Semi Automatic Multi Stud Insertion Machine

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ABSTRACT

Our paper deals with cable box which is mounted on the head of the bore well submersible pump (6 inch). The labours are inserting stud manually in the cable box with the help of gun mounding. The operation in the cable box is oil seal and stud insertion. The main problem in the cable box operation is manually stud insertion. To avoid that process, introducing the semi automation concept using multi spindle insertion. This process reduces the operation time and labour work. Moreover the labours will be getting tired by manual operation for the extended shift hours.

Keywords--- Mean time, Drilling machine, Pillars

I. INTRODUCTION

This paper is based on the common observations that has been made in some small scale industries that use drilling machines for mass production. One of the difficulty observation in the small scale industries was manual stud insertion. So there is need of semi automated special purpose stud insertion machines for cable box application; this lead for development of one such type of multi spindle machine for mass production application.

There are a number of type of special purpose drilling machines available in the market, most of them are imported, and therefore economy point of view it is going to be a big burden for entrepreneurs. Special purpose machines include machines capable of feeding stud in multiple hole at once or drilling holes at different places using actuators to hold stud.

One common machine that was found everywhere is portable drilling machine. In addition bench type power feed drilling machines are in use in big workshops. Portable drilling machines are those, which can be used very easily and can drill holes anywhere in the workshop. This type of drilling machine is used for drilling holes on the objects, which cannot be moved. The motor used here is of universal type that means it can be given either D.C power or A.C. The insertion of stud, which can be obtained by a multi spindle machine, are of range 12mm to 18mm. The diameter of hole, which is obtained through the portable driller, is very small in size. High speeds are employed and actuator spindles are used. In some cases these drilling machines may also work on pneumatic power.

II. PROBLEM DEFINITIONS

The main problem in the cable box is more time consumption of thread insertion operation manually (213 seconds).

MEAN TIME CALCULATION:

<table>
<thead>
<tr>
<th></th>
<th>OIL SEAL (min/sec)</th>
<th>LOCTITE ASSEMBLY (min/sec)</th>
<th>MANUAL FIXING (min/sec)</th>
<th>GUN MOUNTING (min/sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>1.20</td>
<td>1.25</td>
<td>6.32</td>
<td>3.55</td>
</tr>
<tr>
<td>Mean</td>
<td>1.28</td>
<td>1.27</td>
<td>7.05</td>
<td>4.04</td>
</tr>
<tr>
<td>Mean</td>
<td>1.26</td>
<td>1.24</td>
<td>7.37</td>
<td>4.08</td>
</tr>
<tr>
<td>Mean</td>
<td>1.24</td>
<td>1.24</td>
<td>8.20</td>
<td>4.12</td>
</tr>
<tr>
<td>Mean=1.24</td>
<td>Mean=1.24</td>
<td>Mean=7.32</td>
<td>Mean =4.04</td>
<td></td>
</tr>
</tbody>
</table>
III. OBJECTIVES

To reduce the stud insertion operation time from 213 sec to 64 sec (Takt time)

IV. MULTI STUD INSERTION MACHINE

The Multi stud insertion machine has 4 stud holders. The studs are stored in the stud box which is attached with the top plate of the machine. When it is move up and down. It takes the total top body to the same type of motion.

That stud box act as coin box system. It will deliver the studs in the correct manner. The stud moves down ward to the stud holders by the gravity force.

There are two actuators. First one is used for stop the stud, then second one for push in back purpose. When the machine starts work, the actuator 1800p and delivers the studs one by one. The actuator 2 gives the push back motion. There is multi gear box system which is hold and gives the rotary motion for the stud holder. After the completion of stud inserting on the cable box. There is automatic step motor guide is takes the new one for this place

A. BASE PLATE AND PILLARS:

The whole arrangement rests on the Base plate which is mounted on the Drilling machine table. Two pillars are fixed to the Base plate and are provided with springs. The slide plate assembly slides over these pillars vertically.

B. MAIN ECCENTRIC:

It is inserted into the main spindle. The power is transmitted from the machine to the Revolving plate through this Eccentric. A Morse Taper no.3 is provided in this eccentric. The eccentricity is 5mm.

C. REVOLVING PLATE:

The rotary motion of the machine spindle is converted into the revolutionary motion of this plate in which the top pins of the drill holding eccentrics are inserted.

D. STUD HOLDING ECCENTRICS:

The bottom pins of these eccentrics have provision for holding the Studs of according to the design. The revolutionary motion of the revolving plate is converted into rotary motion of the Studs through these eccentrics.

E. ACUATOR:

An actuator is a type of motor for moving or controlling a mechanism or system. It is operated by a source of energy, typically electric current, hydraulic fluid pressure, or pneumatic pressure, and converts that energy into motion. An actuator is the mechanism by which a control system acts upon an environment. The control system can be simple (a fixed mechanical or electronic system), software-based (e.g. a printer driver, robot control system), a human, or any other input.

V. DESIGN CALCULATION

A. NOMENCLATURE:

d_p=diametral pitch
m=module
Td=Tensional shear failure of shaft
Tdesign=torsional load
Fs_{act}=Actual shear stress
Fs_{max}=max.shear stress
Fs_{all}=allowable shear stress
D=minimum diameter of the input shaft
Sult=ultimate tensile strength
Sylt=yield tensile strength
Cs=service factor
Cv=velocity factor
Pt=tangential load
B=Face width (mm)
Dp=pitch circle diameter
P_{eff}=effective load
WT=Lewis strength
Y=lewis form factor
Z=number of teeth
P=power

B. DESIGN PROCEDURE:

ESTIMATING THE MACHINE POWER:

Knowledge of power required to perform machining operations is useful when planning new machining operations, for optimizing existing machining operations, and to develop specifications for new machine tools that are to be acquired.

The power on any machine tool place a limit on the size of cut that it can take. When more metal must be removed from the work piece it is advisable to estimate the cutting conditions that will utilize the maximum power on the machines.

The machine tool transmits the power the driving motor to the work piece where it is used to cut the material.

C. MOTOR SELECTION:

Thus selecting a motor of the following specifications
3 phase induction motor
Power = 0.5 hp= 375 watt
Speed= 1440 rpm.

To calculate arbor Shaft Torque
POWER = \( \frac{2 \pi NT}{60} \)

Motor is 375 watt power, run at 1440rpm, connected to drilling machine spindle by belt pulley arrangement of 1:3 ratio, considering 65% efficiency of belt drive , torque at the arbor shaft is given by,

\( T = 4.84 \times 10^3 = 30 \times 6 \times Fs_{act} \times 17/2 \)

Check for Torsional Shear Failure of Shaft
Assuming minimum section diameter on input shaft = 16 mm
\( d = 16 \ mm \)
\( Fs_{act} = \frac{16 \times Td}{\pi \times d^3} \)

As \( Fs_{act} < Fs_{all} \)
I/P shaft is safe under torsional load.

D. DESIGN OF KEY:

Minimum diameter of the shaft from standard data book is taken as 17 mm:

Check for direct shear failure of key:-
\( T = L \times t \times Fs_{act} \times d/2 \)
\( 4.84 \times 10^3 = 30 \times 6 \times Fs_{act} \times 17/2 \)

Check for crushing failure of key:-
\( T = L \times Fs_{act} \times d/2 \times t/2 \)
\( 4.84 \times 10^3 = 30 \times 6 \times Fs_{act} \times 17/2 \times 6/2 \)

E. DESIGN OF SPUR GEAR BOX:

The multi spindle drilling attachment has a drive train in the form of Spur gear system comprising of the central spur gear and four spur gears Which drive the four individual spindles on which drill chuck are mounted.

The following dimensions are assumed for the gear drive train,
Spur gear
Module =1.5mm
No of teeth=32
Power =0.5HP=375watts
Speed=480rpm
b=10m

T design=4.84 N-m
Sult pinion=sult gear=600N/mm^2
Service factor (Cs) =1.5
dp=48

Now; \( T = \frac{P_t \times dp}{2} \)
\( P_t = 2 \times 4.84 \times 10^3 / 48 = 201.6N \)
\( P_{eff} = (Pt \times Cs/Cv) = (P_t \times 1.5/Cv) \)

Now; \( Cv = (3/3+v) \)
\( V = \pi \times 48 \times 10^{-3} \times 480/60 \)

\( V = 1.2m/sec \)
\( Cv = 0.71 \)
\( P_{eff} = (201.6 \times 1.5/0.71) \)
\( P_{eff} = 424 N \)
Pinion and gear both are of same material and with same number of teeth
Hence
\[ S_y = S_y = 78.8 \]
\[ W_t = (S_y)p \times b \times m = 78.8 \times 10 \times m \times m \]
\[ W_t = 788m^2 \quad (2) \]
Equation (1) and (2)
\[ 788m^2 = 636 \]
\[ m = 0.9 \]
Selecting standard module=1.5mm

F. GEAR DATA:
No of teeth=32
Module=1.5mm
Addendum (m) =1.5mm
Dedendum (1.25) =1.88mm
Pitch circle diameter of gear=160mm

G. ASME CODE FOR DESIGN OF SHAFTS:
Since the loads on most shafts in connected machinery are not constant, it is necessary to make proper allowance for the harmful effects of load fluctuations. According to ASME code permissible values of shear stress may be calculated from various relation.

\[ = 0.18 \times 800 \]
\[ = 144N/mm^2 \]
OR
\[ F_{s_{max}} = 0.3f_yt \]
\[ = 0.3 \times 680 = 204N/mm \]
Considering minimum of the above values;
\[ F_{s_{max}} = 144N/mm^2 \]

<table>
<thead>
<tr>
<th>SL. No.</th>
<th>PARTS</th>
<th>Qty.</th>
<th>MATERIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>i.</td>
<td>Top plate</td>
<td>1</td>
<td>M.S</td>
</tr>
<tr>
<td>ii.</td>
<td>Bottom Plate</td>
<td>1</td>
<td>M.S</td>
</tr>
<tr>
<td>iii.</td>
<td>Stud Holder</td>
<td>4</td>
<td>M.S</td>
</tr>
<tr>
<td>iv.</td>
<td>Center Gear Wheel</td>
<td>1</td>
<td>C.I</td>
</tr>
<tr>
<td>v.</td>
<td>Spindle Gear Wheel</td>
<td>3</td>
<td>C.I</td>
</tr>
<tr>
<td>vi.</td>
<td>Center Shaft</td>
<td>1</td>
<td>M.S</td>
</tr>
<tr>
<td>vii.</td>
<td>Spindle Shaft</td>
<td>3</td>
<td>M.S</td>
</tr>
</tbody>
</table>

VI. CONCLUSION
Using multi-spindle insertion attachment, increase productivity at low cost and in less. Also with the help of equipment, reduce the cycle of operation. Although these multi spindle insertion attachment perform basic drilling operation, there are some specific functions that are performed more accurately and conveniently by each of these type. For enhancement and fast production an index able drill jig can be mounted on the drill machine table.

REFERENCES
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