Auto Feed Radial Drilling Machine

Umang R. Pathak
(U.G. Student (Mechanical))
Hasmukh Goswami college of Engineering
Gujarat Technological University
umangrpathak@gmail.com

Jignesh D. Patel
(U.G. Student (Mechanical))
Hasmukh Goswami college of Engineering
Gujarat Technological University
jdpmeuk@gmail.com

Mayank R. Patel
(U.G. Student (Mechanical))
Hasmukh Goswami college of Engineering
Gujarat Technological University
mayankpatel9031@gmail.com

Amruta R. Mali
(Assistant Professor)
Hasmukh Goswami college of Engineering
Gujarat Technological University
amruta.mali@hgce.org

***Abstract*:** Now a days, there is a tremendous development in the production industry and their relevant machinery to improve the productivity. Productivity of radial drilling machine is changed by anything that affects the design and mechanism of machine. Our idea is to implement auto feed mechanism in Radial drilling machine. Up and Down motion of spindle is accomplished by providing worm and worm gear which is connected to the motor and this is operated by switch. Also for proper clamping of work piece, magnetic table is being used. Processing cost of radial drilling machine decreased by implementing this advance technology of controlling of product parameter and modifying the design and mechanisms i.e. Auto Feed Mechanism.

Keywords—Radial drilling, Auto feed mechanism, clamping etc.

I. INTRODUCTION

Drilling is a metal cutting process carried out by a rotating cutting tool to make circular holes in solid materials as shown inn fig(1). In drilling operation the metal is removed by shearing and extrusion. Tool which makes hole is called as drill bit or twist drill. This cutting tool is held in the drill press by a chuck or Morse taper and is rotated and fed into the work at variable speeds.

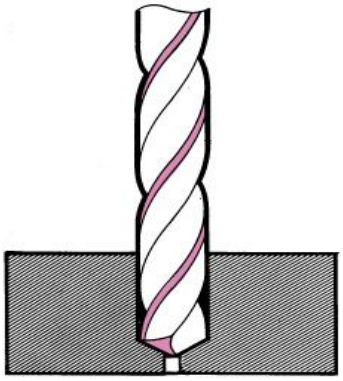

Fig. 1. Drilling Operation

The process of drilling is done with the help of drilling machine. Drilling machine is a power operated machine tool which holds the drill in its spindle rotating at high speeds and when actuated move linearly against the work piece produces a hole. Various types of drilling machines are there. They are as follows:

1. Portable drilling machine
2. Sensitive drilling machine
3. Radial drilling machine
4. Gang drilling machine
5. Multiple drilling machine
6. Multiple spindle drilling machine
7. Upright drilling machine
8. Deep hole drilling machine

Among them our main focus is on radial drilling machine. In radial drilling machine the radial arm slides up and down on the column with the help of elevating screw provided on the side of the column, which is driven by a motor. The drill head is mounted on the radial arm and moves on the guide ways provided the radial arm can also be swiveled around the column. The drill head is equipped with a separate motor to drive the spindle, which carries the drill bit. The arm of the machine can swing in relation to the base of the machine. This operation of swing helps the drill head to move out of the way so a large crane can place the heavy work piece on the base of the radial drilling machine. Also this is used in drilling holes at different locations of the work piece without actually moving the work piece. The radial drilling machine and its parts is shown in fig (2).

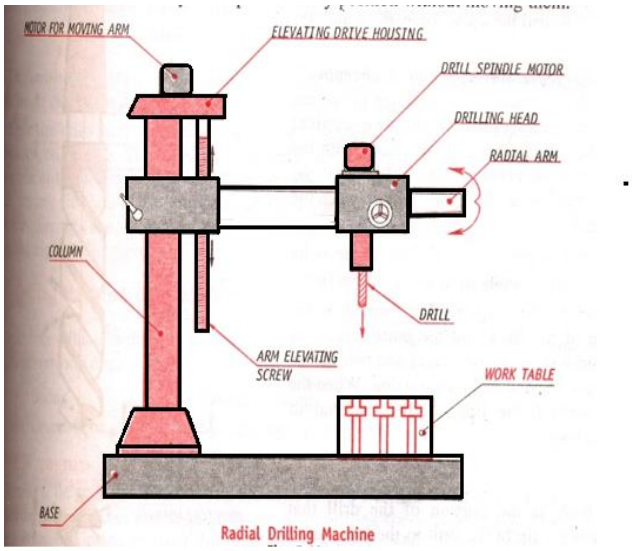

Fig. 2. Radial Drilling Machine and its Parts

Various operations can be performed on drilling machines other than drilling such as boring, reaming, tapping, lapping, countersinking etc.

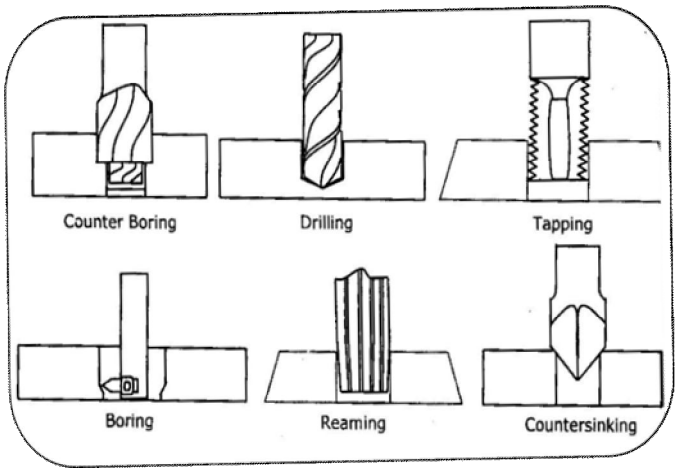

Fig. 3. Various Operations Performed on drilling machine

II. Problem Description

Looking towards current scenario of manufacturing, production requires being fast and automated for higher production rate and good quality operation which indirectly reduced the processing cost which dictates the efficient and effective production.

The machine has a hand feed mechanism for feeding the tool into the workpiece. By this the operator can feel how the drill is cutting and accordingly he can control the down feed pressure. The spindle up-down movement is hand operated so operators required more effort to drill a work piece. During drilling operation if more effort is given then machine tool may damage and there is an inaccuracy in drilling, hole becomes uneven. So due to this there is an inaccuracy in operation.

Also there is a problem in setting up the work piece. Proper clamping must be done on work piece otherwise during drilling the work piece gets disturbed. Other problems associated with the drilling process include uneven hole, tool breakage, and more effort.

This causes the more operation lead time, inaccuracy of drilled hole geometry, more production cost, more labour effort, time and cost.

III. Literature Review

In History, The earliest drills were bow drill which date back to the ancient harrappa's and Egyptians. The drill press as a machine tool came from the bow drill and is many centuries old. Various power sources were used over the centuries, like human effort, water wheels, and windmills, many times with the use of belts. With the coming of electric motor in late19th century, there was a great rush to power machine tools with such motors, and drills were among them. This first electric drill invention is credited to Arthur james amot and William blanch brain, in 1889, at melboume, Australia. Wilhelm fein invented the portable electric drill in 1895, at Stuttgart, Germany. In 1917, black and decker patented a trigger-like switch mounted on a pistol-grip handle [1].

Fig. 4. Bow Drill

PRABIR NAG, in 1970, has studied Improvements in or relating to Drilling Machine, The principle object of the invention is to propose a novel and improved drilling machine in which the vibrations of the tool are kept to the minimum and thus enables precision drilling. A further object of the invention is to propose a drilling machine of such construction that a workman, if he so desires, will be able to use his both hands for positioning and/or holding the job prior to and during drilling operation. [2]

W. W. HECKETHORN, in 1943, has worked on Automatic Drill Press feeder, and it relates to a device for feeding a drill press and has for its principal object the provision of a, simple and highly efficient device which will continuously feed the work to the drill, accurately align it therewith and firmly hold the work during the drilling operation. Other objects of his invention are to provide automatic means for feeding the drill to the work in such a manner as to obtain the most rapid and efficient drilling possible and to prolong the life of the drill

and to perform all of the above operations in the shortest possible time so as to obtain maxi-mum capacity from the drill press [3].

W. C. TRYTHALL, in 1942, has studied on a Drilling and a like machine and the main object of his invention is to provide a boring, drilling or like machine in which a number of tool spindles can be brought to an operative position and pre-set so that each will be driven at a selected speed when in that position. A further object is to provide a preferred form of the improved machine in which a plurality of tool spindles are mounted in a block at equal distances from an axis about which the block is intermittently rotatable. Each spindle is brought by this rotation in succession into driving connection with a driving shaft the speed of which is adjusted, by rotation of the block to any position to a value appropriate to the operation to be carried on by the spindle so brought into operative position. Rotation of the block to each position may for example cause cams to operate speed change devices (for example switches controlling the speed of an electric motor) and these cams may be pre-set according to the desired sequence of speeds [4].

W. C. Wines, in 1946, has studied on Automatic Drilling Machine and the object of the invention is an automatic drilling machine in which the indexing holding and ejecting devices can be easily adapted to different work fixtures. According to the invention, the automatic devices for bringing and registering the work pieces successively into operative position and ejecting and holding them where necessary and are used without mechanical connection with the drilling spindle or with connecting moving parts, by electric circuits having contact devices operated by means on a slow speed shaft mechanically connected to feed the drilling spindle. The fixed table supports an indexing table operated electromagnetically and means to support the workpiece fixture and an electromagnetically operated ejecting device attached to the fixed table of the drilling machine. An electromagnetically operated device is attached to the fixed table, after indexing, into accurate position by pressure applied radially to the formed edge of the indexing table or to work pieces on the fixture. An electromagnetically operated device is also hooked up to the fastened table, accustomed hold work items against being revolved by the drill. The slow speed shaft carry a cam for feeding the drill spindle and also the cams controls the electrical circuits. [5]

IV. DESCRIPTION OF PROJECT

"The rotating fringe of the drill exerts an oversized force on the work piece & the outlet is generated. The removal of metal during a drilling operation is by cutting & extrusion"

Our project is working on new technology which is applied in radial drilling machine as we are working on handle less drill technology. In present industries mechanical technician or helper required through fully concentration on job to prevent from accident as drill chuck up & down is done manually by handle provided in the machine which is operated by the operator.

So we remove the handle and modify the design of radial drilling by providing auto feed mechanism by using worm and worm gear.

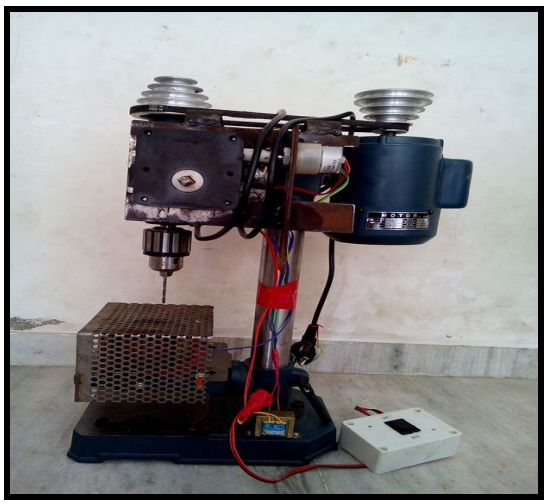

Fig. 5. Radial drilling machine after modification

This technology is followed by worm gear network and this worm gear network is constructed with both type of gear interfacing number.

The worm (screw) continuously rotates and drives the worm wheel. Worm and worm gear form a lower pair as they are having sliding contact with each other. In a worm gear drive, power always transmits from worm to worm wheel, Power cannot transmits from worm wheel to worm. This is called self-locking. It is very much useful in many applications. A worm and worm gear are used to provide a high angular velocity reduction between non-intersecting shafts which are usually at right angles. Worm gears are used for transmitting power between two non-parallels or perpendicular, non-intersecting shafts. High gear ratios of 200:1 can be got.

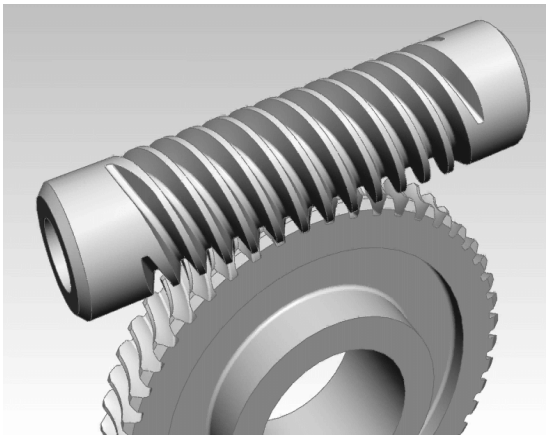

Fig. 6. Worm and worm gear

This worm gear is connected to the spindle shaft where previously handle was connected and the worm is connected to D.C electrical motor of 12V having 30 R.P.M which is operated by double MCN type switch.

1) Forward
2) Stock
3) Reverse

So the up down motion of the spindle is controlled by this switch. When the forward switch is pressed the worm rotates and it rotates the worm gear which is connected to the spindle shaft hence there is a down motion of the spindle and when reverse switch is pressed the worm rotates in opposite direction and spindle comes upwards.

Also an electromagnetically operated holding device is attached to the fixed table which holds the work pieces against being rotated by the drill so proper clamping of workpiece is achieved. This is as shown in the below figure (7).

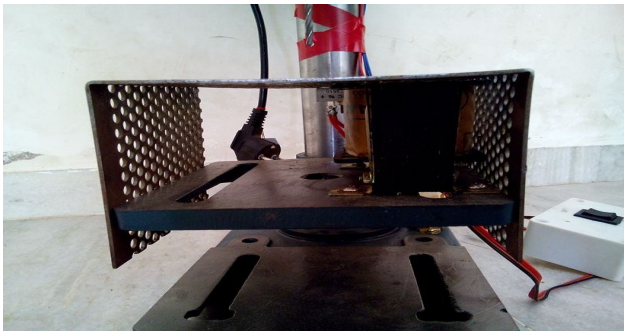

Fig. 7. Electromagnetically operated holding device

Helping the destitute tiny scale industries had been our expression and that we have succeeded in giving an easier resolution that features a huge scope to be impermanent within the close to future.

V. Design of Worm and Worm Gear

Assume 20° Pressure angle for which lead angle should not exceed 25° and z_2 minimum is 21. Allowing 6° lead per thread of worm, the worm could have 4 or less teeth.

Let $Z_1=3$

$G=\frac{n_1}{n_2}=\frac{30}{2}$

$= 15=\frac{z_2}{z_1}$

$Z_2= 15\times3$

$=45$

$\omega_1=\frac{2X\pi Xn_1}{60}$

$=\frac{2\times\pi\times30}{60}$

$= 3.14$ rad/sec

Torque of motor is 120 N.cm, so power is given by,

$P=\frac{2\pi NT}{60}$

$=\frac{2\pi\times30\times1.2}{60}$

$= 3.76$ W

Centre distance is given by,

$A=8[(G+5)p_i]^{0.588}$

$=8[(15+5)3.76]^{0.588}$

$=101.46$mm

$=105$mm

Now,

$\frac{a^{0.875}}{3.0}\leq d_1\leq\frac{a^{0.875}}{1.7}$

$\frac{105^{0.875}}{3.0}\leq d_1\leq\frac{105^{0.875}}{1.7}$

$19.56\leq d_1\leq 34.52$

Let us take $d_1=20$mm

Since $d_1=4p_2$

$P_2=\frac{d_1}{4}=\frac{20}{4}=5$

$m=\frac{p}{\pi}$

$=\frac{5}{3.14}$

$= 1.592$ mm

Take nearest standard module,

i.e. m=2 mm

Hence,

$D_2 = mz_2$

$= 2\times45$

$= 90$ mm

Actual Centre distance,

$a=0.5(d_1 + d_2)$

$= 0.5(20+90)$

$=55$ mm

$P_a =\pi m$

$=\pi\times2$

$=6.28$mm

$L = p_a z_1$

$=6.28\times3$

$=18.84$mm

$\tan\lambda=\frac{L}{\pi d1}$

$=\frac{18.84}{\pi\times20}$

$= 0.299$

$= 0.3$

$\lambda= 16.69°$

$\omega_2=\frac{2\times\pi\times n_2}{60}$.

$=\frac{2\times\pi\times2}{60}$

$=0.209$ rad/sec

$V_2=\omega_2 r_2$

$= 0.209\times0.5\times90\times10^{-3}$

= 0.0094 m/s

$F_t = \frac{Pi}{v}$

$= \frac{3.76}{0.0094}$

= 400N

b=0.73

=0.73 ×20

=14.6 mm

$M_n = m\cos\lambda$

$= 2 \cos 16.69^0$

=1.915 mm

h_a=1m

=2.5 mm

h_f=1.2 m

=3 mm

Hence we select the worm gear of following dimensions:

d_1=20mm

d_2=90 mm

z_1= 3

z_2= 45

m=2 mm

a=55 mm

P_a=6.28mm

λ= 16.69°

V_2= 0.0094 m/s

F_t= 400N

b =14.6 mm

M_n =1.915 mm

h_a=2.5 mm

h_f=3 mm

VI. ADVANTAGES

1. Increase safety of machine and staff.
2. Spindle up down by gear network, therefore correct & powerful pressure applied.
3. High accuracy
4. Increase productivity.
5. Increase quality of job.
6. Simple to control, therefore operators doesn't need abundant ability to control.
7. Permits high production rate

VII. CONCLUSION

Our project is a sincere and combined effort from all the team members concerned. The team goal was to provide a value effective drilling machine which might facilitate the tiny scale business. It'd facilitate to drill holes simply at any desired angle accurately. Thus this project stands in line to provide totally machine-driven transportable drilling machines within the forthcoming years. There are a unit plans to develop the project within the close to future. This can be simply the start.

From the above thesis we have concluded that required work of literature survey and findings for mechanism and other modification of the features are being defined and proposed planning is fulfilling the criteria for completion of the project in time with efficient and effective work.

ACKNOWLEDGMENT

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Finally we would like to thank everyone who directly or indirectly helped us in the project.

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