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ELECTROMAGNETIC SHEARING MACHINE

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ABSTRACT:
As industrial is coming up across the globe various invention and innovations are being carried by human to fasten various processes associated with manufacturing and align things. One such thing is industrial automation unit. In these automation units various machines those can be adopted easily are also getting developed. Considering the examples of piping industry (manufacture of small pipes) where plastic are PVC pipes are needed to be cut, shearing machines are used. There can be various types of shearing machines depending on parts to be cut process of cutting, requirement of cutting length, etc. now a day's hydraulic shearing machine, pneumatic shearing machine and mechanical type shearing machine are popular type of shearing machines used in above industries. These machines are certainly good at work but as with almost all types of machines there are certainly pros and prones association with them to for the purpose various work is being carried out to solve the dilemma. In this project shearing m/c of a new type i.e. electromagnetic shearing m/c is decided to be fabricated. Along with it has also been decided to develop automation unit for the same so that m/c can easily be adopted in today's automated plants.

Keywords**:** *automation, electromagnetic shearing machine, electromagnet, medium density fibre, microcontroller,*

I. INTRODUCTION

Mr. Frederick York Wolseley of Eureka Station, Walgett invented the world's first successful shearing machine in 1887. After years of effort Wolseley eventually perfected his power driven mobile machine to Melbourne with Eureka's best shearer and in front of amazed onlookers, showed that the new machine could equal the fastest hand blade shearer and produce a better clip, closer to the animal with fewer nicks. On June 1887, a comprehensive patent was issued for the machine. Shearing machine is mechanical power shears are self-contained machines with a ram that moves a non-rotary blade (knife), at a constant rake, past the edge of a fixed

blade to perform shearing or cutoff operations. Shears may be mechanically, hydraulically, hydra-mechanically, pneumatically or manually powered and used to perform numerous functions such as squaring, cropping, and cutting to length. In the basic shear operation, stock is fed into the point of operation between two blades. A hold-down may then be activated that applies pressure to the stock to prevent movement. One complete cycle consists of a downward stroke of the top blade until it passes the lower fixed blade followed by an upward stroke to the starting position.

As various application for automation & machinery arise, machinery is developed to meet the needs of the particular application. Recently there has been an increase in the need for machinery [1] which is small in scale. Small scale & miniature machinery include the number of moving parts which can breakdown & lubrication. Problem specific to miniature machinery include the difficulty of lubrication on a small scale & the difficulty of adapting conventional size machines to smaller scale. Another need exists for machinery of any size which can exhibit a fine degree of adjustment [2].In many control system application [3] accuracy of movement is crucial & simple on-off control will not sufficient. It is also desirable that any machine, whatever its size, be efficient & require little or no maintenance.

The electromagnetic shearing machine can reduces the problem which [4], [5] arises during operation in manufacturing unit like lubrication facility, friction arise in between parts, but for the electromagnetic shearing there such problems where prevented. It used the temporary magnet which reduce heat produce during process & not required any cooling system for it. The use of electromagnet shearing give the desire properties of shear force to cut the material.

II. CONSTRUCTION:

The electromagnetic shearing machine consists of frame on which mechanical & automation unit are fixed. A machine consist of a plunger in which iron core is fixed which move from electromagnetic core ,at bottom of plunger a high carbon hard steel tool is fixed for shearing purpose. The plunger assembly is subtended with the help of rubber stand in such a way that only lower inch portion allowed inside electromagnet The rubber strap also required to retract the blade also c stroke is completed. At the bottom of machine feeder & extractor is present which constitute 2 rollers, the roller as shown in fig1.It having the electronic kit with microcontroller of 8051 flash programmer type is used to run the automation unit The step-down transformer is used to convert 230 volt A.C supply into 12 volt A.C The Bridge is used to convert A.C supply current to D.C from 12 volt A.C to 12volt D.C volt for microcontroller flash memory program. L293d IC It is the memory Integrated Circuit which is designed to provide bidirectional drive currents of up to 1 A at voltages from 4.5 V to 36 V. Relay is used as making & braking connection type for the mechanical motion.

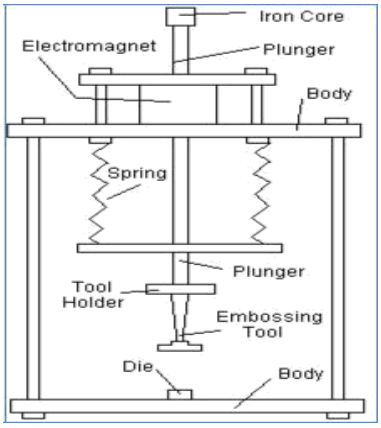

Fig1.electromagnetic shearing machine

III. DESIGN CONSIDERATION

A] Analysis of force - For electromagnetic shearing machine we selected different cross section pipe & different samples for calculating forces on each material for this purpose we select Universal Testing Machine.

The different samples collected are

1. PVC pipe of 6mm thick (4.2mm Id & 6.4mm OD)

2. PVC sticks of 6mm thick

3. Rubber pipe of 6mm thick

4. Pipe of 12mm thick

The result getting after shearing test on each of the martial is given as,

1. In first case the PVC pipe of 6mm thick is get bent on 950N force because of its hollow cavity, when any material get bent on such type of section then bending point of material is considered to be the shearing force of that material so that actual force for such material is consider up to 1000N.

2. In case of PVC stick of 6mm OD the pipe is shear at 1735 N because of fully fill stick it get cut so from this we consider the shearing force is 1735 N.

3. In rubber the shear force coming out to be 1834N which is more than other material so because the rubber is softer than PVC so we required more force to shear.

4. In case 12mm pipe the shear force is coming out to be 1967N it so because the pipe is hollow & it bend on 1900N & gradually increases up to 1960N on which it get flat so from this we take in consideration that for 12mm thick the force is 1967N.

From above result of Universal Testing Machine it is clear that when the shearing area of any material is increases the shearing force is increases so from above result we consider to develop force up to 2000N for shearing different material on electromagnetic shearing machine.

B] So let us assume the number of turns for electromagnet is 1000 & 1mm thick

Then length of conductor required

$L = N \times 2\pi \times r$

Where,

L- Length of conductor

N- Number of turns

r- Mean radius

$L = 1000 \times 2\pi \times (4+11/2) \times 10^{-2}$

$= 471.23$ m

The current supply to electromagnet of 1000 turns & 471.23 m is 2.67 Am which is given by clam Tester.

Then the magnetic field density for 471.23m long & 1000 turn's conductor is calculated as

$B = \mu_0 \times N \times I \times L$

Where, μ_0- co-efficient of magnetic flux ($4\pi\times10^{-7}$) , N- Number of turns , I-current supply , L-length of conductor

$B= 4\pi\times10^{-7}\times1000\times2.67\times 471.23$

$B=1.581\ Wb/m^2$

Force developed by electromagnet on Plunger is

$F=B\times I\times L$

Where, B - Magnetic field density, I – current, L - Length of conductor

Force developed by electromagnet on Iron core

$F=B\times I\times L$

$F= 1.58 \times2.67\times471.23$

$F= 1989.18\ N$

Thus the required force 2000N,
The number of turns selected = 1000,

Length of conductor = 471.23m,

Current induced = 2.67 Am.

C] Mechanism: - When current 2.67Am flow through conductor which is made up of copper wire (20 gauge 1000 turn) it produce mmf which is given as,

Fm= I×N Where fm = Magneto motive force, I= Current Induce N = Number of turns

So, Fm = 1000×2.67 = 2670 Am-turn

This Force pulls the iron core toward electromagnetic cavity due to which vertical motion of plunger which impact the force on pipe which is shear by cutting tool.

Selection of material:-

Availability:-

I) The material used to build up the machine we required Medium density fiber which is available in market from rang 140-250 Rs/square foot in 12mm, 16mm, 18mm& 6mm thickness. So we used 12mm thick MDF sheet for build the model. II) Iron core casted or standard size of nut is used as iron core which is easily available so we used 1inch diameter & 4 inch length. III) Gear box for automation assembly is also available in different sizes & different number of tooth of standard size available. We used reduction gear which gives 100:1 ratio. IV) Cutting tool of high carbon steel with 0.6-1.5% of carbon is available which is made of required size which is selected for cutting tool. V) For plunger the high density polymer pipe is used which readily available with different size & thickness. VI) Cast iron square pipe for frame is available in different size & different thickness. VII) The foam sheet, cardboard paper & gleam wool paper is used for conductor which available with good quality.

Suitability of Material:-

I) Using MDF sheet for project is so taken that when the electromagnetic force produce it only affect the iron core not on the other part so for that we used MDF sheet which is of 12mm thick with good strength than other material also having good machinability without cracking or breaking with smooth finishing so for that it is desired to used MDF sheet. II) Iron core of 0.5 kg of 1inch dia. & 4inch length is used so that the lower portion of the iron core get near to the electromagnet & more sensible to electromagnetic force. III) For plunger the high density polymer pipe is used with good strength & reduces the friction produce during vertical moment of the plunger & it is non-conducting & non-sensible to heat. IV) Cutting tool of high carbon steel which contain 0.6-1.5% carbon, 0.2-0.5% silicon & 0.6-1% Mg which is harder to bear the forces & for shearing operation.

Use of Standard Part: -

The nut & bolt for assembling the various parts are used as standard dimension. 6inch bolt & 4inch bolts are used to create distance between the two plate's .smaller size of nut & bolt are also used to build up the supporting. The gear of standard dimension's & standard number of teeth will be used to make gearbox.

IV.WORKING PRINCIPLE:

At the first the pipe is feeded by inlet guide which attached to the shaft of gearbox is activated from the PCB circuit which runs the roller of feeder for specific interval of time for 1sec or 2sec. When the pipe is reach in between two supporting column, then electric supply given to electromagnet which produces high magnetism due to which the iron core at top position above electromagnet get attracted in core of electromagnet. This Iron core which is attached to the plunger there by pushes it downward, at the other end of this the cutter is attached which activate the cutter assemble for shearing the pipe. After shearing the work piece the extractor at the other end which rolling in opposite direction of feeder extracted the cut pipes. With this operation simultaneously the cutter assemble make a space to come next pipe or work piece in between the cutting portion, by regaining to its initial

Position this can be done by attaching the rubber band or spring which take the assembly up word after every impact. The cut part of pipe is extracted from the motor by extractor subassembly while the main pipe is taken in for cutting with the help of feeder subassembly these two processes are carried out simultaneously by microcontroller.

This whole working repeated for five times in row & system gets halted .The same procedure is repeated for more length of pipe again the same procedure is repeated for much more length of pipe. This is done using three buttons with a 'reset'.

Each of three buttons is associated with a specific length of pipe. Where in, shifting from one length to another length it is very necessary to 'reset' the automation unit which is generally carried out using 'rest' button the automation unit required 5 volt DC to run the microcontroller & 12 volt DC for rest of subunits.

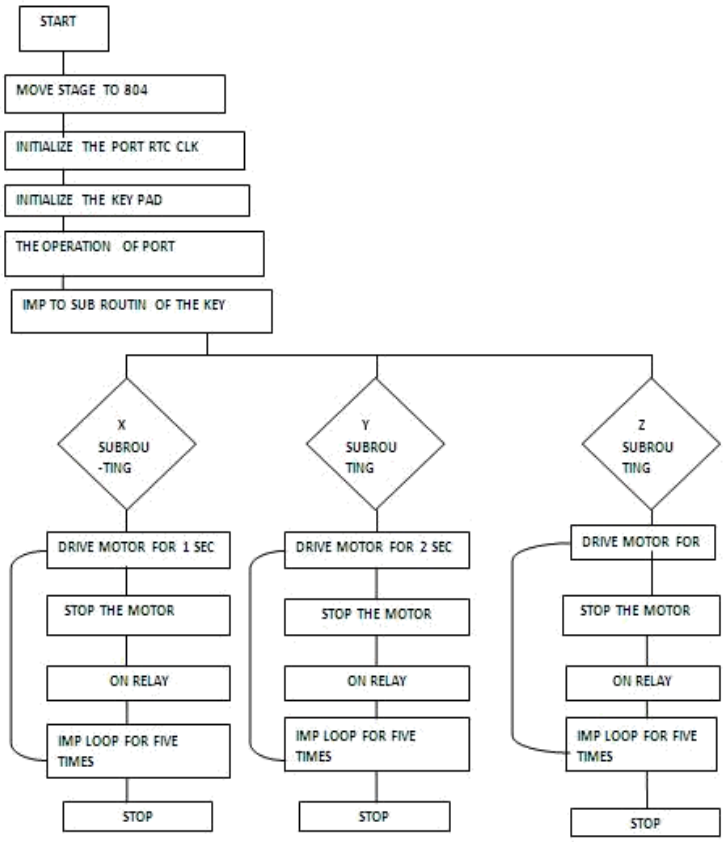

Fig2.LOGIC OF AUTOMATIC SHEARING

MACHINE

V. EXPERIMENTAL RESULT

On the basis of experiment performed in the previous article it is clear that the time taken by electromagnetic shearing machine is minimum comparative to other. Power taken by this prototype machine is 230V D.C which takes a supply when required to shear the pipe. Capacity of shearing is moderate which gives high seed of cutting up to 2000N. The capacity of shearing length we getting is from 45mm to 144mm & the cutting rate is one stroke per sec. For getting the different length of cut time of motor rotation is increases which take very less amount of electricity of 5V DC from this we get different type of length but in other machine it is fixed until the whole unit is not get finish.

VI. CONCLUSION

The project work show that this machine combine probe from various type of shearing machine there by exhibiting a good integrated result this machine can be fixed in less place, requires low maintenance, does not required skill labour his high rate of action, has longer span of time, require less capital investment, has low running cost, hence can be implemented in the industry to help to lower down the production cost. Automating this unit gives a unique advantage of interfacing this unit in this industrial automation unit for more fast production rate & vertically endless working hours. This is very basic & unique ability this machine prohibits can be put itself at remarkable less in the industry. The project can be used directly in industry where shearing in a plant of standard production process. Project itself can be implemented where in the material to be cut full fill the verge of specification of raw material. In the industry linking pipes, tubing, gasket, special purpose rubber, PVC etc this project can directly implement in manual working mode. If the industry has complete automation then this along with the automation unit can also be used within such type of industry for this purpose the automated unit may required some type of implementing changes depending up on the automation system .

VII. FUTURE SCOPE

The project work included very simple type of function & required very much less moving parts. As work was successfully studding & comparing the result of this electromagnetic shearing machine with other type of conventional shearing machine probe associated with machine that can be taking down production machine as well. Being compact & simple this machine can implemented from higher to lower units. Its lower most requirement of maintenance can be beneficial for keeping cost down. This machine use electricity only during cutting stroke & thus running cost can a gradually getting down. This few out of very large number of rows can project this machine across the investment. As per Indian content is concern this machine can be very beneficial for virtually all type of units as it has low capital investment .this machine may form a simple solution for sharing in the future.

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