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QUICK-ACTING SWITCH ARRANGEMENT FOR A HIGH TENSION TRANSFORMER

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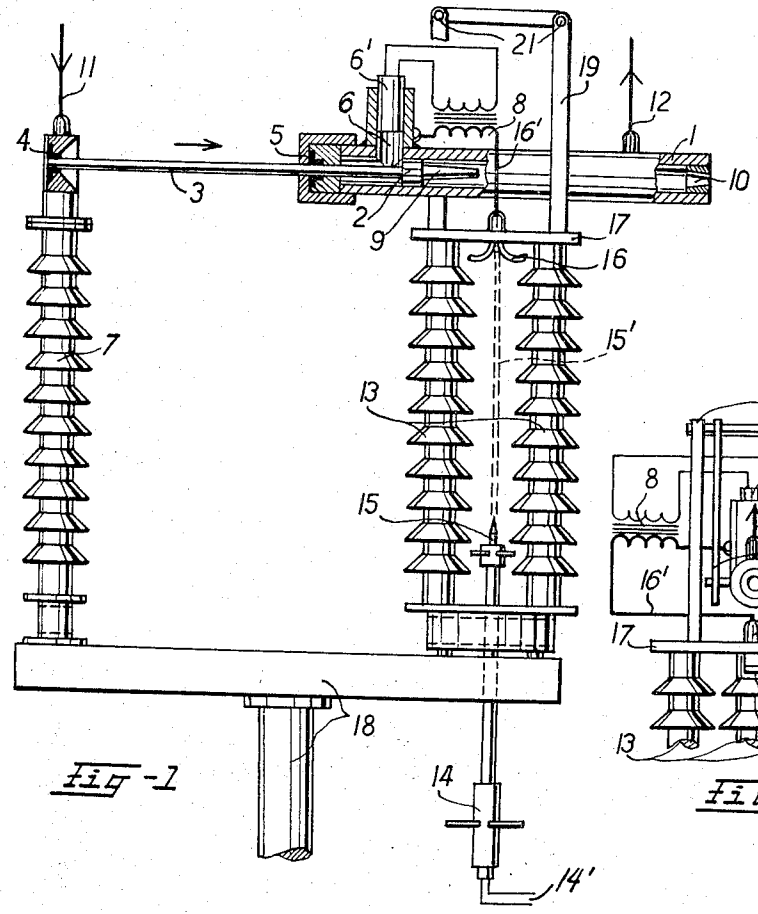


fig -1

fig - 2

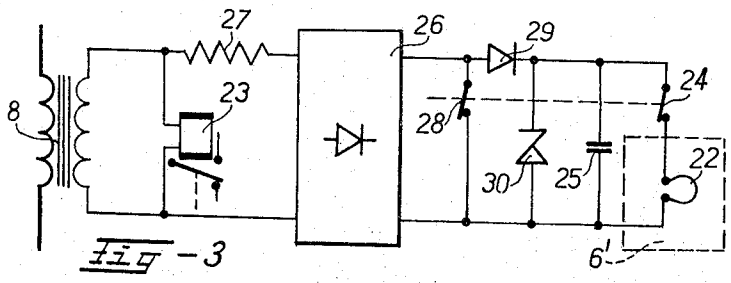


fig -3

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QUICK-ACTING SWITCH ARRANGEMENT FOR A HIGH TENSION TRANSFORMER

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4 Claims. (Cl. 317—15)

This invention relates to protective switch arrangements for high tension transformers, and particularly to a switch arrangement which instantaneously disconnects a damaged transformer from its feeder line after the transformer has been short-circuited.

It is known to ground the primary winding of a damaged transformer by means of an explosive-operated short-circuit switch. Such switches operate with extremely high speed, and are not affected by climatic conditions. The transformer thereafter is disconnected from its feeder line by switches which are controlled. The known disconnecting switches are relatively slow, and are not capable of disconnecting the transformer from the feeder during the short period during which a quick-acting circuit breaker keeps the feeder at zero voltage in response to the short-circuit. It is necessary in conventional switching arrangements to use circuit breakers in the feeder which operate with an adequate delay, or to restore tension in the feeder in two steps. In either case, the power supply from the feeder to consumers other than the damaged transformer is interrupted for a relatively long period.

The primary object of the invention is the provision of a switch arrangement which includes an explosive-operated short-circuit or grounding device for the transformer and also an explosive operated switch which disconnects the transformer from its feeder immediately after grounding. An important feature of this invention is a pulse generator which produces an electric pulse in response to the grounding of the transformer. The pulse triggers the explosion of the charge in a disconnecting switch which disconnects the feeder from the primary winding of the transformer. The time required for disconnecting a damaged transformer from its feeder by means of the switch arrangement of the invention is short enough to permit the operation to be completed within the very short period of zero voltage in the feeder which normally follows the short circuit.

Other features, additional objects, and many of the attendant advantages of this invention will be better understood by reference to the following detailed description of a preferred embodiment when considered in connection with the accompanying drawing in which:

FIG. 1 shows a switch arrangement of the invention in side-elevation, partly in section, and partly in conventional circuit diagram;

FIG. 2 shows the arrangement of FIG. 1 in fragmentary front elevation; and

FIG. 3 shows a modified detonator circuit for the arrangement of FIGS. 1 and 2.

Referring now to the drawing in detail, and initially to FIG, 1, there is seen a cylinder **1** of conductive material whose axis is horizontal, and in which a piston **2** is axially slidable. The piston rod **3** attached to the piston **2** constitutes the movable contact of a disconnecting switch which normally bridges a gap between fixed contact **4** of the switch and a conductive packing **5** on the cylinder **1**. A side tube **6** branches from the cylinder **1** axially between the piston **2** and the packing **5** and holds an explosive cartridge **6'**.

The fixed contact **4** is mounted on an upright high-tension insulator **7**, and the cylinder **1** on the upright insulators **13**. The insulators are arranged on a common supporting structure **18** which is conductive, and will be understood to be grounded. As is better seen in FIG. 2, the tops of the insulators **13** are connected by a carrier plate **17** from which the columns **19** extend upward. The cylinder **1** is suspended from the colunms **19** by means of a pendulum suspension which includes the pivot pins **21** connecting the upper ends of the columns, and hangers **20** of insulating material, which are hingedly attached to the pins **21** and to the cylinder, and permit swinging movement of the same in the approximate direction of its axis from the illustrated normal position. The piston **2** carries a conical braking member **9**, and the end of the cylinder **1** remote from the packing **5** is provided with a conically tapering, outwardly open braking sleeve **10**.

Only an end portion **11** of the feeder line which normally supplies power to the transformer associated with the switch arrangement is visible in FIG. 1, and is attached to the fixed contact **4**. Only a terminal portion **12** of the primary winding illustrates the high-tension transformer protected by the illustrated switch arrangement.

A contact **16** on the carrier plate **17** is connected to the primary winding of an auxiliary transformer **8** by a conductor **16'**. The secondary winding of the transformer **8** is connected to a detonator filament in the explosive cartridge **6'**, not seen in FIG 1.

The grounded support **18** carries a gun **14** which fires a conductive arrow **15** in response to an electric detonating signal received over conductors **14'**. When discharged from the gun **14**, the arrow assumes the position **15'** indicacted in broken lines, and provides a conductive bridge between the contact **16** and the grounded support **18**.

The afore-described switch arrangement operates as follows:

When the transformer **12** is damaged, a signal transmitted to the gun **14** discharges the arrow **15**, and grounds the primary winding of the transformer **12**, thereby also grounding the feeder **11**, in a manner known in itself. The short-circuit current flowing through the primary winding of the auxiliary transformer **8** generates a pulse in the secondary transformer winding which triggers the detonator in the cartridge **6'**. The explosion of the charge drives the piston **2** in the direction of th arrow toward the brake sleeve **10** until the cone **9** engages the sleeve **10**. The recoil is partly absorbed by the pendulum suspension of the cylinder **1**. The rod **3** moves with the piston, and the feeder **11** is quickly disconnected from the transformer **12**.

If the feeder **11** still carries voltage at the moment of movement of the movable contact or piston rod **3**, an electric arc is formed between the contacts **3** and **4**, and is extinguished when the non-illustrated circuit breaker in the feeder **11** responds to the short-circuit. If damage to the switch arrangement may be caused by the arc, the modified pulse generating and detonating circuit shown in FIG. 3 is preferred.

A relay **23** is arranged in parallel circuit with the secondary winding of the auxiliary transformer **8** which is also connected through a resistor **27** with a full wave rectifier **26** which may consist of several crystal diodes in a conventional bridge circuit. The output leads of the rectifier **26** are connected by normally closed contact **28** of the relay, by a Zener diode **30**, by a capacitor **25**, and by the detonator filament **22** of the explosive cartridge **6'** in series arrangement with another normally closed contact

24 of the relay 23. A crystal diode 29 prevents discharge of the capacitor 25 through the contact 28.

The detonating circuit shown in FIG. 3 operates as follows:

When the arrow 15 is fired and grounds the primary winding of the high-voltage transformer 12, the auxiliary transformer 8 causes attraction to the armature of the relay 23, and the contacts 24, 28 are opened. Circuit rectified by the rectifier 26 charges the capacitor 25. When the circuit-breaker referred to above reduces the voltage in the feeder 11 to zero, the relay 23 releases its armature, and the contacts 24, 28 return to the illustrated position. The capacitor 25 is discharged through the detonator filament 22, the charge in the cartridge 6' is exploded, and the movable contact 3 of the disconnecting switch is withdrawn. There is no arcing between the contacts 3 and 4.

The Zener diode 30 protects the capacitor 25 against excessive current pulses from the secondary winding of the transformer 8 in a manner known in itself, by limiting the current supply to the capacitor in cooperation with the resistor 27.

The circuit elements illustrated in FIG. 3 may be encapsulated in plastic for protection against climatic influences in a known manner, and two identical circuits of the type illustrated may be arranged in parallel to guard against malfunctioning of one.

The overall operating time of the afore-described switch arrangement from triggering of the cartridge 6' to the interruption of the feeder circuit at the contacts 4, 5 is readily held to not much more than forty milliseconds so that the damaged transformer may be disconnected from the feeder within the zero-voltage period provided by even an extremely quick-acting circuit breaker.

The switch arrangement of the invention is very compact and can be produced at low cost.

It should be understood, of course, that the preceding disclosure relates to only a preferred embodiment of the invention, and that it is intended to cover all changes and modifications of the example of the invention herein chosen for the purpose of the disclosure which do not constitute departures from the spirit and scope of the invention set forth in the appended claims.

What is claimed is:

1. In a disconnecting switch arrangement for a high voltage transformer having a primary winding, in combination:

(a) short-circuit means for grounding said primary winding in response to an electrical signal;

(b) pulse generating means in circuit with said short-circuit means and responsive to said grounding of the primary winding for generating an electric pulse;

(c) a cylinder member enclosing a cavity;

(d) a piston member movable in said cavity;

(e) explosive means communicating with said cavity and connected in circuit with said pulse generating means for discharging a gas under pressure into said cavity in response to said electric pulse, and for thereby moving said piston member in a predetermined direction;

(f) a source of electric power, and

(g) switch means operatively interposed between said source and said primary winding for energizing said winding by the current of said source, and for disconnecting the winding from said source, said switch means including a movable contact and a fixed contact, said movable contact being connected to said piston member for movement therewith, and responsive to said movement of the piston member in said direction for disconnecting said source from said transformer.

2. In a switch arrangement as set forth in claim 1, said pulse generating means including an auxiliary transformer having a primary winding and a secondary winding, conductive means connecting said primary winding of said auxiliary transformer to said primary winding of said high-voltage transformer and to said short-circuit means for passage of current from said source through said auxiliary transformer when said short circuit means is operated while said switch means connects said source to said primary winding of the high-voltage transformer, said explosive means including a detonator element, the secondary winding of said auxiliary transformer being arranged in circuit with said detonator element for energizing the same in response to current flow through said primary winding of the auxiliary transformer.

3. In a switch arrangement as set forth in claim 2, a relay connected to said secondary winding of the auxiliary transformer for being energized thereby, said relay having two normally closed contacts, a capacitor arranged in parallel circuit with said secondary winding of the auxiliary transformer, rectifier means interposed between said capacitor and said secondary winding, one of the contacts of said relay being shunted across said capacitor, the other contact of the relay and said detonator element being arranged in series, and being jointly arranged in parallel circuit with said capacitor.

4. In a switch arrangement as set forth in claim 1, a conductive support adapted to be grounded, insulator means on said support, pendulum suspension means on said insulator means and carrying said cylinder member for swinging movement substantially in said predetermined direction, and second insulating means on said support carrying said fixed contact.

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