

Multi – Type Operational Gadget for Press

V. Saravana Kumar¹ D. Sridharan² J. Thulasidharan³ C. Hemadri⁴

^{1,2,3}Student ⁴Assistant Professor

^{1,2,3,4}Department of Mechanical Engineering

^{1,2,3,4}R. M. K. College of Engineering & Technology, Thiruvallur Dist. Chennai, India

Abstract— This project presents the concept of Multi-Function Operating Machine mainly carried out for production based industries. Industries are basically meant for Production of useful goods and services at low production cost, machinery cost and low inventory cost. Today in this world every task have been made quicker and fast due to technology advancement but this advancement also demands huge investments and expenditure, every industry desires to make high productivity rate maintaining the quality and standard of the product at low average cost. We have developed a conceptual model of a machine which would be capable of performing different operation simultaneously, and it should be economically efficient .In this machine we are actually giving drive to the main shaft to which scotch yoke mechanism is directly attached, scotch yoke mechanism is used for sawing operation. On the main shaft we have use bevel gear system for power transmission at two locations. Through bevel gear we will give drive to drilling centre and grinding centre. The model facilitate us to get the operation performed at different working centre simultaneously as it is getting drive from single power source. Objective of this model are conservation of electricity (Power Supply), reduction in cost associated with power usage, increase in productivity, reduced floor space. Single power source. Objective of this model are conservation of electricity (power supply), reduction in cost associated with power usage, increase in productivity, reduced floor space.

Key words: Bevel Gear, Scotch Yoke Mechanism, Four Operations

I. INTRODUCTION

Multi-functional machine as our research area motivated to this project in order to be economical and to reduce manufacturing time. Industries are basically meant for production of useful goods and services at production cost, machinery cost and inventory cost. Every industry desires to make high productivity rate maintaining the quality and standard of the product at low average cost. So in this project work is proposed where a machine is designed which can perform operations like centre punching, cutting, spiral punching and stapling at different working centres simultaneously which implies that industrialist will not have to pay for machine performing above tasks individually for operations. This paper mainly presents the concept of multi-functional machine which is mainly capable of producing low cost with economical production. This project we are doing pressing operations which is capable of making holes on centre of the cardboard and the spiral punching which is also capable of making series of holes in the corner of the paper by spiral binder. Additional to this we are including staple and cutting operations which are able to staple the bunch of paper and also to cut the limited papers with scissor.

A. Advantages

- Multi operations can be performed at the same time.
- Power saving as it is manually operated.
- Size is compact therefore it requires less space.
- Time saving.
- Less man power is required.

B. Disadvantages

- It's totally manually operated.
- Time consuming as compared to electrical power.
- Without human effort it's not operated.

C. Power Transmission through Bevel Gear

In this conceptual model we have involved the gear arrangement for power transmission at different working centres, basically gear or cogwheel is a rotating machine part having cut teeth, or cogs, which mesh with another toothed part in order to transmit torque, in most cases with teeth on the one gear being of identical shape, and often also with that shape on the other gear. Two or more gears working in tandem are called a transmission and can produce a mechanical advantage through a gear ratio and thus may be considered a simple machine. Geared devices can change the speed, torque, and direction of a power source. The most common situation is for a gear to mesh with another gear; however, a gear can also mesh with a non-rotating toothed part, called a rack, thereby producing translation instead of rotation.

D. Problem Statement

To design and development of multipurpose mechanical machine, a structured which designed for the purpose of multi operations i.e. Punching, spiral, staple, cutting.

II. LITERATURE REVIEW

Before starting our work we have undergone through many research papers which indicates that for a production based industries machine installation is a tricky task as many factor being associated with it such as power consumption (electricity bill per machine), maintenance cost, no of units produced per machine i.e. capacity of machine, time consumption and many more.

A. Heinrich ARNOLDL (2011)

Rather long re-investment cycles of about 15 years have created the notion that innovation in the machine tool industry happens incrementally.

But looking at its recent history, the integration of digital controls technology and computers into machine tools has hit the industry in three waves of technology shocks. Most companies underestimated the impact of this new technology. This article gives an overview of the history of the machine tool industry since numerical controls were invented and introduced and analyses the disruptive

character of this new technology on the market. About 100 interviews were conducted with decision-makers and industry experts who witnessed the development of the industry over the last forty years. The study establishes a connection between radical technological change, industry structure, and competitive environment. It reveals a number of important occurrences and interrelations that have so far gone unnoticed.

B. Dr. Toshimichi Moriwaki(2006)

Recent trends in the machine tool technologies are surveyed from the viewpoints of high speed and high performance machine tools, combined multifunctional machine tools, ultra precision machine tools and advanced and intelligent control technologies.

C. Frankfrut-Am Main, (2011)

Machine tools nowadays have to be veritable “jack of all trades”, able to handle all kinds of materials, to manage without any process materials as far as possible, and be capable of adapting to new job profiles with maximized flexibility. Two highly respected experts on machining and forming from Dortmund and Chemnitz report on what’s in store for machine tool manufacturers and users.

III. METHODOLOGY

In this project we will generally give the power supply to the shaft on which a bevel gear is mounted on it, and a second bevel gear at a right angle to it has been mounted on a punch shaft to which a punch bit is being attached. At one end of the shaft is connected to power supply other end is being joined to a circular disc through this circular disc scotch yoke mechanism is being performed (rotator y motion is converted to reciprocating motion). Also in between these two helical gear is mounted which transfer its motion to other helical gear which is mounted on a shaft consist of grinding wheel.

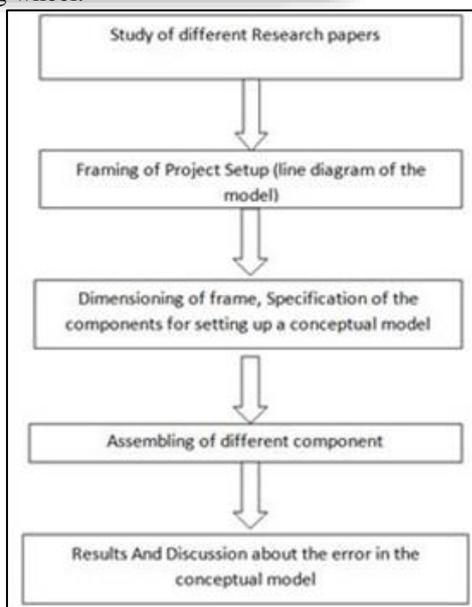


Fig. 1: Flowchart

A. Motion of Mechanism

The objective of this experiment is to investigate the performance of a scotch yoke mechanism and to verify that

the motion the scotch yoke mechanism (reciprocating motion mechanism), converting the liner motion of a slider into rotational motion, or vice versa.

1) Definition of Mechanism

Mechanism is a simplified model, usually in the form of a line diagram, which is used to reproduce exactly the motion occurring in a machine. The purpose if this reproduction is to enable the nature of the motion to be investigated without the encumbrance of the various solid bodies which forms the machine elements.

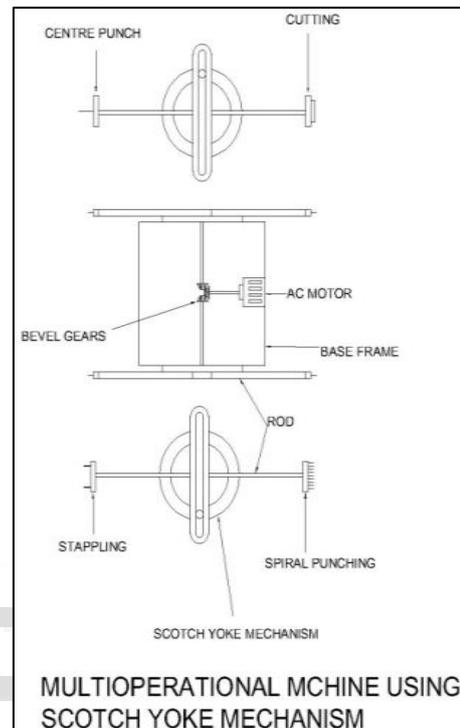


Fig. 2: 2D Layout

B. Scotch Yoke Mechanism

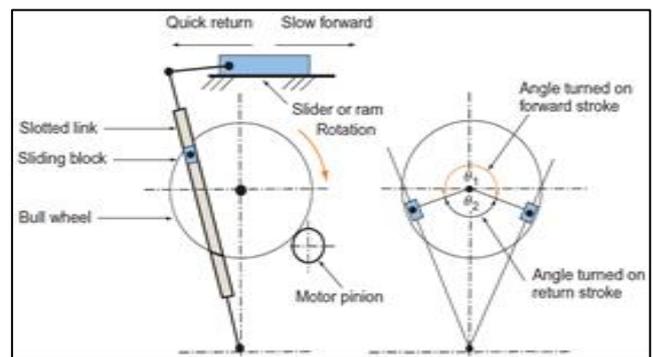


Fig. 3: Scotch Yoke

Scotch yoke mechanism is a simple type of mechanism which converts circular motion into reciprocating motion as discussed in construction part above. The power is supplied to the DC motor, shaft and crank attached to shaft start rotating. As the crank rotates the pin slides inside the yoke and also moves the yoke forward. When the crank rotates through in clockwise direction the yoke will get a displacement in the forward direction Initial position. For a complete rotation of crank the yoke moves through a length equal to double the length of the crank. The displacement of the yoke can be controlled maximum displacement will be equal to length of the crank. When the crank completes the next of rotation the yoke comes back to its initial position.

For the next of rotation, yoke moves in the backward direction.

IV. COMPONENTS OF MACHINE

- Frame
- Bevel Gear
- Motor
- Pulley
- Bearing (Ball & Sliding Bearing)
- Puching Tool
- Siral Punch
- Stapple
- Single Cutting Tool
- Nut & Bolt
- Scotch Yoke Mechanism

A. Descriptions of the Components

1) Bevel Gear

Bevel gears are primarily used to transfer power between intersecting shafts. The teeth of these gears are formed on a conical surface. Standard bevel gears have teeth which are cut straight and are all parallel to the line pointing the apex of the cone on which the teeth are based. Spiral bevel gears are also available which have teeth that form arcs. Hypocycloid bevel gears are a special type of spiral gear that will allow nonintersecting, non-parallel shafts to mesh. Straight tool bevel gears are generally considered the best choice for systems with speeds lower than 1000 feet per minute: they commonly become noisy above this point. One of the most common applications of bevel gears is the bevel gear differential.

a) Advantages

Excellent choice for intersecting shaft systems.

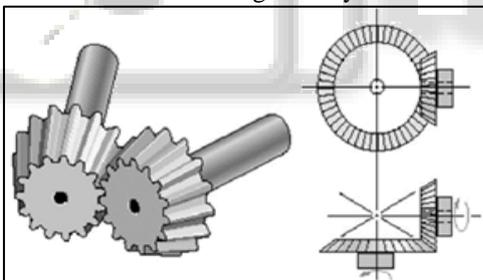


Fig. 4: Bevel Gear

Bevel gears are used to transmit power between two non-parallel shafts. The shafts may be intersecting or non-intersecting. Bevel gears can be described as conical gears as they are cut on conical blanks (tapered). They are not interchangeable and always designed in pairs. The commonly used bevel gears are straight, spiral and hypoid bevel gears.

2) Motor

The reciprocating motion of the Hacksaw blade, which is where the cutting process takes place, is produced with the help of an AC motor shown in figure, which operates by a simple scotch yoke mechanism to convert rotary motion in to reciprocating motion.

3) Specifications

- Voltage and Power: 230 V, 186 Watts.
- Maximum Load Current: 10 A
- HP: 0.25
- Speed: 1200 RPM.

- Torque: 0.15 kg-m/ 1.48 Nm.
- Motor pulley diameter: 30 mm.

B. Scotch Yoke Mechanism

The Scotch yoke is a mechanism for converting the linear motion of a slider into rotational motion or vice-versa. The piston or other reciprocating part is directly coupled to a sliding yoke with a slot that engages a pin on the rotating part. The shape of the motion of the piston is a pure sine wave over time given a constant rotational speed.

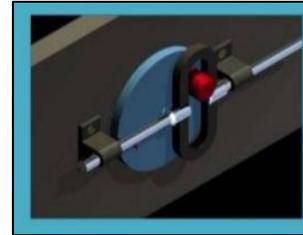


Fig. 5: Scotch Yoke

The scotch yoke mechanism is constructed with iron bars. Here the crank is made of wood in some length and the yoke is made of iron. It is noted that the minimum length of the yoke should be double the length of the crank. The crank and yoke is connected with a pin. Iron bars are welded to both sides of the yoke to get the reciprocating motion. The yoke with the iron bars is fixed on the display board with the help of square pipe that is a bit bigger than that of the iron bars. Now the crank is connected through a screw mechanism to the end of the shaft of the bevel gear mechanism. Now the pin on the crank is connected to the yoke. The pin used to connect yoke and crank is a bolt.

V. FABRICATIONS AND WORKING

A. Fabrication of the Machine

In this project we are fabricating the machine which can perform multi operation which can reduce the machining cost and to be economical in some application like in Xerox shop and also in small scale industries. In this project are using a scotch yoke mechanism to actuate the function with the help of motor. In this machine we are using a bevel gear which is more efficient than other gears like spur gear, worm gear and helical gear. It is also easily lubricated and easily manufacturing. In this project we are using a mechanism called scotch yoke mechanism

B. Designing 3D – View

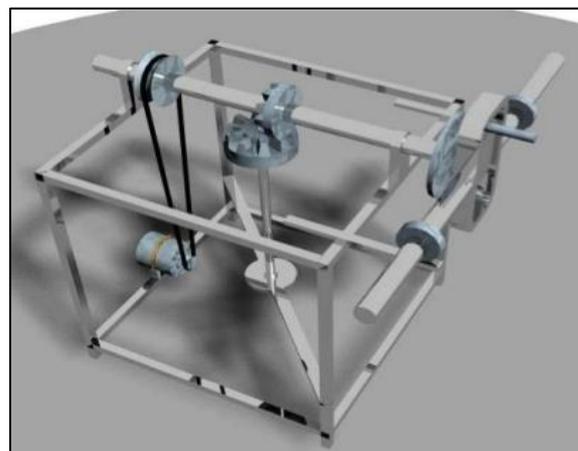


Fig. 6: 3D – view

C. Design in Actual View



Fig. 7: Actual View

D. Working Principle

There are only two major principles on which this proposed model generally works. They are:

- Scotch-Yoke mechanism
- Power transmission through gears. Bevel gears.

The Scotch yoke is also known as slotted link mechanism. The slotted link mechanism is used for converting the linear motion of a slider into rotational motion or vice-versa. This mechanism is generally found on shaping machines where single point cutting tool is mounted on the front of the slider or ram, in a hinged tool post. The tool cuts on the slow forward stroke and lifts over the work piece on the quick return stroke. The slotted link rocks from side to side, driven by the sliding block on the bull wheel. Power Transmission through Gears Bevel gears are gears where the axes of the two shafts intersect and the tooth bearing faces of the gears themselves are conically shaped. Bevel gears are most often mounted on shafts that are 90 degrees apart, but can be designed to work at other angles as well. The pitch surface of a gear is the imaginary toothless surface that you would have by averaging out the peaks and valleys of the individual teeth. The pitch surface of an ordinary gear is the shape of a cylinder. The pitch angle of a gear is the angle between the face of the pitch surface and the axis.

VI. RESULT AND DISCUSSION

A. Various Operations Performed in Press

In this multi – purpose machine we are undertaking four operations namely centre punching, cutting, spiral punching, stapling. So by scotch yoke mechanism we are making to do these operations. Since we have undergone detailed study about multi operational machine with the help of scotch yoke mechanism with other operations like drilling and grinding. We interested to do these operations with the same mechanism. Centre punching is done with the help of centre point tool with sharp edge. Cutting is done with the help of scissors. Stapling is done with the help of stapler actuated by the mechanism. Finally spiral punching is made by readymade spiral binder by the same mechanism with the help of links attached to the binder. Four operations are automated with the help of motor with the power transmission through the bevel gear. So we are interested do

the operations with the mechanism which is more efficient than other mechanism like with worth mechanism or crank slotted mechanism.

B. Operations

- Centre punching
- Cutting
- Spiral punching
- stapling

C. Assembly of Gadget Press



Fig. 8: Assembly of Gadget Press

A centre punch is used to mark the centre of a point. It is usually used to mark the centre of a hole when drilling holes. A drill has the tendency to "wander" if it does not start in a recess. A centre punch forms a large enough dimple to "guide" the tip of the drill. The tip of a centre punch has an angle between 60 and 90 degrees. When drilling larger holes and the web of the drill is wider than the indentation produced by a centre punch, the drilling of a pilot hole is usually needed. a thin blade vs strength and edge durability of a thicker blade.

VII. CONCLUSION

The scotch yoke mechanism is made and its advantages and disadvantages are discussed. Its motion characteristics are studied. It is concluded that this mechanism is a good choice to convert rotating motion into reciprocating motion because of fewer moving parts and smoother operation. It can be used in direct injection engines like diesel engines, hot air engines. In this project report we provide an overview of the issues concerning different aspects of multipurpose machine using scotch yoke mechanism. The paper focused on the principle of scotch yoke mechanism, type of tooling and machining parameters and process performance measure, which include cutting speed, depth of cut, material removal rate with different type of equipment's which can be run simultaneously and fabricate the work piece in multipurpose machine has been presented. The presented results can help to plan the machining of work piece with expected tolerance.

We have presented the development of multipurpose machine in various modes by which it can be actively adopted. We have explained the various parts and components of multipurpose machine using scotch yoke mechanism. Different types of attachments and tools which can be implemented on multi-purpose machine have been discussed.

REFERENCES

- [1] Heinrich Arnoldl "The recent history of the machine tool industry and the effects of technological change" "University of Munich, Institute for Innovation Research and Technology Management, November 2001.
- [2] Dr.ToshimichiMoriwaki "Trends in Recent Machine Tool Technologies" Professor Department of Mechanical Engineering Kobe University, NTN Technical Review No. 74 (2006).
- [3] T. Moriwaki "Multi-functional machine tool", Department of Industrial and Systems Engineering, Setsunan University, Neyagawa, Japan CIRP Annals - Manufacturing Technology DOI:10.1016/j.cirp.2008.09.004.
- [4] Frankfurt am Main "Multi-purpose machines ensure enhanced" January 11.
- [5] "Selecting and Planning the Process of Manufacture: Dr.PulakM.Pandey.
- [6] Aripnammal, S. and Natarajan, S. (1994) 'Transport Phenomena of SmSel – X Asx', Pramana – Journal of Physics Vol.42, No.1, pp.421-425.
- [7] Barnard, R.W. and Kellogg, C. (1980) 'Applications of Convolution Operators to Problems in Univalent Function Theory', Michigan Mach, J., Vol.27, pp.81–94.
- [8] Shin, K.G. and Mckay, N.D. (1984) 'Open Loop Minimum Time Control of Mechanical Manipulations and its Applications', Proc. Amer. Contr. Conf., San Diego, CA, pp. 1231-1236.

