

A NEW THYRISTOR BASED DC CIRCUIT BREAKER IMPLEMENTED ON A DC APPLICATION

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Abstract: A circuit breaker is an electrical switch which is invented to protect an electrical circuit from destructions due to overload or short circuit. Circuit breakers are used in AC and DC systems but compared to AC system interruption of dc fault current in DC system is more unreliable due to the absence of natural zero crossing. A solid state DC breaker in a DC system offers rapid response to faults, but it has greater power losses. The Z-source breaker is a type of solid state circuit breaker which was used conventionally in the systems. Nowadays researchers found that the Z-source circuit breaker topology along with the transformer coupling will allow us to detect fault and isolate the circuit suddenly. The proposed system consists of a thyristor based transformer coupling circuit for quick desolation purposes.

IndexTerms - Dc circuit breaker, Z source breaker, transformer coupling, Fast isolation, Thyristor circuit

Introduction

Dc electric power is seen as beneficial in a host of modern purposes, such as electric ships, data centers, micro grids with renewable energy, and coming up applications such as the dc home. As researchers consider the design of circuit breaker in a dc applications have significant interest.

I. BACKGROUND RESEARCH

The stoppage of DC supply suddenly in a system is a complicated process. The interruption was previously carried out with mechanical breakers which are used in ac systems. But the sudden interruption of dc with an ac can be used within specific range. After that a hybrid mechanical/solid-state breakers have been introduced with the benefit of low losses. Another protection method that has been suggested is to utilize converters and associated control. Alternatively, solid-state dc circuit breakers have been considered. These breakers offer faster response to faults, but tend to have more advanced power losses. The z-source breaker is a recently developed solid-state breaker that naturally reacts to faults. It has advantages of very faster operation and automatic disconnection of defective loads. A new approach in dc circuit breakers which is closely analogous to the z-source dc breaker but with utilization of transformer coupling have more advantages than the conventional ones. Recently researchers have suggested that coupled inductors not only helpful in fault detection purposes, but also for automated isolation. The breaker proposed herein also requires only fewer components than the existing one. It also has a settable level for fault current; that is through breaker design the transformer turns ratio (i.e., N_1/N_2 ratio) can be selected to determine how much fault current is needed for the breaker to operate.

II. METHODOLOGY

The proposed system consists of a breaker which is implemented in a load arrangement as presented in Figure 3.1. It consists of a dc supply, breaker circuit and an inverter circuit.

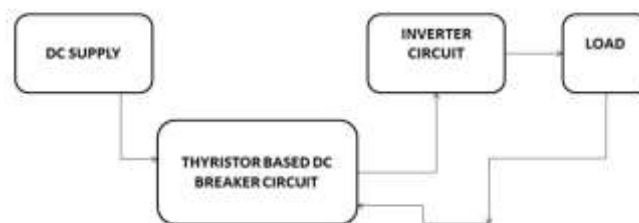


Figure 3.1: Breaker implemented on a load system

The dc supply reaches to the load side through breaker circuit and the inverter circuit. The breaker circuit is based on thyristor triggering and with the help of thyristor the breaker is made to off state. The dc supply from the breaker circuit is converted into an ac supply with the help of an inverter circuit. When a fault is appeared across the load side the excess fault current reaches to the breaker circuit and the thyristor inside this breaker becomes reverse biased and thus the supply will be interrupted. After the clearance of fault the breaker begins to operate. This is the methodology of a thyristor based dc circuit breaker.

III. SIMULATION

The proposed system is implemented in MATLAB software and it was found clear that this system interrupts the supply during abnormal conditions at a faster rate.

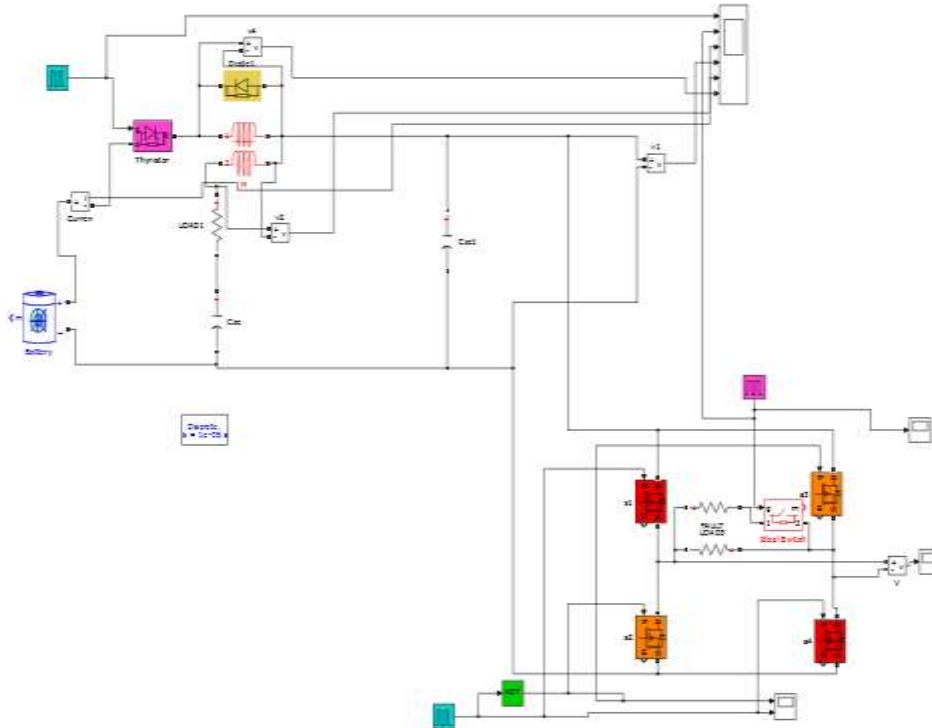


Figure 4.1: Simulation diagram of the breaker system

The simulation diagram of the proposed dc breaker is shown in Figure 4.1. At the load side an ideal switch is placed along with a resistive load. This switch is triggered at 0.1s. When this switch is turned on the load will be increased and thus causes a sudden rise in the current. The excess current in the system will reach to the breaker circuit and this breaker contains thyristors and this thyristor will be in reverse biased state during faulty period. We know that the thyristor won't be conducting on a reverse biased state so this will make the breaker circuit to turn off the system. At this time the breaker is tripped automatically. The interruption of the supply when the load is increased is shown in Figure 4.2. And only after the fault clearance the breaker will be in its on-state. We can find in the output waveform that the supply is turned to off state more fastily.

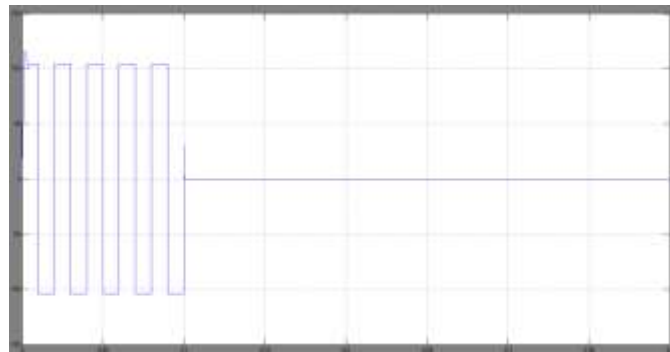


Figure 4.2: The interruption of the supply

IV. CONCLUSION

The thyristor based dc breaker in a dc system can be implemented in a circuit for faster interruption purposes. Comparing to the conventional dc breakers this has lot of advantages. The breaker can be implemented in any dc or ac load systems at a lower cost.

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