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DESIGN AND FABRICATION OF DUAL SHAPER USING SCOTCH YOKE MECHANISM

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ABSTRACT :

This project presents the concept of two directional operating machine mainly carried out for production-based industries. Industries are basically meant for production of useful goods and services are low production cost machinery and low inventory cost. Today in this world every task has been made quicker and fast due to technology advancement but this advancement also demands huge investment and expenditure, every industry desire to make high productivity rate maintaining the quality and standard of the product at low average cost.

The objective of this work is to automate the conventional power shaper machine in order to achieve high productivity of work-pieces. The inputs are given by the user with the help of a manual control, which needs more accuracy and keen concentration for performing the operation. A scotch yoke mechanism is used for activating the motion of the shaper frame during its strokes, that is forward and backward stroke is used for shaper and thus by performing the shaping operation at both sides. This mechanism is powered by an electric motor so working with this system is quite easy when compared to normal machines. The shaping operation is easy and efficient because of the performance of scotch yoke mechanism. This is one of the less time consumption process since two operations are performed at a time.

KeyWords: Scotch yoke Mechanism, Dual shaper, Belt, Single point cutting tool

I. INTRODUCTION

INTRODUCTION MACHINE

Machine design is an important part of engineering By means of a machine an applied force is increased its direction is changed or one form of motion or energy is changed into another form. Thus defined such simple devices as the lever, the pulley the inclined plane.

A **machine** is a tool containing one or more parts that uses energy to perform an intended action. Machines are usually powered by mechanical, chemical, thermal, or electrical means, and are often motorized.

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 over time given a constant rotational speed

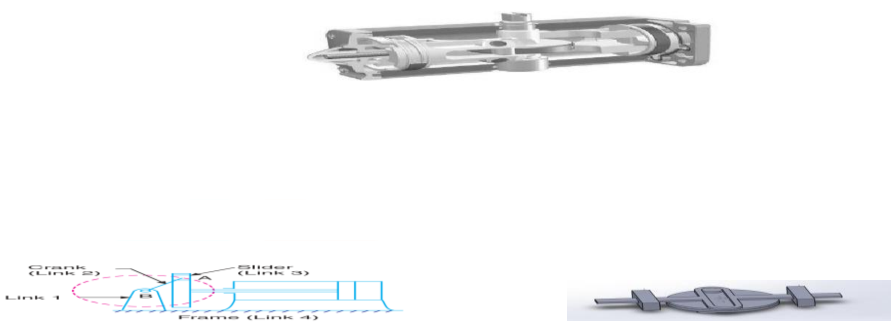


Fig.1.1 Sectional view of Scotch yoke mechanism

2.Construction

The scotch yoke mechanism is constructed with iron bars. Here the crank is made in some length and the yoke is also made using the same material. 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 c clamp. Now the crank is welded to the end of the shaft of the motor. Now the pin on the crank is connected to the yoke. The pin used to connect yoke and crank is a bolt.

3.Working principle

When the power is supplied to the 12v Dc motor, shaft and crank attached to the 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. The maximum displacement will be equal to the 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. When the crank completes a full rotation the yoke moves back to the 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 by varying the length of the crank.

COMPONENTS USED

A.C motor

Scotch yoke mechanism

Spur Gear

Shaping tool

Shaft

Frame

AC MOTOR

AC induction motors are the most common motors used in industrial motion control systems, as well as in main powered home appliances. Simple and rugged design, low-cost, low maintenance and direct connection to an AC power source are the main advantages of AC induction motors. Various types of AC induction motors are available in the market.

Different motors are suitable for different applications. Although AC induction motors are easier to design than DC motors, the speed and the torque control in various types of AC induction motors require a greater understanding of the design and the characteristics of these motors.

This application note discusses the basics of an AC induction motor; the different types, their characteristics, the selection criteria for different applications and basic control techniques.

A.C Motor

A.C MOTOR DATETAILS:

Voltage - 230 V,

Frequency - 50 HZ, 1PH PSC, AMPS - 2.5 AMPS,

Power - ¼ HP,

Watt - 180W,

RPM - 1440rpm.

4.BASIC CONSTRUCTION AND OPERATING PRINCIPLE:

Like most motors, an AC induction motor has a fixed outer portion, called the stator and a rotor that spins inside with a carefully engineered air gap between the two.

Virtually all electrical motors use magnetic field rotation to spin their rotors. A three-phase AC induction motor is the only type where the rotating magnetic field is created naturally in the stator because of the nature of the supply.

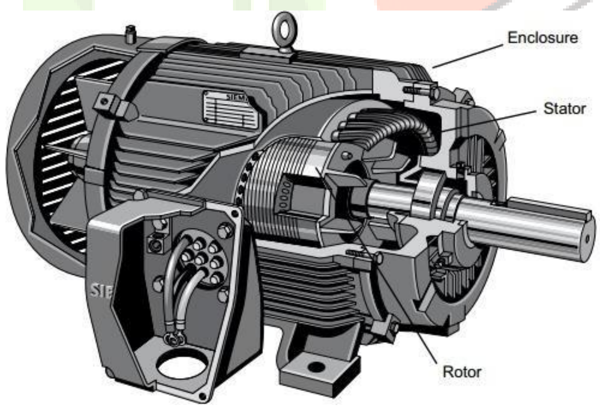
DC motors depend either on mechanical or electronic commutation to create rotating magnetic fields. A single-phase AC induction motor depends on extra electrical components to produce this rotating magnetic field. Two sets of electromagnets are formed inside any motor. In an AC induction motor, one set of electromagnets is formed in the stator because of the AC supply connected to the stator windings.

The alternating nature of the supply voltage induces an Electromagnetic Force (EMF) in the rotor (just like the voltage is induced in the transformer secondary) as per Lenz's law, thus generating another set of electromagnets; hence the name – induction motor. Interaction between the magnetic field of these electromagnets generates twisting force, or torque. As a result, the motor rotates in the direction of the resultant torque.

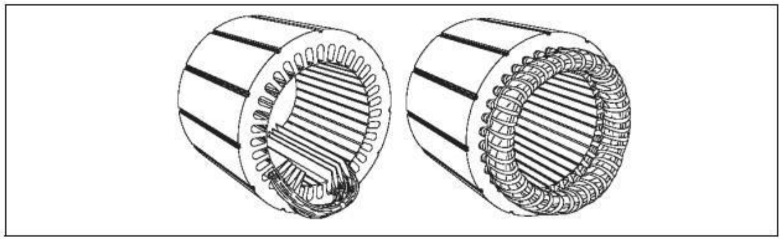
Stator:

The stator is made up of several thin laminations of aluminum or cast iron. They are punched and clamped together to

form a hollow cylinder (stator core) with slots as shown in Figure. Coils of insulated wires are inserted into these slots. Each grouping of coils, together with the core it surrounds, forms an electromagnet (A pair of poles) on the application of AC supply.



The number of poles of an AC induction motor depends on the internal connection of the stator windings. The stator windings are connected directly to the power source. Internally they are connected in such a way, that on applying AC supply, a rotating magnetic field is created.



ROTOR:

The rotor is made up of several thin steel laminations with evenly spaced bars, which are made up of aluminum or copper, along the periphery. In the most popular type of rotor (squirrel cage rotor), these bars are connected at ends mechanically and electrically by the use of rings. Almost 90% of induction motors have squirrel cage rotors. This is because the squirrel cage rotor has a simple and rugged construction. The rotor consists of a cylindrical laminated core with axially placed parallel slots for carrying the conductors. Each slot carries a copper, aluminum, or alloy bar. These rotor bars are permanently short-circuited at both ends by means of the end rings, as shown in Figure.

This total assembly resembles the look of a squirrel cage, which gives the rotor its name. The rotor slots are not exactly parallel to the shaft. Instead, they are given a skew for two main reasons.

The first reason is to make the motor run quietly by reducing magnetic hum and to decrease slot harmonics. The second reason is to help reduce the locking tendency of the rotor. The rotor teeth tend to remain locked under the stator teeth due to direct magnetic attraction between the two. This happens when the number of stator teeth are equal to the number of rotor teeth. The rotor is mounted on the shaft using bearings on each end; one end of the shaft is normally kept longer than the other for driving the load.

Some motors may have an accessory shaft on the non-driving end for mounting speed or position sensing devices. Between the stator and the rotor, there exists an air gap, through which due to induction, the energy is transferred from the stator to the rotor. The generated torque forces the rotor and then the load to rotate. Regardless of the type of rotor used, the principle employed for rotation remains the same.

A TYPICAL SQUIRREL CAGE ROTOR:

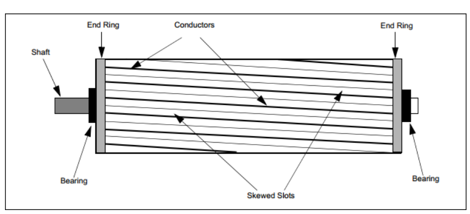


Fig.4.1 Cage Rotor

TYPES OF AC INDUCTION MOTORS:

Generally, induction motors are categorized based on the number of stator windings. They are:

Single-phase induction motor

Three-phase induction motor

Single-Phase Induction Motor:

There are probably more single-phase AC induction motors in use today than the total of all the other types put together. It is logical that the least expensive, lowest maintenance type motor should be used most often. The single-phase AC induction motor best fits this description.

As the name suggests, this type of motor has only one stator winding (main winding) and operates with a single-phase power supply. In all single-phase induction motors, the rotor is the squirrel cage type.

The single-phase induction motor is not self-starting. When the motor is connected to a single-phase power supply, the main winding carries an alternating current. This current produces a pulsating magnetic field. Due to induction, the rotor is energized. As the main magnetic field is pulsating, the torque necessary for the motor rotation is not generated.

This will cause the rotor to vibrate, but not to rotate. Hence, the single phase induction motor is required to have a starting mechanism that can provide the starting kick for the motor to rotate.

The starting mechanism of the single-phase induction motor is mainly an additional stator winding (start/ auxiliary winding) as shown in Figure 3. The start winding can have a series capacitor and/or a centrifugal switch. When the supply voltage is applied, current in the main winding lags the supply voltage due to the main winding impedance.

At the same time, current in the start winding leads/lags the supply voltage depending on the starting mechanism impedance. Interaction between magnetic fields generated by the main winding and the starting mechanism generates a resultant magnetic field rotating in one direction. The motor starts rotating in the direction of the resultant magnetic field.

SCOTCH YOKE MECHANISM

The scotch yoke mechanism is reciprocating motion mechanism, converting the liner 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. In many internal combustion engine, linear motion is converted into rotational motion by means of a crankshaft, a piston and a rod that connects them. The scotch yoke is considered to be a, more efficient means of producing the rotational motion as it spends more time at the high point of its rotation than a piston and it has fewer parts

Disc - M.S

Diameter - 150mm

Movable variation - 25cm

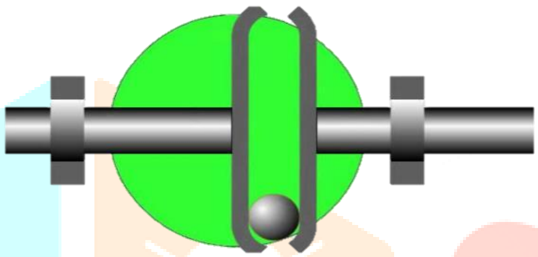
Connecting plate length - 70cm

Blade movable distance - 150mm

Scotch Yoke Mechanism

SHAPING TOOL

A shaper is a type of machine tool that uses linear relative motion between the work piece and a single-point cutting tool to machine a linear tool path. Its cut is analogous to that of a lathe, except that it is (archetypal) linear instead of helical. (Adding axes of motion can yield helical tool paths, has also done in helical planning.) A shaper is analogous to a plane, but smaller, and with the cutter riding a ram that moves above a stationary work piece, rather than the entire work piece moving beneath the cutter. The ram is moved back and forth typically by a crank inside the column; hydraulically actuated shapers also exist.



Operation

A shaper operates by moving a hardened cutting tool backwards and forwards across the work piece. On the return stroke of the ram the tool is lifted clear of the work piece, reducing the cutting action to one direction only. The work piece mounts on a rigid, box-shaped table in front of the machine. The height of the table can be adjusted to suit this work piece, and the table can traverse sideways underneath the reciprocating tool, which is mounted on the ram. Table motion may be controlled manually, but is usually advanced by automatic feed mechanism acting on the feed screw. The ram slides back and forth above the work. At the front end of the ram is a vertical tool slide that may be adjusted to either side of the vertical plane along the stroke axis. This tool- slide holds the clapper box and tool post, from which the tool can be positioned to cut a straight, flat surface on the top of the work piece. The tool-slide permits feeding the tool downwards to deepen a cut. This adjustability, coupled with the use of specialized cutters and tool holders, enable the operator to cut internal and external gear tooth profiles, splines, dovetails, and keyways. The ram is adjustable for stroke and, due to the geometry of the linkage, it moves faster on the return (non-cutting) stroke than on the forward, cutting stroke. This action is via slotted link or Whitworth link.

ADVANTAGES

1. High torque output is achieved
2. Fewer moving parts
3. Smoother operation
4. Simple in construction
5. Maintenance is easy

APPLICATIONS

1. It can perform variable operation in a single time.
2. Operations such as drilling, shaping, cutting can be done with a single drive.
3. It can be used in small, medium as well as large scale industries.

CONCLUSION

We can see that all the production based industries wanted low production cost and high work rate which is possible through the utilization of multi-function operating machine which will less power as well as less time, since this machine provides working at different center it really reduced the time consumption up to appreciable limit.

In an industry a considerable portion of investment is being made for machinery installation. So in this project we have proposed a machine which can perform shaping and sawing operation in two different working centers simultaneously which implies that industrialist have not to pay for machine performing above tasks individually for operating operation simultaneously.

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