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Design and Fabrication of Metal Strip Cutting Machine

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Abstract: Metal cutting is the basic process in any steel industries, ship building and bridges. Usually the industries cut the metal manually by using chop saw. It takes lot of time to measure the required length of the metal strip to be cut, there is no operator safety and the operator feels fatigue which leads to the loss of productivity. In order to overcome this issue there is a need of automatic metal strip cutting machine. This paper explains the design and construction of an automated metal strip cutting machine controlled by an Arduino. It automatically feeds the metal strip by two friction rollers to the cutting zone and also the length of the metal strip is taken care by a limit switch at the end which is adjustable according to the input length. There is an abrasive cutter which starts when limit switch is hit by the strip. Once the strip is cut and falls the limit switch is released and the strip is again fed. This process is continued until required number of strip required is counted by the limit switch.

Keywords: Metal cutting, arduino, safety, fatigue, productivity, chop saw, limit switch, friction rollers.

I. INTRODUCTION

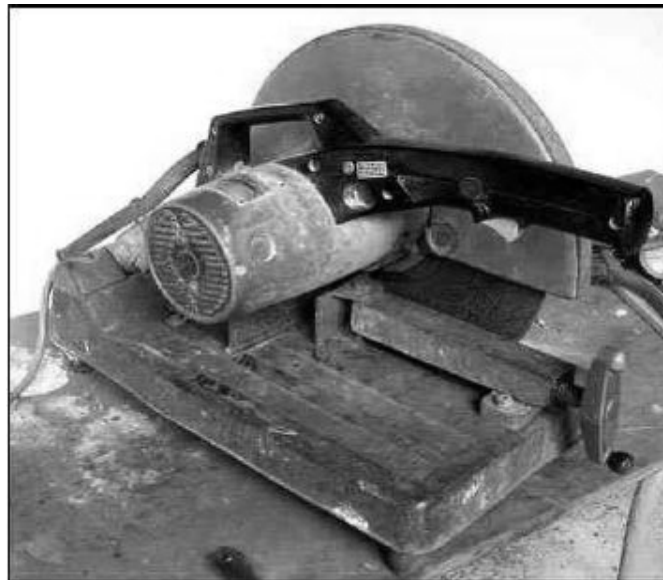


Fig 1. Chop saw Source: - International Journal for Research in Applied Science & Engineering Technology

Earlier hacksaw was used to cut the metal which consumed lot of time to shear the metal. Then there was an invention of chop saw which cut the metal easily and took less time as compared to that of hack saw and the machine is operated manually. Since cutting the metal strip is very difficult and cause harm for the worker there is a need of machine which cuts the metal automatically without any human interruption in a very short period of time [1].

The main objective of this machine should be

Provide safety to the operator which means the blade should not cause any harm to the operator during its operation

Cut the material to required length such that there should be reduction in the scrap

Less expensive as compared to that of chop saw

To be more productive than hacksaw and chop saw. It ensures that there is no wastage of material and no rework is required to reduce the length of the metal strip and which increases the profits of the industry.

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II. NEED ANALYSIS

An intensive literature survey and field visits, field survey was conducted and finally the following need was identified for the proposed work.

- 1) To design a metal strip cutting machine that can cut the metal strip to required length.
- 2) To reduce man power.
- 3) To reduce the work load.
- 4) To reduce the production time
- 5) To reduce the production cost.
- 6) To achieve the good quality product.
- 7) To reduce the fatigue of workers.
- 8) To reduce the risk of the employee in cutting the metal strip.
- 9) To increase the profits. And reduce the wastage of material.

III. LITERATURE REVIEW

A. Four-way hack saw machine

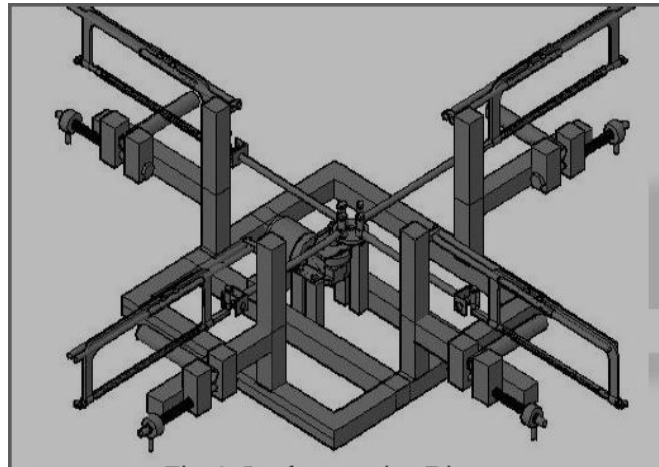


Fig 2. Four-way hack saw machine [2]

This machine is used to cut a large quantity of metal pieces, pvc pipes and solid pipes within a short period of time. The machine consists of four hacksaws which are connected to a single motor. The metal is feed to the hacksaw manually through vices. When the motor starts to rotate, the hacksaw cuts the metal pieces [2]

B. Pedal operated metal cutting machine

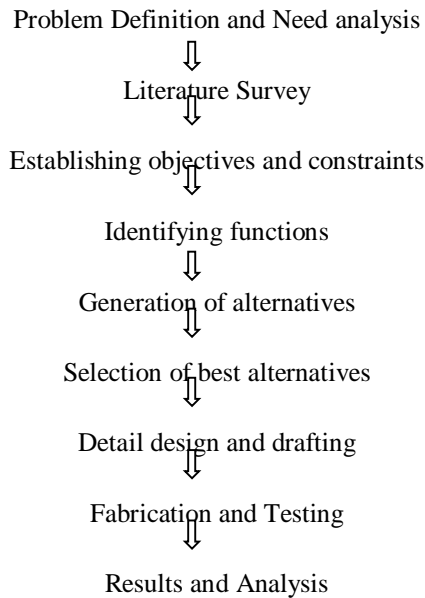
The machine consists of a pedal operated feeder. When the pedal is operated, the metal is feed into the hacksaw blade, the blade cuts the metal. The rotary motion of the pedal is being converted into reciprocating motion by using four bar mechanism. The machine is operated manually. The disadvantage of this machine is that an operator is required to feed and cut the metal and there is a huge loss of energy of the operator due to this operator experiences fatigue [3].

C. Some cases of mishandling traditional machining

This is the case on accidental sharp force injury from J Punjab Acad Forensic Med Toxicol 2012;12(1):57 Isolated case reports of sharp force missile injuries due to moving disc of machine were reported in past and either they are accidental or suicidal. In this case report, an unusual type of presentation is reported where the operator operating the machine died and another child playing in the vicinity had transacted left arm due to one and same broken circular abrasive disc. Abrasive saw blades are used to cut bars, stock pipes and other materials that are made of metal, concrete or masonry. In this communication we have discussed the mechanism for causation of such injuries and suggested some preventive aspects.

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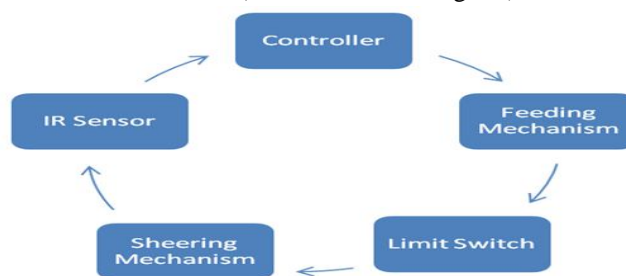
IV. METHODOLOGY



A. Functional analysis

The functional analysis method offer functions such as feeding the metal through rollers and holding the metal for cutting. Cutting the metal with abrasive wheel required length finally collecting the metal. These are the essential functions that machine to be designed must satisfy.

Chart no.1 (Function block Diagram)



B. Alternative

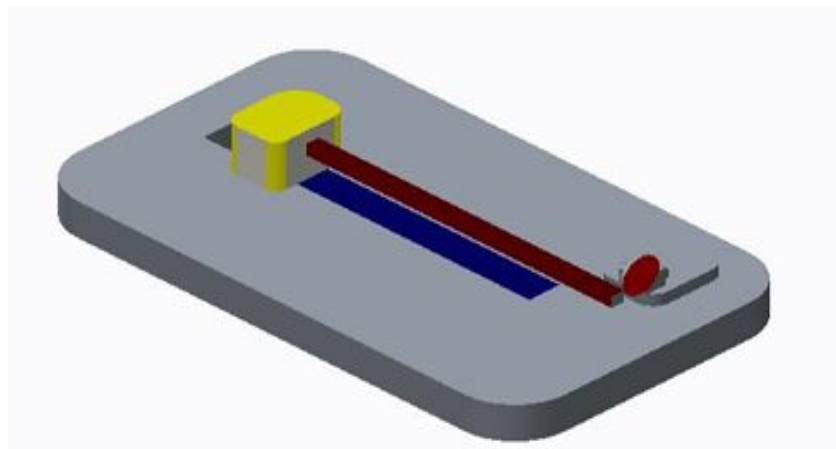


Fig 4. Alternative 1

Source: - Modelled by using Creo Parametric

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The figure shows the design of a metal strip cutting machine by rack and pinion mechanism. The design consists of moving head which consists of chuck. The metal strip is feed into the chuck and is held rigidly inside the chuck. The abrasive blade is mounted on a motor. The motor is mounted on a plate which is moved by means of rack and pinion. Metal strip is feed into the abrasive wheel by means of the roller mills. The limit switches present on the guide ways stops the movement of the strip. And when the strip feeding is stopped, the abrasive wheel cuts the metal strip. And the strip falls out of the guide ways. The sensor present at the bottom of the guide ways counts the metal strip which falls below the guide ways.

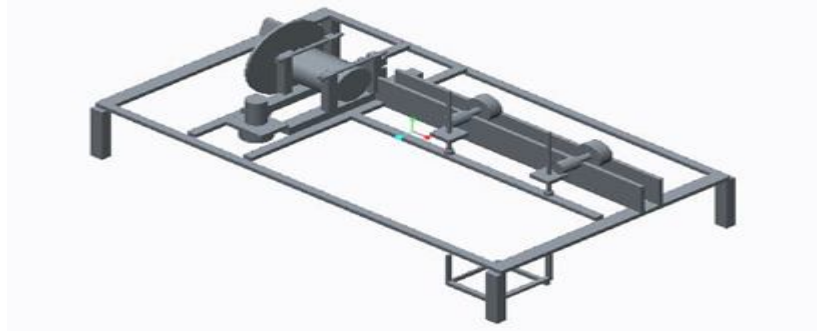


Fig 5. Alternative 2

Source: - Modelled by using Creo Parametric

The figure shows the design of a metal strip cutting machine by rack and pinion mechanism. The design consists of rollers which feed the metal strip into the abrasive blade. The feeding of the strip stops when it hits the limit switch. After this the abrasive wheel is feed into the metal strip by means of rack and pinion mechanism. And the strip falls out of the guide ways. The sensor present at the bottom of the guide ways counts the metal strip which falls below the guide ways.

C. FINAL DESIGN



Fig 6. Final design

Finally alternative B design is selected and that design taken for the prototype model. This design is rigid and it avoids vibration it

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holds the metal tightly during cutting operation. It takes less time to fabrication. From this design, there is a advantage of feeding the metal strip continuously and Operator easily troubleshot the problem when it is not in working condition. It is used for mass production.

V. CONCLUSIONS

This machine has ability to feed metal strips and sheers the metal strips automatically. It is found that metal strip is cut into the required length as per the customer requirement. This machine takes less time to cut the metal strip as compare to manual machine. Finally it's observed that machine is having good dimensional accuracy and it can easily trouble shoot whenever its required.

- 1) From this machine the operator safety is increased.
- 2) It reduces the fatigue of operator.
- 3) It reduces metal clamping time.
- 4) It is continuous Cutting process.
- 5) It improves the productivity.
- 6) From this machine we can achieve high rate production output.

VI. FUTURE SCOPE

Machine can be upgraded by using IOT(Internet of Thing) for example if a customer need 3 numbers of metal strips of length 6 inch each. Based on customer requirement input has to be provided through keypad. Then the machine cuts the metal strip with required length as per input. Then machine will automatically shut down after completing the work. Machine can be designed to have an ability to store the data such as number of outputs, number of scrap strips. Finally the data can be sent to customer via message.

VII. ACKNOWLEDGMENT

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