

# DESIGN AND ANALYSIS OF AUTO SFU OPERATION

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## ABSTRACT

*A circuit breaker is an automatically operated electrical switch designed to protect an electrical circuit from damage caused by over current or overload or short circuit. Its basic function is to interrupt current flow after protective relays detect a fault. Unlike a fuse, which operates once and then must be replaced, a circuit breaker can be reset (either manually or automatically) to resume normal operation. Circuit breakers are made in varying sizes, from small devices that protect an individual household appliance up to large switchgear designed to protect high voltage circuits feeding an entire city.*

*According the manually system, there are too many problems which worker have to face. These problems are as following:*

- *More time consuming.*
- *Required lots of effort.*
- *Chances of damage of machines.*
- *Chances of causes damage on worker when this operation have to do in hazardous area.*
- *Safety of workers is compromised.*
- *This operation has to do in proper time otherwise damage can cause and whole system collapsed.*
- *More man power required.*

*In industry, it works on very high voltage. Once a fault is detected, the circuit breaker contacts must open to interrupt the circuit and then circuit breaker disconnect with the power supply and whole system stop.*

*After the solving the fault, again connect the circuit breaker with the power supply this work has to do manually. This time for reconnect approximately is 5 to 6 sec.*

*After attaching our mechanism with this system this reconnect operation can be done by automatically and it causes less time then manually which approximately is 0.5 to 1 sec. and by this mechanism we also avoid the above problem and get excellent performance.*

**Keyword:** - Switch-Gear, SFU Circuit Breaker, Transformer, Knife Switch, Rack and Pinion

## 1. INTRODUCTION

### 1.1 Problem statement

As per the points we came to know through Customer Reviews, the main problems associated with the Circuit Breaker are as following:

#### 1. Time consuming

After disconnected the circuit breaker from the power supply, the whole system collapsed. This circuit breaker has to reconnect with the power supply and this operation has to do manually and it required more time which approximately is 5 to 10 second.

#### 2. More effort and man power required

In industry, the circuit breaker is large in size and it's hard to operate. For reconnect the circuit breaker, the industry has appointed the worker for the work and it's too hard to reconnect the circuit breaker and it required the too much torque and power to do this works.

#### 3. Problem in Hazardous area

The reconnect operation has to perform in any situation without any accuses. The worker has to also perform this operation in the hazardous area where the chances of the harm to worker is high and where the high power supplied and sometimes the leakage in wire is also occurring in this kind of area. This is harmful for the worker and it can cause the very serious damage to worker.

#### 4. Chances of damage to machines.

When this operation can't perform in the specific or required time then chances of damage the machines is high.

### 1.2 Problem identification

An electric circuit breaker is an important part of home's electrical wiring system. It is designed to discontinue the flow of electricity the moment a fault, such as an overload or short circuit occurs. Circuit breakers come in a variety of sizes, depending on the area that they cover.

The short circuit is also happening during the high voltage supply. The maximum short-circuit current that a breaker can interrupt is determined by testing. Application of a breaker in a circuit with a prospective short-circuit current higher than the breaker's interrupting capacity rating may result in failure of the breaker to safely interrupt a fault. In a worst-case scenario the breaker may successfully interrupt the fault, only to explode when reset.

We use the pneumatic system and rack and pinion gear mechanism and make the system automatically. Because of this change, the reconnect operation is done automatically instead of manually with high torque. The one end of rack is connected to the pneumatic cylinder and this works with the highly compressed air. This rack connected to the pinion which is rotate the disk. On this plane side the connecting rod is attach which connect with the circuit breaker and turns the lever. When this disk rotates, the switch is turn at 90° so the system is reconnected. This process reduces the high torques which apply by human.

### 1.3 Aims and objectives

In present days, the reconnect of circuit breaker is performing manually and it required lots of manpower and high torque. This operation is time consuming process and it takes more time. We do this operation automatically with the use of rack and pinion and pneumatic system. This mechanism also works in the hazardous area. Our main aim is to satisfy the worker safety and do this operation automatically.

The objects are as following:

- Automatically operation
- Worker safety
- Works in Hazardous area
- Less time consuming
- Reduce effort
- Reduce Manpower

## 2. DESIGN & MECHANISM

This 3D model had been made in AUTODESK INVENTOR PROFESSIONAL 2014 by actual dimension and selected mechanism also.

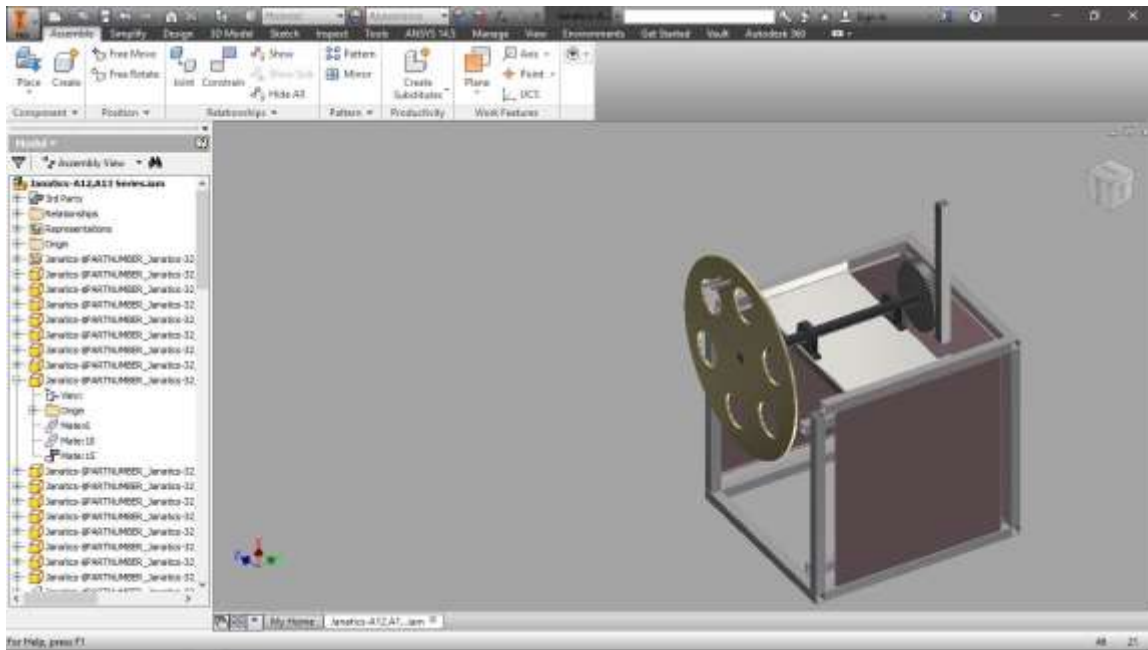


Fig -1 : 3D Model

### 2.1 Mechanism

We use the pneumatic system and rack and pinion gear mechanism and make the system automatically. Because of this changes, the engage operation done automatically instead of manually with high torque. The one end of rack is connected to the pneumatic cylinder and this works with the highly compressed air. This rack connected to the pinion which is rotate the disk. On this disk, the two connecting rod connected to the circuit breaker. When this disk rotate, the switch turn at  $90^\circ$  so the system is engage. This process reduce the high torque which apply by human.

### 2.2 Rack & Pinion gear

A rack and pinion is a type of linear actuator that comprises a pair of gears which convert rotational motion into linear motion. In this mechanism, rack and pinion is use to convert the linear motion to rotational motion. Rack is connected the piston of pneumatic cylinder and it rotate the pinion which rotate the switch plate.

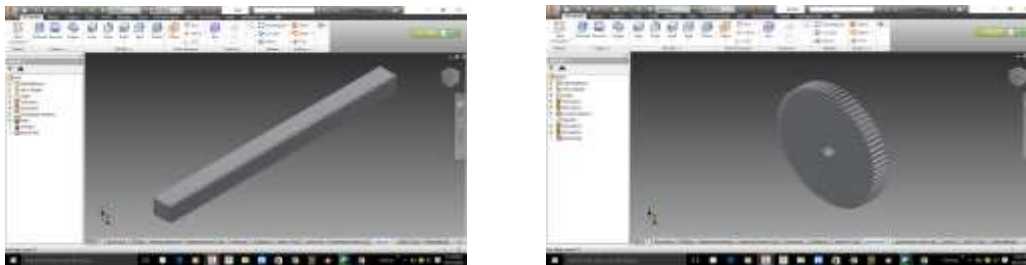


Fig -2: Rack & Pinion gear

### 3. OPERATION OF PNEUMATIC CYLINDER

#### 3.1 Pneumatic cylinder

We use Standard air double acting cylinder in this mechanism.  
The index or model id of our cylinder is A28 080 100 L-S



Features of this cylinder:-

- Adjustable cushioning at both ends with elastomeric pads.
- Wide varieties of mountings.
- Magnetic and Nonmagnetic version.
- High temperature (Vinton seals) 150°C max.
- Non corrosive Stainless steel piston rod and piston rod lock nut (SS 304).
- There are the standard dimension of the pneumatic cylinder which are illustrate as following,

Cylinder bore Ø (mm)	32	40	50	63	80	100						
Cushion stroke (mm)	21	23	23	23	28	28						
Standard strokes (mm)	25	50	80	100	125	160	200	250	300	320	400	500
Medium	Compressed air - filtered - lubricated											
Working pressure	0.5 - 10 bar											
Medium temperature	Regular	5 - 60° C										
	High temperature applications	5° - 150° C max.										
Materials of construction	Aluminium, Brass, Nitrile, Steel, Acetal, Polyurethane											
Mountings	Basic cylinder, Foot mounting, Front flange, Rear flange, Male clevis, Male clevis (with spherical bearing), Female clevis, Female clevis (King pin), Front trunnion, Rear trunnion, Centre trunnion											
Accessories	Clevis foot bracket, Wall mounting bracket, Trunnion bracket, Rod end fork, Rod end aligner, Rod end spherical eye											

#### 4. OBJECTIVE

In present days, the reconnect of circuit breaker is performing manually and it required lots of manpower and high torque. This operation is time consuming process and it takes more time. We do this operation automatically with the use of rack and pinion and pneumatic system. This mechanism also works in the hazardous area. Our main aim is to satisfy the worker safety and do this operation automatically.

The objects are as following:

- Automatically operation
- Worker safety
- Works in Hazardous area
- Less time consuming
- Reduce effort
- Reduce manpower

#### 5. ADVANTAGES

By this mechanism, the circuit breaker reconnect with the main line faster than the manually operate. Reducing the time consuming by use of this system. This system work automatically instead of manually. This system also provides safety of workers from the hazardous area. Hazardous area is harmful for workers and this system works automatically so no need to operate the system in hazardous area. This system is more accurate. So the efficiency of the mechanism of also increasing. This mechanism reduces the human effort which is highly required to reconnect the circuit breaker to the main line. This mechanism reduces the shifting time. The workers have to reach at the circuit breaker at proper time and reconnect it which is reducing by this mechanism.

#### 6. DISADVANTAGES

This system is nosily because of the compressor. System is costly.

#### 7. APPLICATIONS

This system is applicable at High Voltage industries, Circuit houses, Electric sub-station and Electric workshop.

#### 8. SCOPE OF FUTURE WORK

This system is large in size so the size of mechanism can optimize. By use of the Pneumatic system the noise can avoid and make this process smoothly. The improvement in the design can reduce the maintenance and increase the efficiency.

#### 9. CONCLUSIONS

Due to this research so many conclusion taken which is as follows. The reconnect of circuit breaker is performing manually and it required lots of manpower and high torque. This operation is time consuming process and it takes more time. We do this operation automatically with the use of rack and pinion and pneumatic system. This mechanism also works in the hazardous area. Our main aim is to satisfy the worker safety and do this operation automatically, less time consuming, Reduce effort.

## 6. REFERENCES

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