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RESEARCH ARTICLE

ELECTROMAGNETIC FORMING DEVICE

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ABSTRACT

Electromagnetic field is an important, crucial and one of the four fundamental forces available in nature. The behaviour of all ferrous and charged objects is affected when they are in vicinity of the field. EMF is objectively made out of two fields i.e. Electric and magnetic field. The force created by magnetic field is much lower than the force created by EMF. Stationary charges produce the electric field where as the moving charges or the currents produce the magnetic field. Maxwell's equations with Lorentz force law explain the interaction of charges and current with the electromagnetic field. According to the classical theory EMF is considered to be the smooth and continuous field which propagates in the wavelike manner. In quantum field theory EMF is regarded as quantized and composed of individual particles. In electromagnetic forming device a plunger of ferrous material is used so that it can either attract or repel according to its own charge when it comes in contact with the electromagnetic field. This movement of plunger possesses extremely high velocity which makes plethora of operations possible.

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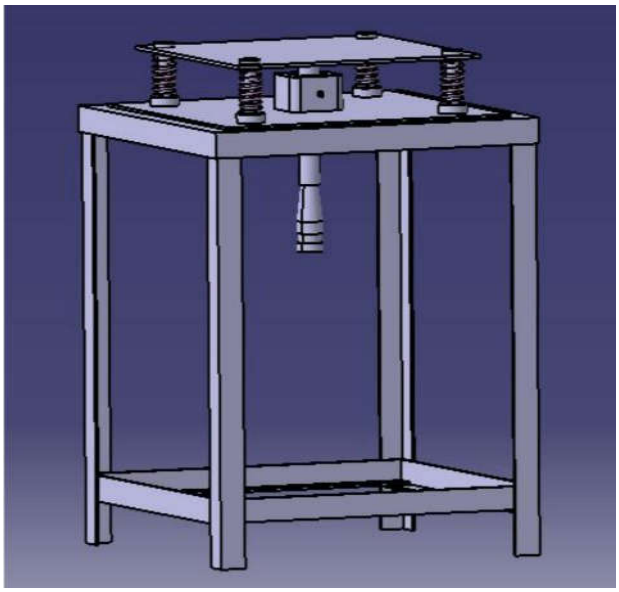
INTRODUCTION

Andre Marie ampere proposed a term called solenoid in 1823 to define a helical coil. Solenoid is a technical term used for pipe like structure which has substantially greater length than its diameter. To get a specific uniform magnetic field, a coil is used on a metallic core. A control magnetic field is obtained through a solenoid; its purpose is to impede charges in the electric current. It can also be more classified as an inductor than an electromagnet. In 1824, William Sturgeon made a solenoid of a horseshoe shape which suggests that solenoid can be of any shape. A transduser device coverts energy into linear motion. This term is also referred as a solenoid valve. It is an integrated device consists of an electromechanical solenoid which handles pneumatic or hydraulic valve, solenoid switch that is particularly a type of relay. This electromechanical solenoid is used to operate electrical switch. Solenoid balls do exist which is a type of electronic mechanical locking system.
There is an infinite continuous solenoid which has a fixed diameter. Such solenoids are made up of infinitely thin coils with minimum space between them. A magnet which produces magnetic field through electric current is called electromagnet. In such magnets magnetic field vanishes as soon as current supply is turned off. The advantage of electromagnet is , it can quickly change its magnetic field by controlling the amount of electric current. However this kind of magnet needs electric current to produce the magnetic field. These magnets are used as components of other electrical devices such as electromechanical solenoids, hard-disks, MRI machines and Magnetic separation equipments. Electromagnets are often used in heavy industries for picking and moving ferrous objects.

Principle of solenoid: For induction, Faraday's law is a fundamental rule of electromagnetism. This is the basic operating principle for Transformers, motors, electric motors, generators and solenoid. Electromagnetism is the production of magnetic field from a current in a conductor. When the current coil passes through windings, an electromagnetic field is created around it. In electromagnet magnetic field is not only produced by electric current but it can be governed as well. A simple one electromagnet has coil insulated wires wrapped around an iron core. Core like pharmacological content Iron increases the magnetic field. The strength of the generated magnetic field is proportional to the amount current through winding. Electromagnet has many applications and solenoid is one of them. When the electric current passes through coil winding, it-treats like electromagnetism and is attracted to the centre of the plunger coil located inside the coil. By arranging magnetic flows within the coil body, this in turn connects a small spring with plunger. The force produced by electromagnetic attraction transmits on the puncture tool



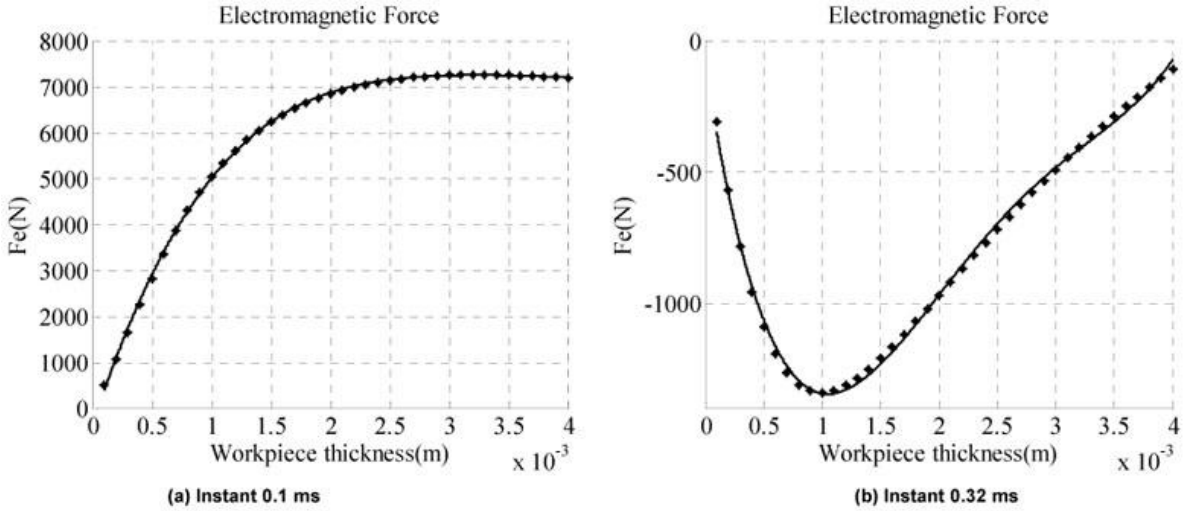


Figure 9. EM force in the 10th circular conductor of the workpiece for different thicknesses for time instants 0.1 ms and 0.32 ms.

through the force of pressure. While the current supply is closed from the electromagnetic field created by the collapse of the coil and the stored energy compressed spring settles the plunger to its original location.

Working Mechanism: Instead of Pusher in a traditional design, a special coil is placed near the metallic work piece. When the system releases its acute magnetic pulse, the coil creates a magnetic field which in turn gives the workplace a hyper-speed and pepper motion. Magnetic pulse and extreme deformity speed transform metal into a visco-plastic state - increasing compatibility without affecting the original power of the material. A rapidly changing magnetic field induces a circulating electric current when it is in the conductor through electromagnetic induction. The induced current creates a related magnetic field around the conductor (plasma physics). Due to the rule of Lentz, the magnetic fields formed within the conductor and work coil strongly backtrack each other. In practice, the work pieces of metal are placed near a heavier wire (called work coil) to be fabricated. A large pulse of current is forced into a switch by using an Igniter or spark gap, through a fast wire discharge by a high voltage capacitor bank. This work creates a rapid oscillation around the coil, ultra strong electromagnetic field.High working coils present (usually tens or hundreds of thousands of amperes) ultra-strong magnetic force which easily removes the strength of the work of metal, resulting in permanent deformation. The process of making metal is very quickly (usually tens of microseconds) and, due to large forces, parts of the work piece pass through high acceleration which reaches the velocity up to 300 m / s.

Formula:

$F = (n \times i)^2 \times \text{magnetic constant} \times a / (2 \times g^2)$

Where,

F = Force, i = Current, g = Length of the gap between the solenoid and a piece of metal, a = Area n = Number of turns, Magnetic constant = 4 x PI x 10-^7.

I= 4amp

G=5cm

N=8000

$A= 2\pi rh+2\pi r^2$

$=514.59\ cm^2$

So,

F= 9196.841 N

Comparing Electromagnetic Forming With Mechanical Forming

Advantages

- Junk can be suppressed in large numbers
- Improved formality (the extent of the drag available without crack)
- The making can be combined with the combination elements including glass, plastic, composites and other metals and combined with combination.
- Near tolerance is possible because spring back can be greatly reduced.
- Single sided die, which can reduce the cost of tooling
- Lubricants become less or unnecessary, so formation can be used in a clean room condition.
- Mechanical contact with work pieces is not required, it avoids surface contamination and tooling marks. As a result, a surface finish can be applied to the work piece before making it.
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Disadvantages

- Non conductive material cannot be made directly, but can be made using a conductive drive plate
- High voltage and included currents require careful security reasons

Conclusion

By implementing this new concept in sheet metal operations, we concluded that the machine is economical for small scale industry. It is a very flexible process in which the ability of the machine can be changed by changing only electromagnet. Power consumption is less compared to the traditional machine for the same size of the product resulting in efficient operation. Changing the value of the current supply can vary according to the force produced for performance. The quality of the product has improved due to the speed of the Commission. From the above conclusion, the total value of the product can be reduced.

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