Increase in productivity by attachment of grinding setup
On lathe machine

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Abstract: Grinding is an operation which is done on metal work piece for removal of material and to get fine surface finish. The available grinding setups are not convenient for small scale industries as they consume lots of time in loading and unloading of work piece from lathe machine to this grinding setups, which also affects the overall productivity of the firm. Here we have fabricated a grinding setup which gets mounted in the available space of lathe machine on lathe cross slide in front of the tool post where cutting tool is placed, with this the operator will be able to use the grinding setup as soon as he finishes his operations on lathe machine without having the need of removing his work piece. Thus the following research paper gives information of the time saved by using the grinding setup which is mounted on lathe machine.

Keywords– grinding setup, lathe machine, productivity, surface finish, work piece

I. INTRODUCTION

Grinding is a material removal and surface generation process used to shape and finish components made of metals and other materials. From more than a century the development in grinding machine is taking place and it still continues, grinding machines such as cylindrical grinder, surface grinder, bench grinder and other recent grinding setup such as tool post grinder are available for performing grinding operation. Although these many machines are now available for performing grinding operation there are still some drawbacks which are needed to be overcome specifically, for performing some operation on lathe machine it is needed to load and unload the workpiece from workplace to this grinding machines which consumes time and effects productivity. The other machine such as tool post grinder have a drawback of removing the tool post for mounting the grinding setup which also takes considerable time of the operator.

We have focused our study in development of such a grinding setup which gets fit in the available space of lathe machine without having the need of removing the tool post also the cost of this grinding setup is way less as compared to that of the available grinding machine in the market. Our grinding setup will be capable of performing grinding operations on surfaces which are cylindrical in shape and also there will be no interference of our grinding setup with the conventional operations on lathe machine such as turning, facing etc.

With this setup, small scale industries which are low on budget will be benefited tremendously as they will no longer be needed to buy expensive grinding machines also proper space utilization will take place with overall increase in productivity.

1.1 Lathe machine specifications

For mounting our grinding setup, Light duty belt driven without Norton gearbox lathe machine with following specifications has been used.
### II. FABRICATION PROCEDURE

Following are the various steps involved in the fabrication of our grinding setup for lathe machine:

1) For the attachment of our grinding setup it was necessary to estimate the space available on our lathe machine, so that the setup fix rigidly on the lathe cross slide and all the components adjust in the available space. For this we took all necessary measurements of lathe carriage and estimated the available working space considering its rigidity and dimensions.

2) After that a proper design of fixture was necessary, the fixture was designed such that it fits in the available space of lathe carriage which carry all necessary components inside it such as shaft, bearing, grinding wheel and other components which are explain below
   i) Fixture should be able to with stand the motor load with less vibration.
   ii) Fixture should have provisions for belt tightening adjustment and rotating plate for angular grinding.
   iii) Rectangular shaped legs provided so that bearing blocks can be fixed on them with nut bolt arrangement.

With operations such as drilling, welding the fixture was made ready.

*Figure 1 shows the complete grinding setup with fixture attached rigidly.*
3) The motor selection was done by considering the necessary conditions for grinding operations and space constraints. The motor was attached on the designed fixture with proper nut bolt arrangement and rubber pad provision beneath the motor for less vibrations and height adjustment.

4) **C-SLOT for Angular Grinding** - A rotating plate was made so that the grinding wheel rotates 30 degree on both side, for that Scale marking was done on C-SLOT. The C-SLOT rotating Plate was made as follows -
   i) First we took the metal plate of required dimensions on which we drilled the circular hole for pivoting the metal plate at its Centre
   ii) After that a C-SLOT was made with vertical milling cutter which ensured the required constrain necessary for angular grinding.

   *Figure 2 shows the C-SLOT for angular grinding*

5) **Attachment of shaft and bearing** - Based on design calculation we have selected standard shaft size so that it can take the necessary load on it, for proper shaft support we have used foot step Bearing which can take radial load of shaft. The bearing blocks were attached on rectangular shaped legs with nut and bolt arrangement, to with stand shaft vibrations isolator was provided in between bearing block and legs.

6) **Attachment of grinding wheel on shaft** - We kept one side of shaft at higher diameter compared to that of other side of shaft which is inside the bearing block, the grinding wheel was attached on higher side with special arrangement such as threading and bush, the threading ensure that the grinding wheel gets attached rigidly on shaft with nut arrangement and bush for friction reduction.

7) **Arrangement made for belt tightening** – for installing and uninstalling the belt from pulleys and also to adjust its tightness we have mounted a metal plate with hinge support at one side. This plate have two bolts on other side of hinge at two ends from which we can set the height of plate as per requirement.
8) **Attachment of fixture on lathe cross slide** – for rigid attachment of fixture on lathe cross slide as per the available space, we have welded two legs on the base plate of the fixture at two ends. This two legs slide inside the lathe cross slide smoothly, in order to restrict the to and fro motion of fixture on lathe cross slide and attach it rigidly we have drilled holes on both side of two legs and by using the nut and bolt arrangement we have fixed the legs with the fixture on lathe cross slide.

9) **Attachment of belt and pulley** – Two pulleys were used for power transmission, one pulley was mounted on motor shaft and other was mounted on grinding wheel shaft, the two pulley’s were fixed rigidly on shaft with the help of bolt which passes through pulley and the small hole drilled on shaft. Based on design calculation we used v-belt for small center distance between two pulleys which provides proper grip and avoid slip of belt.

10) The whole fixture was made ready with above fabrication procedure successfully after that the grinding setup was painted with suitable paint for aesthetics as well as for corrosion resistance.

### III. FIXTURE LAYOUT WITH DIMENSIONS

Following figures shows the various components of the designed fixture with dimensions

#### 3.1 LAYOUT OF DESIGNED FIXTURE

The weight of the designed fixture is 7.3 kilogram and it can withstand a load 1000 newton

*Figure 3 shows the layout of fixture designed in inventor*
3.2 DIMENSIONS OF FIXTURE COMPONENTS

1) **BASE PLATE** = 190.05 MM * 108 MM * 16 MM

2) **ROTATING PLATE** = 177.80 mm * 101.60 mm * 8 mm
4.1 SELECTION OF WORKPIECE
The workpiece material selected for investigation is ASTM-A-36
Diameter of raw workpiece -
\[ D_{raw} = 24 \text{ mm} \]
\[ L_{raw} = 102 \text{ mm} \]

Operations perform on raw material
A. Facing
B. Turning
C. Cylindrical Grinding

1. First two operations A and B performed on lathe machine and grinding operation performed on cylindrical grinder
2. All operations A, B and C performed on lathe machine

4.2 WORKPIECE DESCRIPTION

*Figure 4 shows the dimensions of the selected workpiece*
1. Length of Job (L) : 100 mm
2. Diameter of Job (D) : 20 mm
3. Rpm of Job (N) : 560 rpm
4. Rpm of Grinding Wheel : 2880 rpm
5. Depth of Cut (mm) : 0.5 mm
6. Feed (mm/Rev) : 0.1071 mm/rev

**Figure 5** shows grinding operation performed on grinding setup and conventional lathe machine

### 4.3 OBSERVATION TABLE

<table>
<thead>
<tr>
<th>SR. NO.</th>
<th>PARAMETERS</th>
<th>CONVENTINAL CYLINDRICAL GRINDING TIME (min)</th>
<th>GRINDING ATTACHMENT TIME (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>SETUP TIME</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A. Unloading Job from Lathe M/C</td>
<td>0.233</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>B. Travelled Time On lathe M/C to Cylindrical grinding M/C</td>
<td>0.450</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>C. Loading of Job</td>
<td>0.916</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>D. Job Clearance Checking</td>
<td>0.366</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>E. Other Time</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>I. set up time II. Inspection Time</td>
<td>0.166</td>
<td>0.216</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.208</td>
<td>0.208</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>2.173</td>
<td>0.424</td>
</tr>
<tr>
<td>2.</td>
<td>OPERATION TIME</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A. M/C Time</td>
<td>9.6</td>
<td>9.6</td>
</tr>
<tr>
<td></td>
<td>B. Unloading Time</td>
<td>0.233</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>MISCELLANEOUS TIME</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A. Checking and Inspection</td>
<td>0.676</td>
<td>0.96</td>
</tr>
<tr>
<td></td>
<td>B. Fatigue Allowance</td>
<td>0.338</td>
<td>0.48</td>
</tr>
<tr>
<td></td>
<td>C. Preposition of Operator on Lathe</td>
<td>0.45</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>TOTAL TIME (1+2+3)</td>
<td>$T_1$ =13.636</td>
<td>$T_2$ =11.464</td>
</tr>
<tr>
<td></td>
<td>TOTAL TIME SAVE FOR ONE JOB $T_{SAVE}$ = $T_2$ - $T_1$</td>
<td>2.1720 min</td>
<td></td>
</tr>
</tbody>
</table>

From the above table we observe that-
For production of 100 jobs time saving goes to more than 3.5 hours in a day.
V. RESULT AND CONCLUSION

Time
Time is the most important factor affecting every manufacturing process, from this grinding setup we have been able to save time up to 3.5 hours a day for production of 100 jobs. This saving of time will increase the overall productivity of the firm and will help small scale industries to achieve more profit in terms of economy and man workforce.

Accuracy
For attaining highest surface accuracy up to 20 microns if we compare manual grinding process with our grinding setup we observe that for manual grinding process on lathe machine we have to remove job from chuck of lathe and have taken the job to the grinding machine which is mounted at specific location in workshop it affects the accuracy of final product because of human errors. And our grinding wheel attachment is mounted on lathe with use of frame and with this there is no errors because we are not removing job from lathe. Finally from this above two factors our grinding setup attachment has advantages over manual grinding process.

From our grinding setup we have been able to achieve surface roughness in between 10 to 15 microns which is better as compared to conventional grinding machines.

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