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(73) Proprietor : **MITSUBISHI DENKI KABUSHIKI KAISHA**
2-3, Marunouchi 2-chome Chiyoda-ku
Tokyo 100 (JP)

(72) Inventor : **Ito, Katsuaki**
2-4-15, Higashi Shirakawadai Suma-ku
Kobe City Hyogo Prefecture (JP)

(74) Representative : **Lawson, David Glynne et al**
MARKS & CLERK 57-60 Lincoln's Inn Fields
London WC2A 3LS (GB)

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Description

The present invention relates to a tap changer used in a transformer for changing a voltage by stages by a predetermined number of taps.

In a conventional tap changer such as the one disclosed in Japanese Laid-Open Patent Publication No. 56-107542 (West German Patent Application No. P 29 36 519.3 filed on September 10, 1979), a terminal or a neutral point of a transformer is electrically connected to one end of a main winding. The other end of the main winding is electrically connected to one end of a first tap winding for the rough adjustment of voltage and to a stationary contact of a first change-over switch. The first change-over switch has another stationary contact connected to the other end of the first tap winding, and a current collecting contact which is electrically connected to one end of a second tap winding for the rough adjustment of voltage and to a stationary contact of a second change-over switch. The second change-over switch has another stationary contact connected to the other end of the second tap winding, and a current collecting contact connected to a tap winding device for the fine adjustment of voltage. The fine adjustment tap winding device comprises a fine adjustment tap winding with a predetermined number of taps and an auxiliary tap for changing voltage. An auxiliary change-over switch has one stationary contact connected to the other end of the first tap winding, the other stationary contact connected to the other end of the second tap winding, and a current collecting contact connected to the fine adjustment tap winding device. Each of the first, second, and auxiliary change-over switches has a movable switching member for electrically connecting the current collecting contact to either of the stationary contacts. The stationary and current collecting contacts of each change-over switch are disposed between the movable switching members thereof. An output terminal is connected through a diverter switch to either of two movable conductors which can be electrically connected to the fine adjustment tap winding device.

In a transformer having such a tap changer, the voltage between the neutral point and the output terminal is changed by stages by the switching operations of the first, second, and auxiliary change-over switches and the switching operations of the taps of the fine adjustment tap winding device.

However, the above tap changer has the following disadvantages.

1) It is necessary to dispose change-over switches the number of which is the same as the number of rough adjustment tap windings, and auxiliary change-over switches the number of which is less by one than the number of rough adjustment tap windings. When the number of rough adjustment tap windings increases, the number of change-over switches and auxiliary change-over switches correspondingly increase.

2) Since it is necessary to install the change-over switches and the auxiliary change-over switch in each phase as stated in (1), it is necessary to install them three times in the case of three phases.

3) Since the contacts of each change-over switch are disposed between the movable switching members thereof, a powder is formed within the transformer by the wearing of the contacting portions between the contacts and their movable switching members, which is not desirable from the standpoint of the withstand voltage of the apparatus.

To overcome the above disadvantages, an object of the present invention is to provide a tap changer in which the number of rough adjustment tap windings is increased by only increasing the number of stationary contacts of a change-over switch and an auxiliary change-over switch, and in which the wearing of the contacts is preferably reduced, thereby obtaining a compact and reliable tap changer.

With the above object in view, the present invention aims to improve a tap changer used with a transformer including a main winding, at least two tap windings for the rough adjustment of voltage, one tap winding having a predetermined number of taps for the fine adjustment of voltage, and first and second change-over switch devices each having stationary contacts and one current collecting contact, in which the rough-adjustment windings are electrically connected in series to the main winding and each other, the stationary contacts of each change-over switch device are electrically connected to the connecting portions between the respective windings and to the end of the other rough adjustment tap winding which is not electrically connected to any winding, the current collecting contact of the first change-over switch is electrically connected to an end of the fine adjustment tap winding, and the current collecting contact of the second change-over switch is electrically connected to a stationary contact installed in the tap-selector for the auxiliary tap. Such a tap changer is disclosed in GB-A-886 432.

In accordance with the present invention

a) the stationary contacts and current collecting contacts of the first and second change-over switch devices are disposed on the same inner circumferential surface and can be electrically connected to each other by a movable rotary conductor ;

b) the stationary contacts of the first and second change-over switch devices are integrally formed with each other ;

c) each change-over switch device comprises three change-over switches for three phases, each change-over switch having stationary contacts and a current collecting contact ; and

d) the stationary and current collecting con-

tacts for each phase are respectively disposed on the same circumference of three circumferentially divided walls.

The present invention will now be described with reference to the preferred embodiments thereof in conjunction with the accompanying drawings in which :

Fig. 1 is a view schematically showing the electrical arrangement of one embodiment of a tap changer used in a transformer ;

Fig. 2 is a view showing an arrangement of contacts of change-over switches of the tap changer in Fig. 1 ;

Fig. 3 is a cross-sectional view of each of the change-over switches taken along line III-III in Fig. 2 ;

Fig. 4 is a view schematically showing an electrical arrangement of another embodiment of a tap changer used in a transformer ;

Fig. 5 is a view showing an arrangement of contacts of change-over switches of the tap changer in Fig. 4 ;

Fig. 6 is a plan view showing current collecting contacts and movable rotary conductors in Fig. 1 in the case of three phases ;

Fig. 7 is a view showing an arrangement of contacts of change-over switches in a further embodiment of the present invention ;

Fig. 8 is a cross-sectional view taken along Line VIII-VIII of Fig. 7 ; and

Fig. 9 is a table showing the relation between taps through which the electric current flows and the change-over switches in the tap changer in Fig. 1.

In Fig. 1, a transformer with which a tap changer of the present invention can be used comprises a main winding 51 electrically connected at one end thereof to a terminal or a neutral point 50 of the transformer, and first and second tap windings 54 and 58, respectively, which are electrically connected in series to each other without change-over switches and which are used to roughly adjust the voltage of the transformer. The connecting portion between the main winding 51 and the first tap winding 54 is electrically connected to a stationary contact 11 of a first change-over switch 70 and a stationary contact 15 of a second or auxiliary change-over switch 71. The connecting portion between the first tap winding 54 and the second tap winding 58 is electrically connected to a stationary contact 12 of the first change-over switch 70 and a stationary contact 16 of the auxiliary change-over switch 71. The end of the second tap winding 58, which is not electrically connected to the first tap winding 54, is electrically connected to a stationary contact 13 of the first change-over switch 70 and a stationary contact 17 of the auxiliary change-over switch 71. A tap changer used in the transformer comprises the first and second change-over switches 70 and 71, respectively.

A current collecting contact 14 of the first change-over switch 70 can be electrically connected to one of the stationary contacts 11 to 13 thereof by a movable rotary conductor A, and is electrically connected to one end 61 of a tap winding 62 comprising a predetermined number of taps 101 to 109 for the fine adjustment of voltage. A current collecting contact 18 of the auxiliary change-over switch 71 can be electrically connected to one of the stationary contacts 15 to 17 thereof by a movable rotary conductor B, and is electrically connected to an auxiliary tap K which can be electrically connected to a diverter switch 65 by a movable conductor of tap selector 64b. The fine adjustment tap winding 62 and the auxiliary tap K constitute a tap winding device for the fine adjustment of voltage of the present invention. The diverter switch 65 has a movable switching member for electrically connecting an output terminal 66 to either of the movable conductors of tap selector 64a and 64b. Each of the movable conductors of tap selector 64a and 64b can electrically come in contact with one of the taps of the fine adjustment tap winding 62.

Fig. 2 shows an arrangement in which the contacts of the first change-over switch 70 and the auxiliary change-over switch 71 disposed on an inner circumferential wall are seen from the inside thereof. Each of the movable rotary conductors A and B can rotate from one stationary contact to another stationary contact in order to electrically connect each of the current collecting contacts 14 and 18 to one of the stationary contacts. Fig. 3 shows in cross section the structure of the contacts of each of the change-over switches 70 and 71.

In the tap changer constructed as above, the operation for reducing the voltage between the neutral point 50 and the output terminal 66 will now be described. As shown in Fig. 1, the movable conductor of tap selector 64b is electrically connected to the auxiliary tap K, and the output terminal 66 is electrically connected to the movable conductor of tap selector 64b by the switching member of the diverter switch 65. The movable conductor of tap selector 64a electrically contacts a tap 101. This state corresponds to position No. 10 in Fig. 9, and the transformer is operated at the position of the auxiliary tap K. Then, while the movable conductor of tap selector 64a is moved from the tap 101 to a tap 109, the rotary conductor A of the change-over switch 70 is separated from the stationary contact 13 and electrically connected to the stationary contact 12. After the rotary conductor A has been electrically connected to the stationary contact 12, the switching member of the diverter switch 65 is switched to electrically connect the output terminal 66 to the movable conductor of tap selector 64a, operating the transformer at the position of the tap 109 in the fine adjustment tap winding 62. This state corresponds to position No. 11 in Fig. 9.

Next, while the movable conductor of tap selector 64b is moved from the auxiliary tap K to a tap 108, the rotary conductor B of the auxiliary change-over switch 71 is separated from the stationary contact 17 thereof and is electrically connected to the stationary contact 16. After the rotary conductor B has been electrically con-

nected to the stationary contact 16, the switching member of the diverter switch 65 is switched to electrically connect the output terminal 66 to the movable conductor of tap selector 64b, operating the transformer at the position of the tap 108 in the fine adjustment tap winding 62. This state corresponds to position No. 12 in Fig. 9. It will be understood that the increase in voltage is performed by an operation opposite to the above operation. The increase and decrease in voltage by the first tap winding 54 are respectively performed by an operation similar to the above operation.

Fig. 9 shows the relation between the taps of the tap selector, the change-over switch 70, and the auxiliary change-over switch 71 in Fig. 1 through which the electric current passes, further clarifying the successive operations mentioned above.

Figs. 4 and 5 show another embodiment of a tap changer of the present invention used in a transformer in which one further tap winding for the rough adjustment of voltage is added to the transformer in Fig. 1. A third rough adjustment tap winding 68 is connected in series to a second tap winding 58, and the end of the third tap winding 68, which is not connected to the second tap winding 58, is electrically connected to a stationary contact 19 of a first change-over switch 70' and a stationary contact 10 of an auxiliary change-over switch 71'. The structure of the transformer having the tap changer in Figs. 4 and 5 is otherwise similar to the structure in Figs. 1 and 2. It will be understood that according to the second embodiment in Figs. 4 and 5, an effect similar to the effect in Figs. 1 and 2 is obtained.

Fig. 6 shows a tap changer for three phases comprising three change-over switches each of which is similar to each change-over switch in Fig. 1. Each of three circumferentially divided members on a circumferential wall defines a current collecting contact 14 or 18 of each of the three change-over switches 70 or 71, respectively. Stationary contacts of each change-over switch 70 or 71 are disposed on the same circumference as the circumference of each current collecting contact 14 or 18. Similar to the structure in Fig. 2, each current collecting contact 14 or 18 can be electrically connected to each stationary contact by a movable rotary conductor A or B, respectively. It will be understood that the effect of the present invention can obtained in the tap changer for three phases stated above. Furthermore, in comparison with the conventional tap changer in which stationary and current collecting contacts are disposed between movable conductors and in which it is difficult to electrically insulate three change-over switches from each other, the current collecting contacts 14 and 18 as well as the stationary contacts can be disposed on an inner circumferential wall, and it is therefore easy to electrically insulate the three change-over switches from each other.

As can be clearly seen from Figs. 1 and 4, the electric potentials of the stationary contacts of the first change-over switch are respectively the same as the electric potentials of the stationary contacts of the auxiliary change-over switch. Therefore, as seen from Figs. 7 and 8, the stationary contacts 11, 12, and 13 of the first change-over switch 70 can be integrally formed with the stationary contacts 15, 16, and 17, respectively of the auxiliary change-over switch 71.

As mentioned above, according to the present invention, the following effects can be obtained by changing the structure of connections between a main winding, at least two rough adjustment tap windings, and first and second change-over switches, and the structure of contacts between the change-over switches.

1) The number of rough adjustment tap windings can be increased by increasing only the number of stationary contacts of first and second change-over switches without increasing the number of change-over switches.

2) A tap changer for three phases can be obtained without increasing the number of first and second change-over switches by a structure in which one current collecting contact of each change-over switch can be electrically connected to stationary contacts thereof by a movable rotary conductor.

3) By the structure mentioned in (2), there is less wear between contacts, the electrical insulation between them is reliable, and the driving torque required for each movable rotary conductor is small.

4) Therefore, a compact and reliable tap changer can be obtained.

Claims

1. A tap changer used with a transformer including a main winding (51), at least two tap windings (54, 58) for the rough adjustment of voltage, one tap winding (62) having a predetermined number of taps for the fine adjustment of voltage, and first and second change-over switch devices (70, 71) each having stationary contacts (11-13, 15-17) and one current collecting contact (14, 18), in which the rough-adjustment windings (54, 58) are electrically connected in series to the main winding (51) and each other, the stationary contacts of each change-over switch device are electrically connected to the connecting portions between the respective windings and to the end of the other rough adjustment tap winding (58) which is not electrically connected to any winding, the current collecting contact (14) of the first change-over switch (70) is electrically connected to an end of the fine adjustment tap winding (62), and the current collecting contact (18) of the second change-over switch (71) is electrically connected to a stationary contact installed in the tap-selector (65) for the auxiliary tap, characterised in that

a) the stationary contacts (11-13, 15-17) and current collecting contacts (14, 18) of the first and second change-over switch devices (70, 71) are

disposed on the same inner circumferential surface and can be electrically connected to each other by a movable rotary conductor (A, B) ;

b) the stationary contacts (11-13, 15-17) of the first and second change-over switch devices (14, 18) are integrally formed with each other ;

c) each change-over switch device comprises three change-over switches for three phases, each change-over switch having stationary contacts and a current collecting contact ; and

d) the stationary and current collecting contacts for each phase are respectively disposed on the same circumference of three circumferentially divided walls.

Patentansprüche

1. Anzapfumschalter, der zusammen mit einem Transformator eingesetzt ist, mit einer Hauptwindung (5'), wenigstens zwei Anzapfwindungen (54, 58) für die Grobeinstellung der Spannung, einer Anzapfwindung (62), die eine vorgegebene Anzahl an Anzapfstellen für die Feineinstellung der Spannung aufweist, und mit ersten und zweiten Umschalteinrichtungen (70, 71), von welchen jede stationäre Kontakte (11-13, 15-17) und einen Stromabnehmerkontakt (14, 18) aufweist, wobei die Grobeinstellungswindungen (54, 58) mit der Hauptwindung (51) und untereinander elektrisch in Serie geschaltet, die stationären Kontakte jeder Umschaltereinrichtung elektrisch mit den Verbindungsteilen zwischen den entsprechenden Windungen und mit dem Ende der anderen Grobeinstellungsanzapfwindung (58), die nicht mit irgendeiner anderen Windung elektrisch verbunden ist, verbunden sind, und wobei der Stromabnehmerkontakt (14) der ersten Umschaltereinrichtung (70) elektrisch mit dem Ende der Feineinstellungsabzapfwindung (62) verbunden und der Stromabnehmerkontakt (18) der zweiten Umschaltereinrichtung (71) elektrisch mit einem stationären Kontakt verbunden ist, der in einen Anzapfwähler (65) für die Hilfsanzapfung eingebaut ist, dadurch gekennzeichnet, daß

a) die stationären Kontakte (11-13, 15-17) und die Stromabnehmerkontakte (14, 18) der ersten und der zweiten Umschaltereinrichtung (70, 71) an der gleichen innen umlaufenden Oberfläche angeordnet sind und untereinander durch einen beweglichen drehbaren Leiter (A, B) verbunden sein können ;

b) die stationären Kontakte (11-13, 15-17) der ersten und der zweiten Umschaltereinrichtung (14, 18) miteinander einstückig geformt sind ;

c) jede Umschaltereinrichtung drei Umschalter für drei Phasen umfaßt, wobei jeder Umschalter stationäre Kontakte und einen Stromabnehmerkontakt aufweist ; und

d) die stationären Kontakte und die Stromabnehmerkontakte einander zugeordnet am selben Umfang dreier in Umfangsrichtung unterteilter Wände angeordnet sind.

Revendications

1. Un commutateur de prise utilisé avec un transformateur comprenant un enroulement (51), au moins deux enroulements de prise (54, 58) pour le réglage approximatif du voltage, un enroulement de prise (62) ayant un nombre de prises prédéterminé pour le réglage minutieux du voltage et un premier et second dispositif de commutation (70, 71) chacun muni de contacts fixes (11-13, 15-17) et un contact de collection de courant (14, 18), dans lequel les enroulements de réglage approximatif (54, 58) sont connectés électriquement en série entre-eux et à l'enroulement principal (51), les contacts fixes de chacun des dispositifs de commutation sont connectés électriquement aux parties de connexion entre les enroulements respectifs et au bout de l'autre enroulement de prise de réglage approximatif (58) qui n'est connecté électriquement à aucun enroulement, le contact de collection de courant (14) du premier commutateur (70) est connecté électriquement à un bout de l'enroulement de prise de réglage minutieux (62), et le contact de collection de courant (18) du second commutateur (71) est connecté électriquement à un contact fixe installé dans le sélecteur de prise (65) pour la prise auxiliaire, caractérisé en ce que

a) les contacts fixes (11-13, 15-17) et les contacts de collection de courant (14, 18) du premier et second dispositifs de commutation (70, 71) sont disposés sur la même surface circonférentielle intérieure et peuvent être connectés électriquement entre-eux par un conducteur rotatif mobile (A, B) ;

b) les contacts fixes (11-13, 15-17) du premier et second dispositif de commutation (14, 18) sont constitués intégralement entre-eux ;

c) chacun des dispositifs de commutation comprend trois commutateurs pour trois phases, chacun des commutateurs est muni de contacts fixes et d'un contact de collection de courant ; et

d) les contacts fixes et de collection de courant pour chaque phase sont disposés respectivement sur la même circonférence de trois parois divisées de manière circonférentielle.

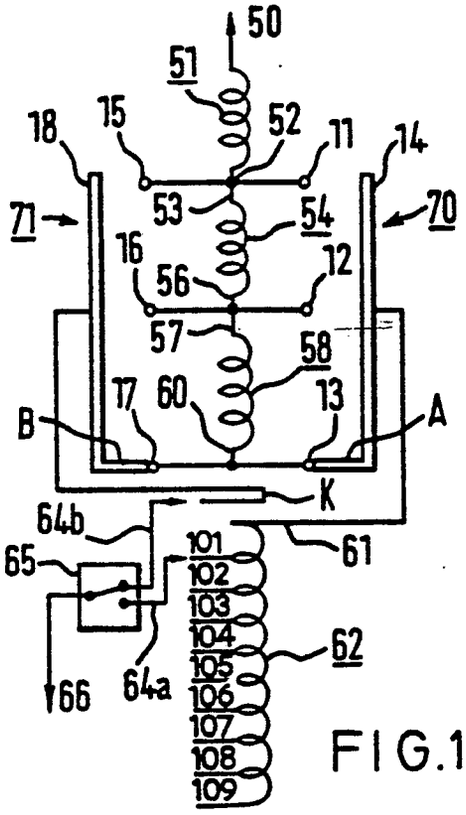

FIG.1.

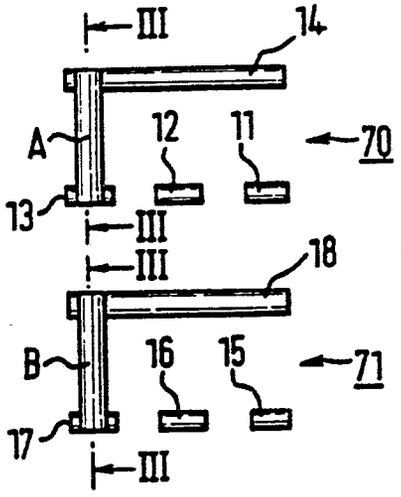

FIG.2.

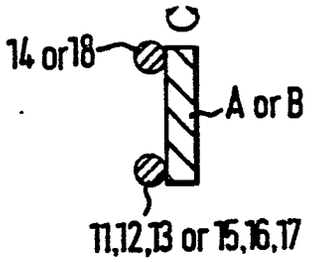

FIG.3.

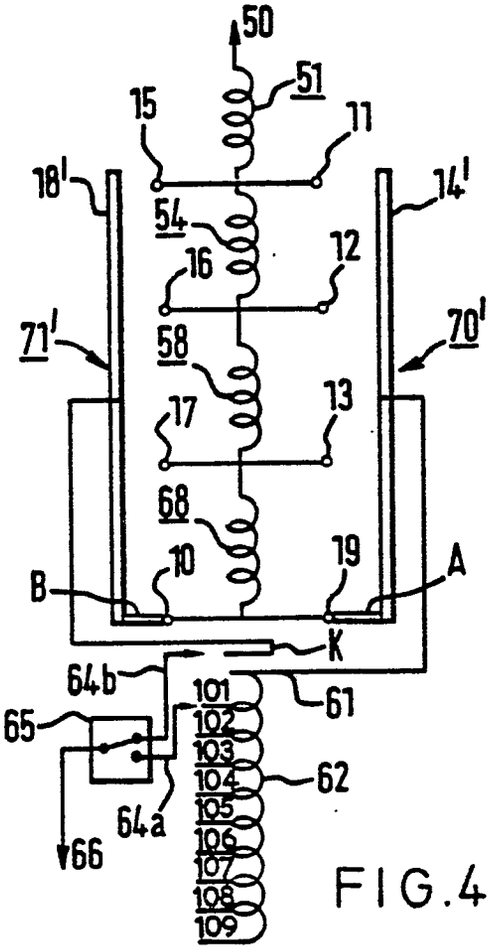

FIG.4.

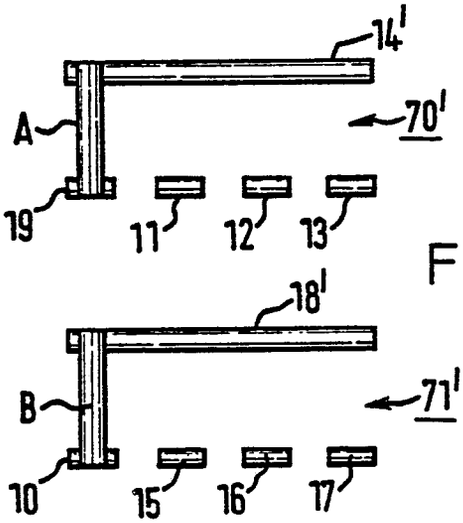

FIG.5.

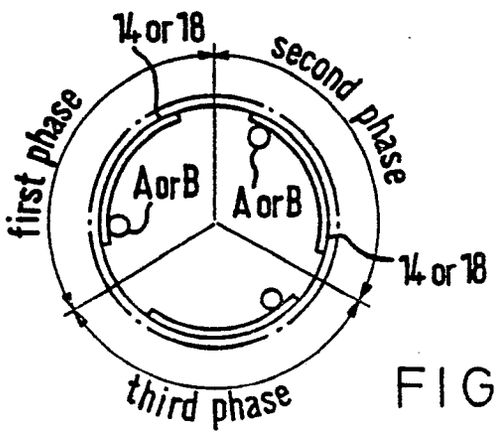

FIG.6.

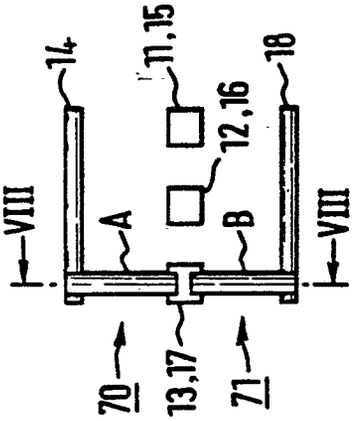

FIG.7.

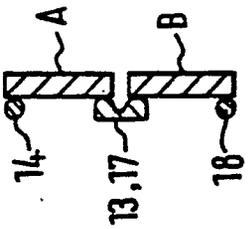

FIG.8.

Position Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Top Selector	109	108	107	106	105	104	103	102	101	K	109	108	107	106	105	104	103	102	101	K	109	108	107	106	105	104	103	102	101
Change-over Switch	13										12										11								
Auxiliary Change-over Switch	17										16										15								

FIG.9.