# "DESIGN AND MANUFACTURING OF SLOTTING ATTACHMENT ON DRILLING MACHINE"

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**ABSTRACT**

*Now a day's small scale industries face the problem of scarcity of finance. so small scale industries want to save money and earn more profits with the limited resources. For saving money and increase flexibility we come up with the idea of developing the slotting attachment on the drilling machine. It avoids the separate machine tool cost, tool set up time and material handling. This project is helpful for the small scale industries where a drilling machine exists. In this attachment, the bevel gear and crank and slotted quick return mechanism are used for converting the rotary motion into reciprocating motion. The crank and slotted quick return mechanism increases the productivity. This project relates to developing an inexpensive slotting attachment for drill machine which would produce the internal and external slots and many other similar operations which ordinarily require the use of large machine.*

**Keyword**: - *Designing Attachment, Slotting & Drilling, Slotting Model*

## 1. INTRODUCTION

In the industries different types of production machine tools are available like a lathe machine, milling machine, slotting machine, and drilling machine. Industries easily produce the slots in the job by the use of the slotting machine but it is quite difficult for the small scale industries because they have limited resources as well as scarcity of funds. The small scale industries pay a high amount for the small job due to lack of machinery. Now a day's main objective of the small scale industries is to increase the productivity with the available resources. This project is designed for the small scale industries where the drilling machine is commonly available. This project is relating to developing inexpensive slotting attachment which is directly fitted into drilling machine. This device is used for external and internal slots and many other similar operations which would ordinarily perform by the large machine. Mostly this is used for the batch type production. This attachment is lifted on or off to the base and rigidly secured in the place in few minutes. It would be eliminating the tool setup time and machining time.

### 1.1 Objective

- To design the bevel gear by analytical method.
- To design the Crank & slotted quick return mechanism
- To manufacturing the slotting attachment.

## 2. SLOTTING ATTACHMENT

The major component in this attachment is bevel gear. The bevel pinion is attach on the vertical shaft. On the one end of the shaft Morse taper (MT 2) is machined. This Morse taper is perfectly fitted into the drilling spindle. The horizontal and vertical shaft is connected by suitable bevel gear arrangement whose module is 3.5 mm. The diameter of the bevel gear is 210 mm and bevel pinion is 105 mm. In this we are using crank and slotted quick return mechanism. The crank diameter is 165 mm and its mounted on the horizontal shaft one end. Length of stroke can be easily adjusting by moving the connecting pin in the slots of the crank. The slotted arm is pivoted on one end of the gear box frame. Connecting link is directly attach with the slotted arm and link up with the dovetail guideways. The cutting tool is perfectly position in the tool holder which is rigidly fixed on the dovetail guide ways. The work is clamp on the work holding device and longitudinal and transverse motion is given to the work by means of the compound slide. Compound slide maximum travel distance is 250 mm in the both direction.

**Fig -1**: Slotting Attachment

**2.1 Working Principal**

We are performing the operation on pillar drill and radial drill machine. An available space in the pillar drill machine is 1100 mm and in radial drill is 2000 mm. height of the attachment is 1000 mm. by the rack & pinion mechanism we are adjusting the height of the attachment according to the drill space available. This attachment is directly fitted in to the drilling spindle. The spindle rotates at the speed of 100 rpm so the vertical shaft rotate at the speed of 100 rpm, here the gear ratio of the bevel gear is 2.so the crank(rotor) and horizontal shaft is rotates with 50 rpm. now connecting pin fixed on crank. It has rotary as well as sliding motion in the slotted arm.so slotted arm gets oscillating motion. Connecting link is attach with slotted arm and the dove tail guideways. Due to the connecting link oscillating motion converted into the reciprocating motion.so cutting tool is reciprocating.

**Fig -2**: Drilling machine

## 3 ANALYTICAL DESIGN

### 3.1 Bevel Gear

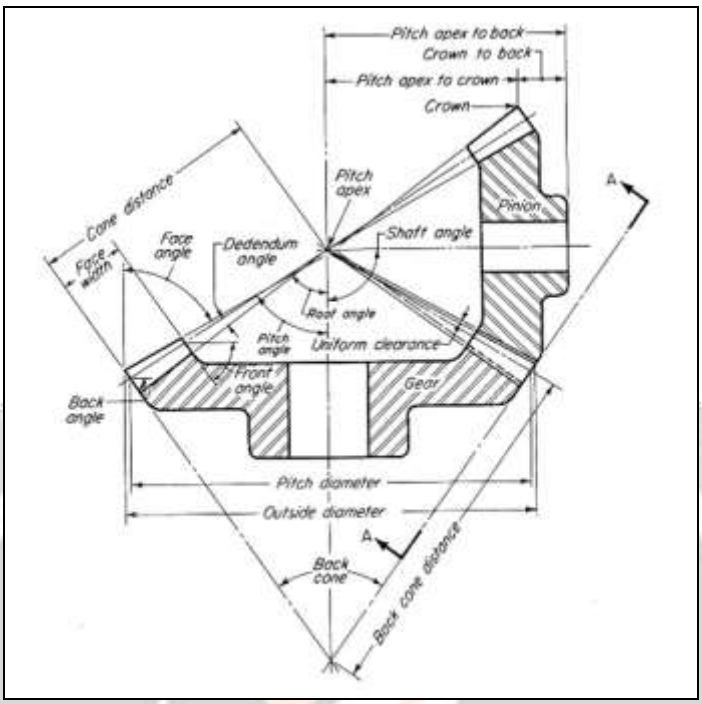


**Fig 2**: Terminology of Bevel Gear

Now we take the gear and pinion made of Mild steel.

For Mild steel ultimate tensile strength $S_{ut} = 580 \ \frac{N}{mm^2}$

Surface hardness =217BHN

**$20^{\circ}$ Full depth involute teeth system**

- **Beam strength of pinion**

$$F_b = m * b * \sigma_b * (Y')_p * \left[1 - \frac{b}{A_0}\right]$$

- **Wear strength**

$$F_w = \frac{0.75 * d_p * b * Q' * k}{\cos \gamma_p}$$

- **Effective loading**

$$F_{eff} = \frac{K_a K_m F_t}{K_v}$$

Now checking for the safety,

$\boldsymbol{F_b > F_{eff}}$

So, design is safe against the bending failure.

$\boldsymbol{F_w > F_{eff}}$

So, design is safe against the wearing (pitting) failure.

**Table-1:** Result table of bevel gear

| Sr. No. | Dimension | Value |
|---|---|---|
| 1 | Module$(m), mm$ | 3.50 |
| 2 | Gear Ratio$(I)$ | 2.00 |
| 3 | Teeth on Pinion$(Z_p)$ | 30 |
| 4 | Teeth on gear$(Z_g)$ | 60 |
| 5 | Diameter of pinion($d_p$),mm | 105 |
| 6 | Diameter of gear($d_g$),mm | 210 |
| 7 | Bending Strength$(F_b), N$ | 6621 |
| 8 | Wear Strength$(F_w), N$ | 3714 |
| 9 | Effective loading$(F_{eff}), N$ | 2202 |

### 3.2 Crank and Slotted Quick Return Mechanism

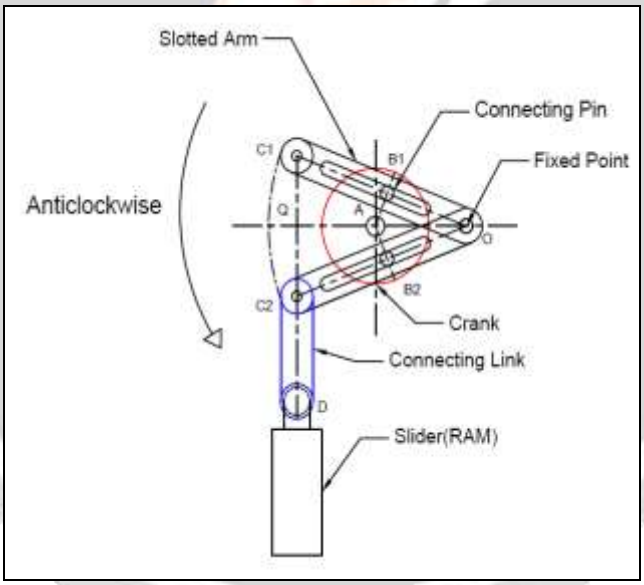


**Fig 3:** Crank & Slotted Quick Return Mechanism

Total travers a distance of $C_1C_2$ during cutting stroke and return stroke .

So travel of total $length\ of\ stroke = C_1C_2$

$$length\ of\ stroke = 2C_1Q$$

$$length\ of\ stroke = 2(OC_1 \sin \angle C_1OQ) \ \because (\sin \angle C_1OQ = \frac{C_1Q}{OC_1})$$

$$length\ of\ stroke = 2(OC_1 \sin(90 - \tfrac{\alpha}{2}))$$

$$length\ of\ stroke = 2OC_1 \cos\frac{\alpha}{2}$$

$$length\ of\ stroke\ = 2OC_1\left(\frac{AB_1}{OA}\right) \because (\cos\frac{\alpha}{2} = \frac{AB_1}{OA})$$

Hence link $OA$ is fixed which make turning pair,

$take\ OA = 140mm$

$\boldsymbol{AB_1 = 50.8mm\ (2")}$

$OC = 275mm$

$$\sin\left(90 - \frac{\alpha}{2}\right) = \frac{50.8}{140}$$

$$\sin\left(90 - \frac{\alpha}{2}\right) = 0.3571$$

$$\left(90 - \frac{\alpha}{2}\right) = 20.92°$$

$$\left(\frac{\alpha}{2}\right) = 69.08$$

$\alpha = 138.16$

$length\ of\ stroke = 2(OC_1 \sin(90 - \frac{\alpha}{2}))$

$length\ of\ stroke = 2 * 275 * \sin(90 - 69.08)$

$length\ of\ stroke = 203.2\ mm$

$\boldsymbol{length\ of\ stroke = 101.6\ mm(4")}$

**Cutting Ratio:**

$$\frac{time\ of\ cutting\ stroke}{time\ of\ return\ stroke} = \frac{\beta}{\alpha} = \frac{(360 - \alpha)}{\alpha} = \frac{(360 - 138.16)}{138.16} = 1.6$$

**Table-2:** Result Table of Crank & Slotted quick Return Mechanism

| Sr No. | Stroke Length | Cutting angle | Return Stroke angle | Ratio |
|---|---|---|---|---|
| 1 | 4 inch | 222° | 138° | 1.6. |
| 2 | 6 inch | 246° | 114° | 2.2 |

## 4. CONCLUSIONS

| Sr No. | Stroke length | Conventional Machine | Attachment |
|---|---|---|---|
| **1** | 4 inch stroke | 38000/- | 17900/- |
| **2** | 6 inch stroke | 47000/- | 17900/- |

After the designing and manufacturing the slotting attachment we can conclude that, we reduce the separate machine tool cost, by the use of quick return mechanism we improve the productivity, the stroke length should vary in a range between the 4 inch to 6 inch.

## 5. REFERENCES

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