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71 Applicant: MITSUBISHI DENKI KABUSHIKI KAISHA
2-3, Marunouchi 2-chome Chiyoda-ku
Tokyo 100(JP)

72 Inventor: Yoshida, Kazuo c/o Itami Works
Mitsubishi Denki K.K. 1-1 Tsukaguchi Hon-machi 8-c
Amagasaki City Hyogo Prefecture(JP)

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

54 On-load tap changing device.

57 An on-load tap changing device has an energization exclusive contact 12 provided in parallel with a circuit which has a resistor R, for flow of a load current to the energization exclusive contact in parallel with the circuit having the resistor. Because the load current flows to the energization exclusive contact 12 in parallel with the circuit having the resistor, the thermal capacity of the resistor can be limited.

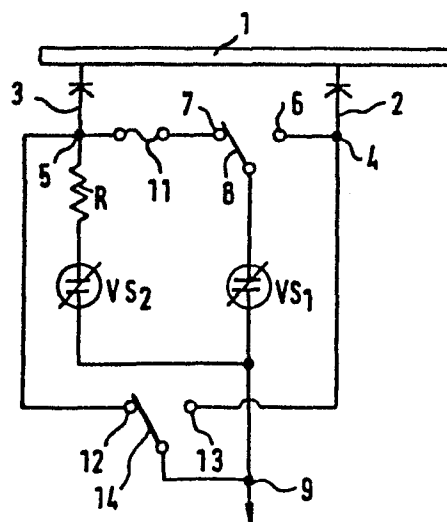


FIG. 3.

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ON-LOAD TAP CHANGING DEVICEBACKGROUND OF THE INVENTION

The present invention relates to an on-load tap changing device using a vacuum switch, and more particularly, to an improvement of the device for preventing a transformer from mortally damaging at shortcircuiting time between taps of the transformer.

Fig. 1 is a diagram of an electric circuit showing a conventional on-load tap changing device disclosed, for example, in Japanese Patent Laid-open No. 55-110,015 official gazette. In Fig. 1, reference numeral 1 designates a regulating winding of a transformer; numerals 2 and 3 designate tap selection branches of a tap selector for selecting odd and even taps on the winding 1; numeral 4 designates an input terminal of the even side of a changeover switch connected to the tap selection branch 2; numeral 5 designates an input terminal of the odd side of the changeover switch connected to the selection branch 3; numerals 6 and 7 designate energization stationary contact respectively connected to the input terminals 4 and 5; numeral 8 designate an energization movable contact selectively engaged with the stationary contacts 6 and 7; numeral 9 designates an output terminal of the changeover switch; reference characters VS1 and VS2 designate vacuum switches; and character R designates a current limiting

resistor. Numeral 11 designates a fusible element made of a fuse or a fine conductor which can continuously flow normally the rated load current or its overload current of a transformer but is rapidly disconnected by a large
5 current such as a shortcircuiting current between taps, and connected between the input terminal 5 and the stationary contact 7.

The removal of a shortcircuit defect between the taps will be described with reference to Figs. 1. If the vacuum
10 switch VS1 fails to break a load current due to a certain cause when the vacuum switch VS1 is opened as shown in Fig. 1(b), a shortcircuit between the taps (a route designated by a broken line in Fig. 1(c)) occurs through a space arc
10 at the stage of Fig. 1(c), an excessive current flows as described above, the fuse is melted, and the shortcircuit
15 defect between the taps is removed. When the defective current is removed, the load current i_l of the transformer is supplied through an electric circuit of the branch 3, the input terminal 5, the resistor R, the switch VS1 and
20 the output terminal 9 as shown in Fig. 1(d). Then, when the vacuum switch VS1 is closed as shown in Fig. 1(e), the load current is flowed in the circuit of the branch 2, the input terminal 4, the contact 6, the contact 8, the switch VS1 and the output terminal 9, and the circulating current
25 i_l between the taps is flowed through the circuit shown by

a broken line in Fig. 1(e). Then, when the switch VS1 is opened in the state of Fig. 1(f), only the load current i_l is supplied from the even side tap, and the tap is completely switched. Figs. 2 show the reverse switching to the above in Figs. 1, i.e., the switching from the even tap to the odd tap.

If switched to the odd tap when the load current i_l is supplied from the even tap through the vacuum switch VS1 as shown in Fig. 2(a), the vacuum switch VS2 is first closed as shown in Fig. 2(b). The load current i_l is supplied through an electric circuit shown by a solid line in Fig. 2(b) at this time, and the circulating current i_c between the taps is flowed through the electric circuit shown by a broken line in Fig. 2(b). Then, the vacuum switch VS1 is opened as shown in Fig. 2(c), tending to break the vector sum of the load current i_l and the circulating current i_c . If the breakage of the current is failed due to a certain cause at this time, a shortcircuit between the taps occurs through a space arc 10 as shown in Fig. 2(c) at the next stage, i.e., at the stage shown in Fig. 2(d), and an excessive current flows in the circuit shown by a broken line in Fig. 2(d). Therefore, as shown in Fig. 2(e), the fusible element 11 is rapidly disconnected to remove the shortcircuiting current between the taps. Subsequently, the vacuum switch VS1 is closed as shown in Fig. 2(f), and

the tap changing operation is completed. However, since the element 11 is melted and disconnected different from the switching from the odd tap to the even tap at this time, the load current i_l cannot be supplied through the switch VS1, the load current i_l is flowed through the resistor R and the electric circuit of the branch 3, the input terminal 5, the resistor R, the switch VS2 and the output terminal 9 as shown in Fig. 2(f). Therefore, it is necessary to largely set the thermal capacity of the resistor R.

More particularly, the conventional on-load tap changing device supplies the load current through the current limiting resistor if the fusible element is melted and disconnected due to the shortcircuit between the taps. Thus, the conventional device has a drawback that if the time for switching the load to the other system becomes long, the thermal capacity of the resistor must be increased that much.

SUMMARY OF THE INVENTION

The present invention is made to eliminate the above-described problem and has for its object to provide an on-load tap changing device which can supply a load current without intermediary of a resistor even if a fusible element is melted and disconnected.

BRIEF DESCRIPTION OF THE DRAWINGS

Figs. 1 are explanatory views showing the circuit diagram and the operations of a conventional on-load tap changing device;

Figs. 2 are explanatory views showing the operation of the circuit diagrams in Figs. 1 at the reverse switching time;

Fig. 3 is a circuit diagram showing an embodiment of the present invention; and

Fig. 4 is the operating sequence of Fig. 3.

In the drawings, the same symbols indicate the same or corresponding parts.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 3 is a circuit diagram showing an embodiment of the present invention. In Fig. 3, reference numerals 1 to 9, 11, and reference characters VS1 and VS2 designate the same as those in Fig. 1. Reference numeral 12 designates an energization exclusive stationary contact connected to the odd side input terminal 5; numeral 13 designates an energization exclusive stationary contact connected to the odd side input terminal 4 of a changeover switch; and numeral 14 designates an energization exclusive movable contact constructed to be connected at one end to the output terminal 9 and selectively connected at the other end to the contacts 12 and 13. Fig. 4 shows an operating sequence. The state of the vacuum switch VS1 at the

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breakage failure time is entirely the same as those in Figs. 1(c) and 1(d). In the conventional circuit in Fig. 1(a), the thermal capacity of the current limiting resistor R is irrespective as the protecting operation at the

5 switching from the odd tap to the even tap. This is the same even in Fig. 3. Therefore, the operation of Fig. 3 will be described merely for the shortcircuit between the taps at the switching time from the even tap to the odd tap. The switching is performed when the stages are

10 advanced from the right to the left of the sequence of Fig. 4. In Fig. 4, the vacuum switch VS1 is opened at the position III, and the vector sum of the load current and the circulating current is broken. When the switch VS1 fails to break at this time, a shortcircuit between the

15 taps occurs at the position II through an electric circuit of the branch 3, the input terminal 5, the fusible element 11, the contact 7, the space arc 6, the input terminal 4 and the branch 2, and the excessive current flows.

Therefore, the fuse 11 is melted to remove the defective

20 current. The load current of the transformer is flowed through an electric circuit of the branch 3, the input terminal 5, the resistor R, the switch VS2 and the output terminal 9. Further, if the movable contact 14 is

25 contacted with the stationary contact 12, the load current is transferred to an electric circuit of the branch 3, the

input terminal 5, the contact 12, the contact 14, and the output terminal 9 to complete the tap changing.

Since the electric circuit of the branch 3, the input terminal 5, the contact 12, the contact 14 and the output terminal 9 is originally constructed to have the continuously energizing capacity, it does not disturb the supply of the load current if the tap changing operation is locked by employing the circuit arrangement of Fig. 1.

In the embodiment described above, the example that the fuse 11 is connected between the odd side input terminal 5 and the energization stationary contact 7 has been described. However, the present invention is not limited to the particular embodiment. For example, the fuse 11 may be connected between the odd side input terminal 4 and the energization stationary contact 6, or connected between both.

According to the present invention as described above, the load current is flowed to the energization exclusive contact by providing the energization exclusive contact in parallel with the circuit which includes the resistor. Therefore, the increase in the thermal capacity of the resistor can be advantageously prevented.

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CLAIMS:

1. An on-load tap changing device comprising:

first and second tap selection branches (2,3) selectively connected to first and second taps of a transformer (1);

a first energization stationary contact (6) connected to the first tap selection branch (2);

a fusible element (11) connected with the second tap selection branch (3) and fused by a predetermined current;

a second energization stationary contact (7) connected to the second selection branch through the fusible element;

a first energization movable contact (8) selectively connectable to one or the other of the energization stationary contacts (6,7);

an output terminal (9) for producing a load current;

a first vacuum switch (VS1) connected between the output terminal and the first energization movable contact; and

a resistor (R) and a second vacuum switch (VS2) connected in series with each other and connected between the second selection branch and the output

terminal; characterised in that third and fourth energization exclusive stationary contacts (12,13) are respectively connected with the selection branches;

5 a second energization exclusive movable contact (14) is connected to the output terminal and can be selectively connected to the third and fourth energization exclusive stationary contacts; and

10 the fusible element (11) is inserted to and connected at least to one of between the first tap selection branch (2) and the first energization stationary contact (6) and between the second tap selection branch (3) and the second energization stationary contact (7) to melt at a predetermined current.

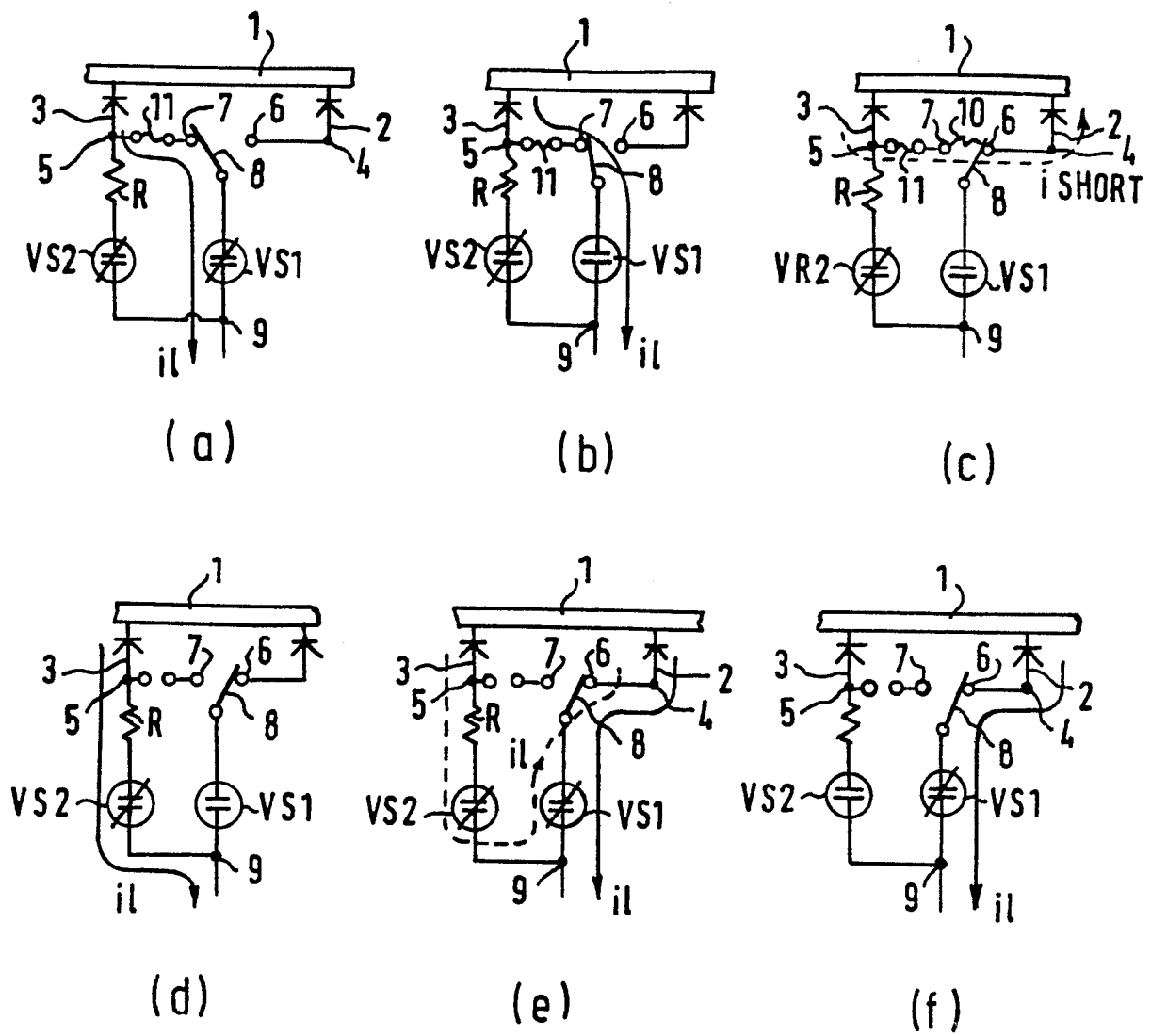


FIG.1. PRIOR ART

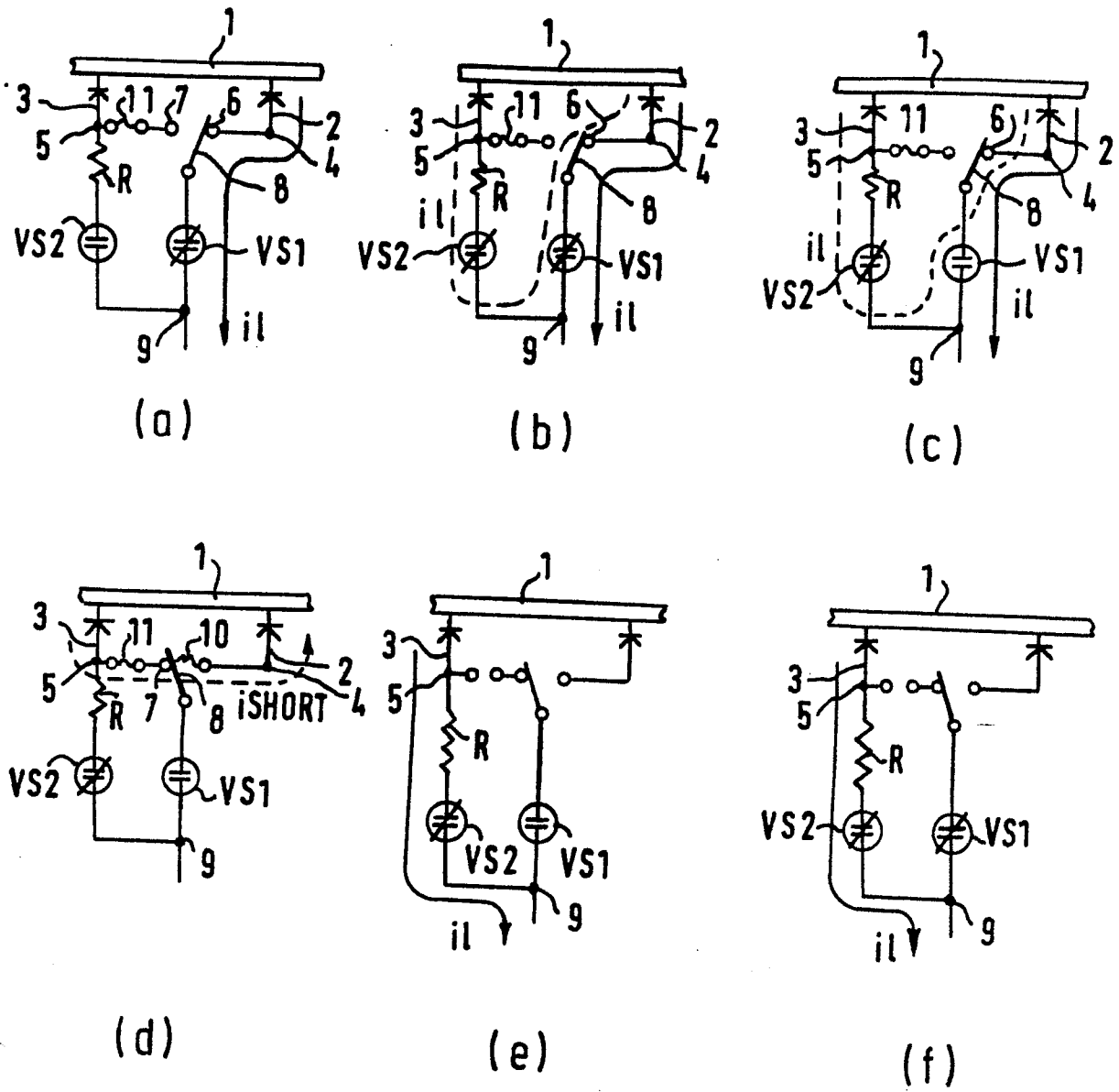


FIG. 2. PRIOR ART

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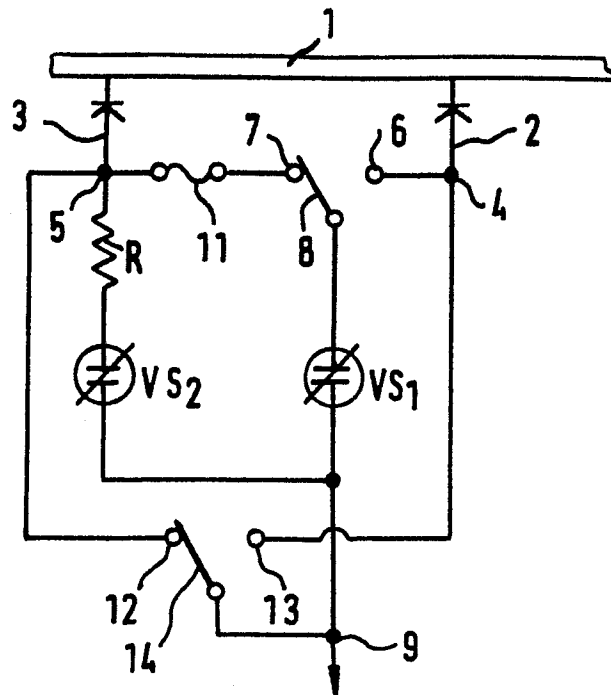


FIG. 3.

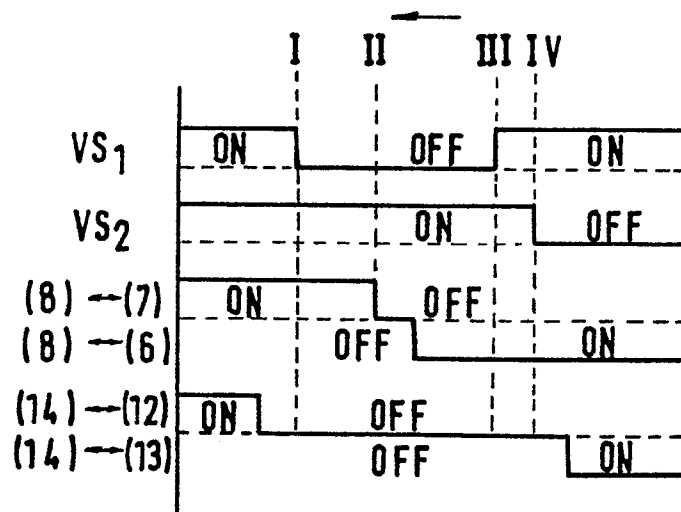


FIG. 4.