

ELECTRONIC FUSE USING RESETTABLE POLY FUSE FOR OVER CURRENT PROTECTION

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Abstract— This paper presents a new technique to deal with the high load currents or fluctuating currents using poly fuse as its major component. Poly fuse is a resettable fuse which goes on increasing its resistance, blocking the excess current until the current is back to normal. Once the current is under normal conditions, the resistance stabilizes and the path between supply and load is reconnected. The proposed work also uses a reed relay which breaks the path exactly at the specified rating, allowing a fast switch. The combination of poly fuse and reed relay provides more efficient outputs as compared to traditional circuit breakers. The fast-switching action, accurate results and the smaller size makes poly fuse more suitable for most of the power devices.

Keywords— poly fuse, electronic fuse, over current, circuit breakers, resettable.

I. INTRODUCTION

Most of the power devices and electronic circuits around the world uses traditional circuit breakers (fuse) to tackle the over current problem. However, these traditional tin wire fuses have some drawbacks associated with them. Those include:

- The tin wires do not allow the breakdown exactly at the specified rating.
- Some amount of high current passes through them, damaging the circuit.
- After every breakdown, we have to replace the tin wire or rewind it.

To overcome these drawbacks, a device with high efficiency and accuracy was needed. Also, the problem to rewind the tin wire should be eradicated. Something which can break itself by the application of high current and can restore it after the high current stabilizes.

Poly fuses are well known for this kind of operation. With the proper arrangement of poly fuse and relays, a circuit is designed which can actually break the flow of high current at the specified rating. Also, allowing the flow as soon as the current stabilizes. The rest of the paper is organized as follows. Proposed work is explained in section II.

Experimental results are presented in section III. Concluding remarks are given in section IV.

II. PROPOSED WORK

A. Reed Relays –

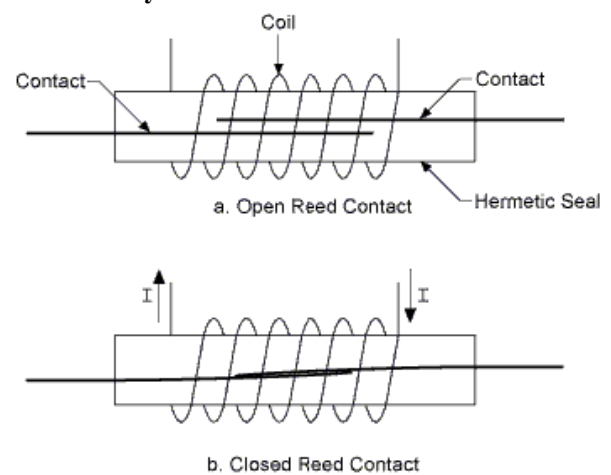


Fig. 1. Working of Reed Relay

The turns of the reed relay winding depend on the current flowing through them. We can set the current rating at which the contacts will close by changing the no. of turns [4].

As the current flows through the coil, magnetic induction causes the contacts to close, allowing the current to flow through them.

Table 1. Standard ratings

| Current (A) | No. of turns | SWG |
|-------------|--------------|-----|
| 5 | 10 | 16 |
| 2.5 | 20 | 18 |
| 1.25 | 4 | 21 |

Table 1 shows the standard current ratings which can be obtained by using the specific SWG and the no. of turns [3].

For the requires experiment, we have selected 1A current with 21 SWG, 3.3 turns.

B. Polyfuse –

A poly fuse is a device which can reset itself after it is broken. Also called as multi fuse, a poly fuse in its broken state, increases resistance, thereby blocking the current to flow. As soon as the excess current is back to normal, the resistance decreases and the path again establishes to let the current flow [1].

Commercially, a variety of poly fuses are available, ranging from 40mA to 10 A.

C. Circuit –

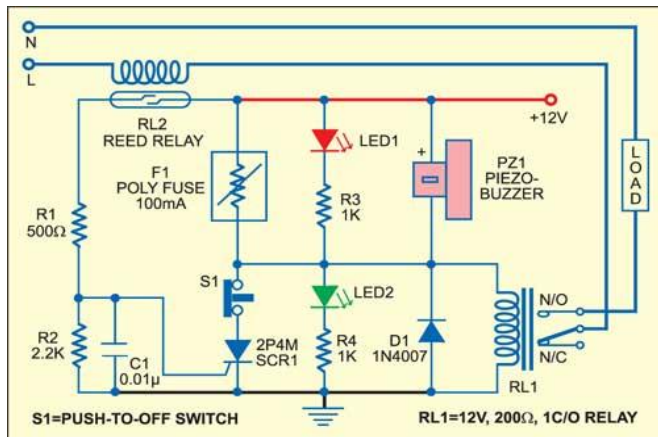


Fig. 2. Complete circuit

III. EXPERIMENT AND RESULT

The experiment was performed on Proteus 7 software according to the circuit diagram shown. Input supply is taken as 230V AC, 1A. For this purpose the reed relay selsected was of 1A with 3.3 turns of 21 SWG.

This supply is given to the load which is connected to a normal 12V relay.

The normal relay (RL1) is energised by an internal battery of 12V. This battery provides a current of 60mA. Therefore, the poly fuse selected is of rating 60mA.

When the input supply is $<1A$, the contacts of reed relay are open. The battery energises the relay RL1 and the load receives the power. As soon as the input current is $\geq 1A$, the reed relay coil energises and the contacts connect. As a result, (the current flows through the lowest resistance path and) the SCR gets triggered and the poly fuse goes in high resistance state, disconnecting the load. A red led and BUZZER gets activated, indicating the failure of the circuit.

Once, the current is back to normal ($<1A$), the reed relay coil deenergises. The circuit will still be in the failure state as SCR will still be in conduction mode. The circuit can be brought back to normal state by pressing thr switch button which is normally pressed. As the contact between poly fuse and SCR breaks, the SCR is brought back to forward blocking mode. Eventually, the path of the current is again from 12V-polyfuse-green led, RL1-ground. This green led indicates that the current is stable.

Table -2 Experiment Result

| Input | Expected breakdown at | Actual breakdown occurred at |
|------------|-----------------------|------------------------------|
| 230V, 1A | 1A | 0.999A |
| 230V, 1.2A | 1A | 1.002A |
| 230V, 1.5A | 1A | 1.004A |

Table 2 shows the experimental results. It compares the expected and actually observed readings. The readings clearly indicates that there is not much difference between the expected and observed readings. With an average lag of just 2mA.

IV. CONCLUSION

This paper illustrates a new concept of circuit breakers. The circuit uses poly fuse which eradicates the need of replacing the fault wire as in the case of traditional circuit breakers. Also, the use of reed relays as the switching element, fastens the circuit, while breaking the flow of high current exactly at the specified rating. Overall, the efficiency of the circuit increases by a considerable amount, saving the time required to replace the tin wire. Also, the results performed at 230V, 1A are very constructive with only 0.002% error.

V. REFERENCE

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