

Milling Fixture for Arcing Contact

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Abstract: *The main aim of all kinds of circuit breaker is to prevent the reestablishment of arcing after current zero by creating a situation where in the contact gap will withstand the system recovery voltage. The air circuit breaker does the same but in different manner. For interrupting arc it creates an arc voltage in excess of the supply voltage. Arc voltage is defined as the minimum voltage required maintaining the arc. This circuit breaker increases the arc voltage by mainly three different ways: It may increase the arc voltage by cooling the arc plasma. As the temperature of arc plasma is decreased, the mobility of the particle in arc plasma is reduced hence more voltage gradient is required to maintain the arc.. It may increase the arc voltage by lengthening the arc path. As the length of arc path is increased, the resistance of the path is increased, and hence to maintain the same arc current more voltage is required to be applied across the arc path. That means arc voltage is increased. 3. Splitting up the arc into a number of series arcs also increases the arc voltage.*

Keywords: Circuit breaker, Fixture, Arcing contacts, Milling, Loading and unloading time

1. Introduction

Arching contacts act as a medium in transferring electricity to the breaker. Once a fault is detected, contacts within the circuit breaker open to interrupt the circuit; some mechanically-stored energy (using springs or compressed air) contained within the breaker is used to separate the contacts, although some of the energy required may be obtained from the fault current itself. Arcing contacts are contacting devices which help in the breaking of the Air circuit breaker when over current passes through the circuit thereby preventing other devices from being damaged. These arcing contacts are made up of copper or copper alloys. When the circuit breaker opens, the main contacts part first and then the arcing contacts part, drawing the arc across them. When the circuit breaker closes, the arcing contacts make first, again drawing the arc across them. This prevents the main contacts from carrying the arc and preserves them. Small circuit breakers may be manually operated while larger units have solenoids to trip the mechanism, and electric motors to restore energy to the springs.

The main aim for which this project was undertaken was to increase productivity by reducing loading & unloading time and increasing yield per cycle. Secondly to reduce the operator fatigue during the loading and unloading of components.

2. Literary Survey

A study was carried out on the production line to identify the decrease in production of the arcing contacts; which had even halted the production of Air Circuit Breakers. Along with it the complaints from the operators also elucidated that:

- 1) The maximum area of the machine bed was not utilised by the current fixture completely as a result of which the production of the arcing contacts was less than expected.
- 2) The aged operators found it difficult to load and unload the components as after every operation the operator had to manually pick up the fixture for loading and unloading of components.

- 3) The design of the fixture did not suite to load components in a timely effective manner as a result of which after every operation the machine was idling till new components were inserted.
- 4) The current fixture incurred huge maintenance charges as well.

In order to eliminate all the above problems there was a need to design a new fixture.

3. Problem Definition

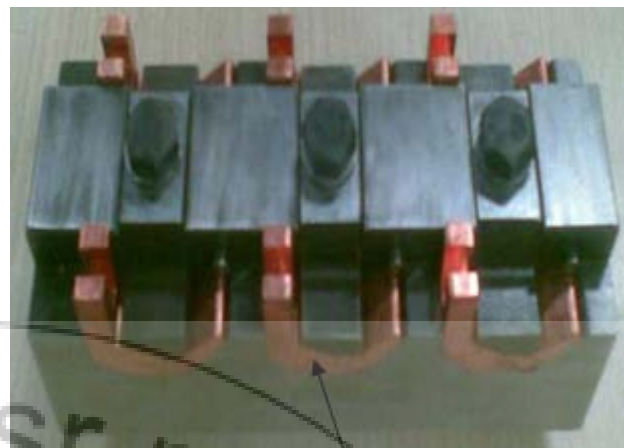
To increase productivity by reducing loading & unloading time and increasing yield per cycle.

4. Methods/ Approach

A proper analysis of the fixture was done taking into account its Blue print, which stated that the existing fixture consumed lot of time in loading and unloading of components and only **two** components were milled per cycle. The time taken to mill these components was recorded and was found to be **1 minute**. Moreover the fixture utilized very small area of the machine bed and a large part of the machine bed was just going waste which could have been utilised, hence scope existed in designing a new fixture to utilize larger area of the machine bed, thereby increasing number of components per cycle. As a result study of the machine bed was done to design a fixture that could accommodate more number of milling components. At the same time the strength of the arcing contacts was even checked so that they effectively withstand the milling forces when inserted into the new design. Tests were carried out with a few components and the results were satisfying. This led to the designing of the new fixture.



Earlier Fixture

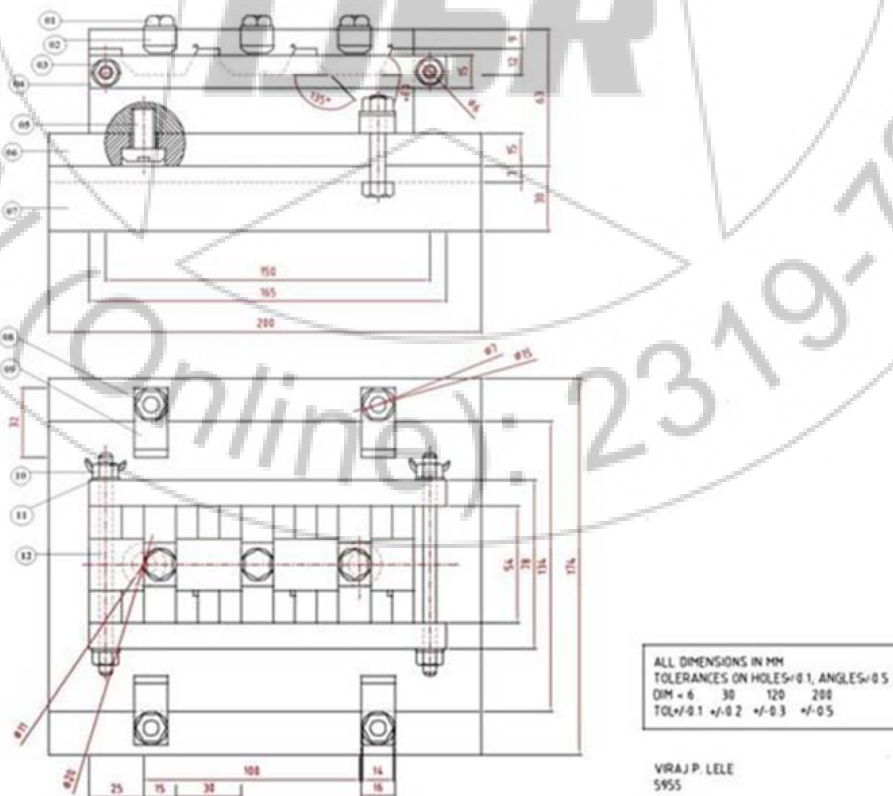


New Fixture with Arcing Contacts

The new fixture which can be seen in the fig. below took care of almost all the limitations as experienced in the earlier fixture; however it was later noted that the fixture was not clamped onto the machine bed as a result the operator had to remove it from the machine to load and unload the components there by causing fatigue and increasing the loading and unloading time.

It thus became inevitable to make changes in the new fixture as well to eliminate the above limitations. Hence a few design changes as discussed below were made assuaging the problem. The proposed design incorporated simpler clamping and fixed location, enabling faster loading and unloading of components, thereby reducing idle time and even eliminating operator fatigue. The following measures were taken in designing of the proposed fixture:

- 1) The base of the fixture was removed and the bottom was fixed on a surface with the help of nut and bolt as seen in the Fig. below.
- 2) Two strips each of length 165mm were held on both the sides with the help of rod, flange nuts as shown in the Fig. below. (The length 165mm was decided after studying the new fixture's length configuration and the length of machine bed.)
- 3) The entire fixture was then clamped on the bed as shown in Fig. below.



Proposed fixture with Bill of Materials

| | | | | |
|----------|----------------|------|------------|----------|
| 12 | CONNECTING ROD | 2 | Ø5×98 | MS |
| 11 | WASHER | 8 | Ø15×2 | MS |
| 10 | FLANGE NUTS | 2 | Ø6×10 | MS |
| 9 | CLAMP | 4 | 16×10×30 | MS |
| 8 | NUTS | 4 | Ø7×20 | MS |
| 7 | BASE PLATE | 1 | 200×174×30 | CI |
| 6 | FIXTURE BASE | 1 | 200×134×15 | CI |
| 5 | BOLT | 2 | Ø20×Ø11×25 | MS |
| 4 | SIDE PLATE | 2 | 165×24×15 | MS |
| 3 | NUT | 2 | Ø6×10 | MS |
| 2 | SUPPORT PLATE | 3 | 54×15×12 | MS |
| 1 | NUT | 3 | Ø14×25 | MS |
| PART NO. | DESCRIPTION | QTY. | DIMENSION | MATERIAL |

5. Results / Discussions

As one set of components are milled the operator will half turn the flange nuts and will swivel the plates as well as half turn the nuts on the top surface thereby removing the milled components, and will insert the new components which will be further milled. This decreased the loading and unloading time of the components and more production was obtained. Also it increased the production of the components i.e. earlier 2 components were milled in **60 seconds** whereas due to the proposed changes the new fixture milled **6** components in **40 seconds**. As this fixture was in contact with the milling machine bed so the idling time of the machine and operator fatigue were also eliminated.

It was reported that the fixture had a low maintenance cost. In contrast to the earlier case as the production of arcing contacts had abated the production of Air Circuit Breakers and caused huge losses to the company, the new design improved the production rates of arcing contacts as a result of which production of Air Circuit Breakers was even fostered and the company made a profit of **Rs. 5 lacs**.

6. Conclusion

Thus the proposed fixture eliminated all the factors responsible for lowering the production, and at the same time even benefitted the company with Rs.5lacs. The project is currently implemented by the company and the production of arcing contacts even facilitated hereon.

7. Future Scope

Scope of improvement does exist in every case and this project is no exception to the same. In near future automation can be implemented in the loading and unloading of components thereby reducing the time factor by almost half in comparison to the current scenario which will even contribute in reducing operator fatigue. Changes can be made in the proposed model thereby further reducing the cost and improving productivity by making changes in the milling equipments as a whole to mill more number of components in the prescribed period.

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Author Profile



Viraj P. Lele, Bachelor of Production Engineering and Gold medallist of the University of Mumbai in Production Engineering for the academic year 2013-2014. Graduated as Production Engineer from Fr. Conceicao Rodrigues College of Engineering, Bandra (West), Mumbai and implant trainee at 'Larsen and Toubro Limited' EAIC department where the above project was carried out.