts 33, 34, 35, 36 may engage one of the fixed auxiliary contacts 23, 24, 25, 26 and be separated from the latter.

FIG. 1 shows main contacts 21, 31 and auxiliary contacts 23, 33 of transfer switch L movable and contacts being in disengaged positions. The linkages supporting contacts 31, 32, 33, 34, 35, 36 may be operated in the required sequence by cams 37 and 38 or other means as, for instance, those disclosed in U.S. Patent 3,174,097 to A. Bleibtreu, Mar. 16, 1965, for Transfer Switch for Tap Changers for Regulating Transformers or U.S. Patent 3,218,400 to A. Bleibtreu, Transfer Switches for Tap-Changing Regulating Transformers Having Squirrel-Cage-Shaped Support for the Fixed Contacts Thereof. It will be noted that the circuitry of FIG. 1 is in substance the same as that shown in FIG. 3 of U.S. Patent 3,174,097 and described in that patent. For the reasons stated in U.S. Patent 3,174,097 this circuitry is known as a Flagg-Pennant transfer switch circuitry, or briefly FP transfer switch circuitry. As shown in FIG. 1 the circuit under consideration includes a lead A connecting the movable contacts 31–36 of transfer switch L with a load (not shown).

The circuitry of FIG. 1 further includes a pair of auxiliary change-over switches 53, 54 each having an open position and a closed position. In FIG. 1 auxiliary switch 53 is shown in its closed position indicated by solid lines, the open position of auxiliary switch 53 being indicated by dotted lines. In FIG. 1 auxiliary switch 54 is shown in its open position indicated by dotted lines, the closed position of auxiliary switch 54 being indicated by dotted lines. It will be noted that auxiliary switch 53 is arranged in lead 51 for conductively connecting slip ring 43 with fixed main contact 21 and that auxiliary switch 54 is arranged in lead 52 for conductively connecting slip ring 44 with fixed main contact 22. Auxiliary switch 53 includes a pivotable contact arm adapted to engage selectively fixed contact a and fixed contact b. In a like fashion auxiliary switch 54 includes a pivotable contact arm adapted to engage selectively fixed contact c and fixed contact d. Lead 56 connects conductively the pivotable contact arm of auxiliary switch 53, or the portion of lead 51 on the side of switch 53 adjacent transfer switch L, to fixed contact d of auxiliary switch 54. In like fashion lead 55 connects conductively the pivotable contact arm of auxiliary switch 54, or the portion of lead 52 on the side of switch 54 adjacent transfer switch L, to fixed contact b of auxiliary switch 53.

In the position of selector switch Sr, auxiliary switches 53 and 54 and transfer switch L shown in FIG. 1 the following current path is established: tapped winding W, tap 3, lead 103, fixed contact 3 of selector switch Sr, contact arm or contact bridge 41, portion of lead 51 adjacent selector switch Sr, auxiliary switch 53, portion of lead 51 adjacent transfer switch L, fixed main contact 21, movable main contact 31, lead A. Contact bridge 42 is in engagement with slip ring 44 and fixed contact 2 of selector switch Sr, and thus the following current path is then established: tap 2 of winding W, lead 102, contact 2 of selector switch Sr, slip ring 44, the portion of lead 52 adjacent selector switch Sr. Since auxiliary switch 54 is in the open position thereof there is no conductive connection between tap 2 of winding W and fixed contacts 22, 25, 26 of transfer switch L. Auxiliary switch 54 establishes, however, in its open position a conductive connection between fixed contacts 22, 25, 26 of transfer switch L and engaging contacts 21, 23, 33 of transfer switch L. This conductive connection includes the pivotable contact arm of auxiliary switch 54, its fixed contact d, lead 56 and the portion of lead 51 adjacent transfer switch L. The contacts of transfer switch L are at the same potential. This closes the path to the engaging pairs of contacts 21, 23, 31 and 33 as well as to fixed contacts 22, 24, 25 and 26, all having the same potential as tap 3 of winding W. Since all movable contacts 31, 32, 33, 34, 35, 36 and 37 are connected
to the lead, or outgoing line A, the movable contacts not engaging any fixed contact are likewise at the potential of tap 3. In other words, there are no differences in potential between any of the contacts of transfer switch L.

Fig. 2 illustrates diagrammatically the sequence of steps involved in a tap-changing operation from tap 3 to tap 4 of winding W. e indicates the point of time at which the tap changing operation begins and i indicates the point of time at which the tap-changing operation ends. If it is intended to switch from tap 3 to tap 4 of winding W, the first tap-changing step consists in moving, or pivoting, contact bridge 42 from contact 2 to contact 4 of selector switch Sr. This step (illustrated by the first rectangle on the top of Fig. 2) is completed at the point of time g. Thereupon the transfer switch L connects the load to tap 4. This step (illustrated by the second rectangle from the top of Fig. 2) is completed at the point of time h. Auxiliary switch 53 remains closed up to the point of time h (illustrated by the third rectangle from the top of Fig. 2), but auxiliary switch 54 closes already at the point of time f by pivoting in counterclockwise direction (as seen in Fig. 1) and is closed at the point of time i, at which time all the steps involved in the change from tap 3 to tap 4 are completed (the bottom rectangle of Fig. 2 refers to the timing of auxiliary changeover switch 54). The movable contacts of transfer switch L are operated in the proper sequence required for Flag-Pennant transfer switches or DP transfer switches. This is disclosed in considerable detail in the paper by Rudolf Klaus, Untersuchungen an Lastwählen und Lastumschaltern (System Dr. Jansen) für grosse Schaltläufigkeit—Investigations on selector switches and transfer switches (system Dr. Jansen) for high repetitive switching rates. At the point of time f, movable contact 32 engages fixed main contact 22, and movable auxiliary contact 36 engages fixed auxiliary contact 26, and all other contacts of transfer switch L are out of engagement. Since—as mentioned above—auxiliary switch 53 remains closed up to the point of time h and auxiliary switch 54 closes at the point of time f and remains closed thereafter, neither of both auxiliary switches 53, 54 carries current when performing a switching operation. Hence arcing is no problem in designing auxiliary change-over switches 53 and 54. The time during which there is a difference in potential between the contacts of transfer switch L is limited to the very short period when the tap-changing operation is being performed, and as explained above. Auxiliary switches 53 and 54 and the circuitry related to these switches maintain all contacts of transfer switches L at the same potential when that switch is in either of its two limit positions, applying the voltage of taps 1, 2, 3, 4 ... 9, 10, 11, 12 to the load of the transformer.

It will be apparent from the foregoing that a tap-changing operation from a tap of winding W having a relatively high number to a tap of winding W having a relatively low number involves an inversion of the steps which have been described above. To be more specific, in such an instance auxiliary switch 53 is first closed and this is followed by opening of auxiliary switch 54.

The sequence of steps required of a transfer switch for performing a tap-changing operation depends upon the type of transfer switch under consideration. A number of different types of transfer switches, their operating characteristics, vector diagrams and sequences of contact operation have been outlined in the aforementioned U.S. Patent 3,174,097 to A. Bleibtreu. A tap-changing operation in the structure of Fig. 1 involves merely of movable main contact 31 from fixed main contact 21 after contact bridge 42 has been pivoted to contact 2 of auxiliary contact 24. Upon completion of the aforementioned sequence of steps the resistors R1, R2 shown at the left of Fig. 1 are connected in parallel in the load circuit. Thereupon movable auxiliary contact 35 engages its cooperating fixed auxiliary contact 25 and movable auxiliary contact 33 parts from its cooperating fixed auxiliary contact 23. Finally movable main contact 32 engages its cooperating fixed main contact 22 and movable auxiliary contact 35 parts from its cooperating fixed auxiliary contact 25.

Referring now to Figs. 3 to 5, reference character S has been applied to indicate the housing of an operating mechanism for operating a transfer switch L arranged in a housing L' below housing S. The housing L' intended to receive transfer switch L houses also auxiliary switches corresponding to auxiliary switches 53, 54 of Fig. 1. These auxiliary switches will be described below more in detail. Reference character G has been applied to generally indicate a gear mechanism for operating the aforementioned auxiliary switches. The gear mechanism comprises a pair of meshing gears 58, 59. The former is operated by a shaft 57 which, in turn, is operated by the operating mechanism (not shown) inside of housing S. The selector switch Sr is arranged below housing L' for transfer switch L and the aforementioned auxiliary switches.

The upper part of shaft 57 and the lower part of shaft 58 are electrically insulated from each other and the aforementioned gear 58 is mounted on the lower end of shaft 57. Gear 59 operates shaft 62 by the intermediary of crank lever 61 mounted on shaft 62, tie rod 68 pivoted to crank lever 61 and pin 67 secured to gear 59. A substantially star-shaped cam 63 of electric insulating material having three cam arms enclosing angles of 120 degrees is mounted on and jointly pivotable with cam shaft 62. The radially outer ends of star-shaped cam 63 have transverse contact-operating projections of which one has been designated by the reference character 64. The transverse projections 64 of cam 63 are intended to engage pivotable contacts, and to be disengaged from these contacts. Reference numeral 65 has been applied to indicate one of these pivotable contacts. The structure of Fig. 4 includes a total of six such contacts. Each of these contacts is under the influence of a spring 66 tending to move the respective contact out of engagement with one of a pair of fixed contacts and into engagement with the other of said pair of fixed contacts. Reference character 53 has been applied in Fig. 4 to indicate an auxiliary switch comprising a pair of fixed contacts a and b and a pivotable contact adapted to engage selectively those contacts a and b. In a similar fashion, reference character 54 has been applied to indicate an auxiliary switch comprising a pair of fixed contacts c and d and a pivotable contact 65 adapted to engage selectively fixed contact c with a selector switch. Leads 51 and 52 of Fig. 4 are the full equivalent of the auxiliary switches 53, 54 of Fig. 1. In Fig. 4 reference character 51 has been applied to indicate a lead for connecting fixed contact a to a selector switch, and reference character 52 has been applied to indicate a lead for connecting fixed contact c with a selector switch. Leads 51 and 52 of Fig. 4 are the full equivalent to leads 51 and 52 of Fig. 1.

In Fig. 4 reference character 55 has been applied to indicate a lead conductively interconnecting fixed contact b of switch 53 and the pivotable contact of switch 53, and reference character 56 has been applied to indicate a lead conductively interconnecting fixed contact d of switch 53 and the pivotable contact of switch 53. Leads 55, 56 of Fig. 4 are equivalents of leads 55, 56 of Fig. 1. Fig. 4 shows leads 55, 56 in dotted lines since these leads are situated at a lower level than star-shaped cam 63 and not exposed to view. For the same reason all the leads interconnecting the three pairs of auxiliary switches 53, 54—of which each pair is operatively related to one phase of a three-phase electrical circuit—are omitted in Fig. 4. In Fig. 4, these connections being the same as shown in switches 53, 54 to transfer switch L have been deleted in Fig. 4, these connections being the same as shown in
FIG. 1, and described in connection with this figure. FIG. 4 further shows but the external connections 51, 52 of one pair of switches 53, 54 or one phase, to the selector switch S, the corresponding connections of the two other phases of the three-phase circuit being deleted in FIG. 4.

Conducting with a given tap-changing operation shaft 57 is operated and pivots star-shaped cam 63 by the intermediary of transmission means 58, 59, 67, 60, 61 and 62. In the position shown in FIG. 4 projection 64 of cam 63 engages movable contact 65 and maintains the latter against the action of a spring 66 in engagement with fixed contact 67 so as to conduct an electric current through switch 53 being in engagement with the fixed contact thereof. The aforementioned clockwise motion of star-shaped cam 63 frees contact 65 of switch 54, and thus this contact is pivoted under the bias of its spring 66 from right to left into engagement with fixed contact 68. As star-shaped cam 63 continues its clockwise motion, the selector switch S and the transfer switch T are being operated, as fully described above in connection with FIGS. 1 and 2. Star-shaped cam 63 has a pair of limit positions. As star-shaped cam 63 reaches its left limit position, one of its contact-operating projections 64 engages the pivotal contact of auxiliary change-over switch 53 and moves said contact against the bias of its spring from fixed contact a to fixed contact b. This completes a tap-changing operation.

Shaft 57 performs pivotal motions of 180 degrees. The sense of these motions depends upon whether a change to a higher tap number or to a lower tap number is effected. Switches 53, 54 change their respective positions irrespective of the sense of the pivotal motion of shaft 57.

Although I have shown and described specific structures embodying my invention, it is to be clearly understood that the same was disclosed merely for the purpose of illustration, and that changes and modifications may readily be made by those skilled in the art without departing from the spirit and scope of the invention.

1 claim as my invention:

1. A tap-changing transformer comprising in combination:

(a) transformer winding having a plurality of taps;
(b) a selector switch having a plurality of fixed contacts each conductively connected to one of said plurality of taps, said selector switch further including a pair of movable contact means each adapted to cooperatively engage selectively different of said plurality of fixed contacts;
(c) a transfer switch including a pair of fixed main contacts, fixed auxiliary contacts arranged between said pair of fixed main contacts, resistor means conductively connecting each of said fixed main contacts to said fixed auxiliary contacts immediately adjacent thereto, and said transfer switch further including a pair of movable main contacts and movable auxiliary contacts for engaging and disengaging said pair of fixed main contacts and said fixed auxiliary contacts in a predetermined sequence;
(d) a gear box arranged at a level below said pair of auxiliary change-over switches, said gear box housing a mechanism driven by said shaft for operating said selector switch and said gear box further housing gear means and linkage means driven by said shaft for operating said pair of auxiliary change-over switches;
(e) a pair of auxiliary change-over switches each inserted into one of said pair of leads and each having a first limit position establishing a conductive connection between one of said pair of movable contact means of said selector switch and one of said pair of fixed main contacts of said transfer switch,
(f) a pair of auxiliary change-over switches further having a second limit position;
(g) a pair of leads each for conductively interconnecting said pair of fixed main contacts of said transfer switch when one of said pair of auxiliary change-over switches is in said second limit position thereof.

2. A tap-changing transformer as specified in claim 1 including power driven operating means for operating said pair of auxiliary change-over switches, said operating means allowing one of said pair of auxiliary change-over switches to remain in said first limit position thereof, while causing the other of said pair of auxiliary change-over switches to be moved from said second limit position thereof to said first limit position thereof, and said operating means further allowing said other of said pair of auxiliary switches to remain in said first limit position thereof while causing said other pair of auxiliary change-over switches to be moved from said second limit position thereof to said first limit position thereof.

3. A tap-changing transformer as specified in claim 1 including a drive for said selector switch arranged above said transfer switch, a vertical shaft operated by said drive for operating said selector switch, said selector switch being arranged below said transfer switch, and an operating mechanism under the control of said shaft for operating said pair of auxiliary switches, said pair of auxiliary switches being arranged between said transfer switch and said selector switch.

4. A tap-changing transformer as specified in claim 1 wherein said plurality of fixed contacts of said selector switch includes even contacts arranged in a circular pattern at a predetermined level and odd contacts arranged in a circular pattern at another level than said predetermined level, wherein said transfer switch is arranged at a level above said selector switch and wherein said pair of auxiliary switches is arranged at a level intermediate said selector switch and said transfer switch.

5. A tap-changing transformer as specified in claim 1 comprising:

(a) a drive for said transfer switch arranged at a level above said transfer switch;
(b) a housing for said transfer switch, said pair of auxiliary change-over switches being also located inside said housing at a lower level than said transfer switch;
(c) an insulating shaft driven by said drive for said transfer switch and extending in downward direction; and
(d) a gear box arranged at a level below said pair of auxiliary change-over switches, said gear box housing a mechanism driven by said shaft for operating said selector switch and said gear box further housing gear means and linkage means driven by said shaft for operating said pair of auxiliary change-over switches.

6. A tap-changing transformer as specified in claim 1 wherein each of said pair of auxiliary change-over switches includes a pivotable contact and spring means for biasing said pivotable contact to a first limit position, said pair of auxiliary change-over switches further including a pivotable cam selectively engaging said pivotable contact of each of said pair of auxiliary change-over switches to move said pivotable contact against the action of said spring means to a second limit position thereof.

7. A tap-changing transformer as specified in claim 1 including:

(a) a power driven selector-switch shaft;
(b) an auxiliary change-over switch operating shaft operated by said selector switch operating shaft by the intermediary of a transmission;
(c) a substantially star-shaped cam having three arms enclosing angles of 120 degrees mounted for joint pivotal motion on said auxiliary change-over switch operating shaft; and
(d) three pairs of auxiliary change-over switches, each of said pairs of auxiliary change-over switches including a pair of spring biased pivotable contacts.
9. A tap-changing switching system for tapped transformer windings comprising in combination:
(a) a selector switch having a plurality of fixed contacts, a pair of fixed slip-rings, and a pair of contact bridges adapted to selectively interconnect said plurality of contacts and said pair of slip-rings;
(b) a transfer switch including a pair of fixed main contacts, fixed auxiliary contacts arranged between said pair of fixed main contacts, resistor means conductively connecting each of said pair of fixed main contacts to said fixed auxiliary contacts immediately adjacent thereto, and said transfer switch further including a pair of movable main contacts and movable auxiliary contacts for engaging and disengaging said pair of fixed main contacts and fixed auxiliary contacts in a predetermined sequence;
(c) a pair of leads each conductively connecting one of said pair of slip-rings of said selector switch to one of said pair of fixed main contacts of said transfer switch;
(d) a pair of auxiliary change-over switches each inserted into one of said pair of leads and each having a first limit position establishing a conductive connection between one of said pair of slip-rings of said selector switch and one of said pair of fixed main contacts of said transfer switch, each of said pair of auxiliary change-over switches further having a second limit position; and
(e) means for shunting said pair of fixed main contacts of said transfer switch when one of said auxiliary switches is in said second limit position thereof.

9. A switching system as specified in claim 8 including common drive means for said selector switch, said transfer switch and said pair of auxiliary change-over switches, and means for positively controlling the sequence of operation of said selector switch and said pair of auxiliary change-over switches.

10. A switching system as specified in claim 8 including:
(a) a selector-switch operating shaft;
(b) an auxiliary change-over switch operating shaft operated by said selector switch operating shaft by the intermediary of transmission means;
(c) a cam mounted for joint pivotal motion on said auxiliary change-over switch operating shaft; and
(d) a pair of pivotable change-over switch contacts each biased to a first limit position thereof and each engageable by said cam and movable by said cam against spring bias to a second limit position thereof.

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