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Multi-Function Operating Machine

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Abstract: This paper 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 location. 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.

KEYWORDS: Scotch yoke mechanism, different operation, bevel gear system, single power source, conservation of electricity

I. INTRODUCTION

This deal with design of multiple operating machine. In today's era every task have been made rapid and faster due to technology enhancement 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. So in this mechanism we have a proposed a machine which can perform operations like drilling, grinding, cutting, punching and some other lathe operations at different working centers simultaneously which implies that industrialist have not to pay for machine performing above tasks individually for operating operation simultaneously. In present condition many electrically operated power machines of different companies with different specifications are available for the use in shop floor. These machines are so precise that they can cut metal with minimum time made up of different materials but they have one and major disadvantage that those are able to perform single operation of machining at a time. For industries to achieve the mass production, it is necessary to perform multiple operations with high rate. So it is impossible to depend upon conventional single machines and need the improvement in technology and design of such machines. Multi-function operation machine tool helps us to get high speed cutting rate and to achieve mass production for maximum profit in related companies. As this machine overcomes all the limitations and drawbacks of conventional machines, it is also helpful for small scale industries due to its simple working and operating conditions along with its compatibility, efficiency and affordable price. Moreover, the above mentioned operations can be replaced by similar type of operations. This machine is may be used in industries and domestic operation and low production cost. This project work subject is one in which actually we are learning theoretical concepts in practical view. In an industry a considerable portion of investment is being made for machinery installation.

II. MECHANISMS USED IN MACHINE

1. SCOTCH-YOKE MECHANISM



Figure 5.1: Scotch-yoke Mechanism

Construction

Iron bars are employed to make the scotch yoke mechanism. Since the crank is of a certain length, same material is used to build yoke and crank. Twice the length of crank should be minimum length of yoke. The pin is used to join the yoke and crank. Both the sides of the yoke are welded to iron bars in order to obtain the required motion. In the construction of the mechanism the steel bar is connected with display board by the help of clamps.

Working Principle

To operate the machine, energy is required. The value of power supply is 230V AC. The rotation of the crank and the sliding of the pin inside the yoke and also moves the yoke forward. The rotation of the crank in a clockwise direction results in the yoke getting displaced in a forward direction. The maximum quantum of displacement will be equal to the length of the crank. As soon as the crank completes the rotation of the yoke will come back to its initial position. At the next rotation, the yoke will moves in the reverse direction. On completion of a full rotation by the crank, the yoke will moves back to its original position. The yoke moves across a length are equivalent to double the crank for a complete rotation. To change the crank length, displacement of yoke only need be changed.

2. BENDING MACHINE

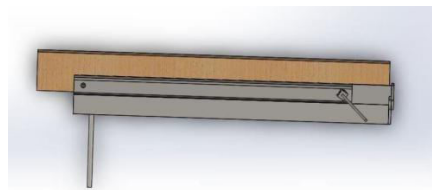


Figure 5.2: Bending Machine

Bending machine is made using steel bars. It is connected to one side of the frame. It is manually operated. Iron rod is attached to one face to make the motion perpendicular for the bending purpose. It is done with some connectors. One rod with spring is also used for holding the work-piece. It is attached with the frame with help of screws.

WORKING PRINCIPLE

In our bending machine the work is done manually by an operator. There is no need of a skilled worker. On one face of the machine an arrangement of rod with spring is used for holding the work-piece. The work-piece is firmly held by tightening the rod. While tightening the spring get compressed and there by holding work- piece firmly by spring force. On the other face there is another rod to provide the required movement of the face so that bending can be done successfully. Specified connectors are used for connecting the steel bars so that they provide the required motion.

3. DRILLING MACHINE



Figure 5.3: Drilling Mechanism

Construction

The power from the main shaft is made perpendicular with help of bevel gears. Two bevel gears make the motion perpendicular and a shaft is connected with perpendicular bevel. The drill bit is connected to shaft. The vertical motion of the work-piece is made possible with the help of screw jack. On top of screw jack a clamp is fixed for holding work-piece.

Working Principle

The main shaft is powered by AC motor with belt drive using pulley. A bevel gear is attached to one end of main shaft and another bevel gear is made to mate at an angle of 90degree. Thus 22 bevel gear transmit or convert the horizontal rotation of shaft to vertical. A drill bit is fixed at the end for drilling. Our drill bit is not movable. Thus the work piece movement is made possible with the help of screw jack. For holding the work piece clap is fixed at top of screw jack with help of screws. The rotation of the screw make the vertical motion of screw jack this is transmitted to clamp their by work piece move vertically.

4. CUTTING MACHINE



Figure 5.4: Cutting Mechanism

Construction

The cutter is connected to the shaft by connectors. The shaft is held in position with help of frame. A pair of similar pulley with the help of belt power the shaft with cutter for performing the required operation. The pulleys used are of same size to reduce losses.

Working

The main power from the AC motor is transmitted to a parallel shaft at a distance with the help of pulleys and belt. The cutter is connected at the end of the parallel shaft. The reduction in velocity will be smaller, as same sized pulleys are used. The cutter is not movable, but the work piece can be moved thus required operation can be done.

III. METHODOLOGY

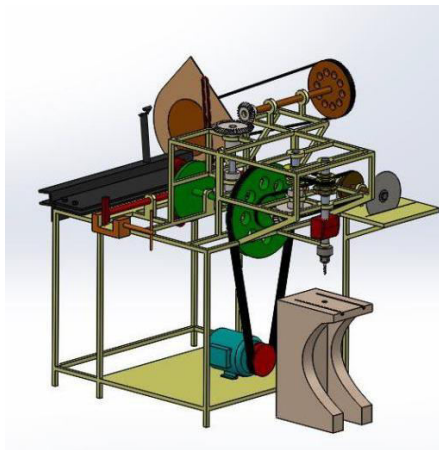


Figure 6.1 Solid Works Model Figure 6.2 Fabricated Machine

Our basic idea for the project is to develop a machine which can perform different operations with the help of a single motor. The next challenge faced by us is to decide which all operations are most important in a machining operations and later we came to a conclusion to choose drilling, cutting, shaping and sheet metal bending machine. The next step we take is to find the motor rating required to do such problems and done the calculations and the revolution per minute and HP required for the motor. The result after calculation we got is 1440 rpm and 0.46HP. After this result we select a motor of 0.5 HP motor. The second step we done is to design the machine in a solid works model. We draw a model in solid works and later do certain corrections according to the guidance of our project guide. After thinking and doing certain corrections we came up with the final model in solid works modeling software. The next challenge ahead of us is to do the analysis and to choose which software is to prefer and later we decided to do the analysis in ANSYS software. We have done part by part analysis of the component rather than full machine analysis because mesh size will be large in full body machining and it will result in the accuracy reduction so we prefer part by part meshing. We have done stress and strain analysis of our machine part and at last we got a result which is satisfactory to do it. On the way of the analysis process many corrections are done to make this machine possible and certain changes are done in this designing.

The final and the most important step is the fabrication process. It gives us a lot of knowledge and experiences. It took almost a month to finish the project first we placed a motor centrally and connected a pulley to the motor. It is then connected to the main shaft of the motor with the help of a cone pulley. The main shaft is connected to the bevel gear with module ($m=2.5$) and the bevel is connected to a vertical shaft which is connected to the drilling mechanism. The end of the main shaft is connected with a rotating wheel cutter and in addition to it a grinding wheel is connected to the other end. We have also placed an another shaft of 20mm diameter perpendicular to the main shaft and connected shaper machine with the help of a scotch yoke mechanism. The other side of the machine is used for placing sheet metal bending machine which is placed according to the slotted lever mechanism. At last we have coated the machine with primer to protect it from rust and atmospheric conditions.



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IV. CONCLUSION

Though our team initially planned to set up a multiple purpose Machine but can't able to do the full fabrication process due to the current covid 19 pandemic. But we completed the modelling and analysis process and done all the necessary calculations showing the power requirements and shaft dimensions of our project. Our machine performs four major operations such as cutting, drilling, bending and shaping with the help of a single motor. We can use this machine to make different products such as sheet metal box and metallic angle brackets. This machine is highly useful for mini industries who cannot afford huge expenses and need to perform various operations. The machine is also easily transportable. It is a compact machine uses less space and needs less floor space so that it is easy for the operator to work with machine easily and a single operator can perform various operations in less time and easily.

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