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MULTI-PURPOSE BUFFING MACHINE

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ABSTRACT

The term Buffing is a super finishing process in which there is a buffing wheel(attached with abrasive disc) that is used to remove the bur or unwanted material from the workpiece for smoothing the surface of the workpiece. Polishing is a surface machining technique to produce a high-quality finished surface on the product. It is a multistage process, in which each subsequent stage uses a finer abrasive. This paper aims to design and fabricate a polishing machine that performs polishing stages continuously, eliminating the idle time in the polishing process. The designed machine consists of four spindle heads, each of which carries a unique flap wheel. The flap wheels can raise or lower according to the size of the workpiece to be polished. Three types of rollers were adopted in the machine: a mild steel roller coated with heat resistant rubber, a hylam roller and a nylon roller. A pneumatic clamping system was placed at the feeder to fix and hold the workpiece. In addition, the compressor pressure is regulated by a pressure regulator. A prototype of the polishing machine was fabricated according to the design, and used to polish several types of workpieces. The results show that this machine can polish stainless-steel flat bars, square tubes and rectangular tubes into 10mm-150mm width products, operate at a high speed of 2,000~3,000 rpm, and, most importantly, execute multiple polishing operations continuously. The proposed polishing machine is helpful to the automation of the polishing industry.

Keywords: polishing machine, metallographic ,grinding, manufacture, local, components.

1. INTRODUCTION

1. 1 Introduction:

In the present age of increasing demand of productivity the theory of mechanization or automation of processes in order to achieve higher production rates with minimal of human input, there is need to develop innovative machinery to cater the above needs.

Buffing operation is mainly done on the face of the components which is similar to polishing with the view to improve the surface finish of the components. The buffing operation is presently done by mounting an abrasive disk on the spindle of a hand grinder and feeding this rotating disk against the job surface.The parts produced by various machining operation such as turning, drilling ,milling etc. although fairly accurate in size, do not carry a very high degree of surface finish. In much industrial application, very high degree of surface finish is essential and desired.

When very close dimensional accuracy is required in addition to high surface finish. As in polishing, the abrasive particles must be periodically replenished. As in polishing, buffing is usually done manually, although machines have been designed to perform the process automatically. This operation makes the surface smooth producing a high luster and mirror finish if desired. This is done with the use of buffing wheels and buffing compounds. Buffing is a finishing operation similar to polishing, in which abrasive grains are not glued to the wheel but are contained in a buffing compound that is pressed into the outside surface of the buffing wheel while it rotates. As in polishing, the abrasive particles must be periodically replenished. As in polishing, buffing is usually done manually, although machines have been designed to perform the process automatically. This operation makes the surface smooth producing a high luster and mirror finish if desired. This is done with the use of buffing wheels and buffing compounds.

These compounds can be used to smooth and/or shine metals, plastic, wood, and other materials. The names Buffing compound and polishing compound are used interchangeably and refer to fine abrasive fillers combined with greases which are formed into solid bars or liquid. This buffing operation removes scratches and makes the surface smoother. The edge, or face, of the wheel is the 'sanding block', which carries a thin layer of compound' which is the sandpaper. Varying types of wheel are available, and the different grades of compound are scaled similar to sandpaper. The compounds are made from a wax substance which has the different abrasive powders added to it. When this hard block is applied to the edge of a spinning buffing wheel, the heat from the friction melts the wax, and both wax and abrasive are applied in a thin slick to the face of the wheel.

This operation makes the surface smooth producing a high luster and mirror finish if desired. This is done with the use of buffing wheels and buffing compounds. Buffing can be divided into two steps; cut buffing and color buffing. These compounds can be used to smooth and/or shine metals, plastic, wood, and other materials. The names Buffing compound and polishing compound are used interchangeably and refer to fine abrasive fillers combined with greases which are formed into solid bars or liquid. Buffing abrasives utilize the fine grades of aluminum oxide and silicon carbide abrasives. Buffing also uses fine graded alumina, Tripoli, iron oxide and chrome oxides abrasives that are carried by greaseless or tallow base materials forced into the buffing wheels(which acts as the abrasive carrier) or sprayed onto the buffs of automated systems.

1.2 Necessity:

- The process of obtaining a very fine surface finish, having a grain less appearance on metal object.
- Buffing typically uses a cloth wheel and very fine abrasive.
- A thin layer of abrasive is applied to the playable perimeter of the cloth wheel using a compound which can be applied as liquid or solid.
- There are stages in buffing process-typically coarse, medium and fine, each using a style of buffing wheel and different type compound.
- The term buffing is often is used interchangeably with polishing .Without a clear material science foundation and success often relies upon the skills of the operator.
- It is a polishing operation in which the work-piece is brought in contact with a revolving cloth buffing wheel.
- Grip the workpiece as lightly as possible.
- Do not push workpiece against buffer with excessive force.
- Buff only on the down stroke side.
- Maintain a working angle not in excess of 90 degrees to the down stroke side of the buffer.

2. LITERATURE SURVEY

2.1 Introduction:

Buffer capacity allocation in production lines has been studied quantitatively for over 50 years and hundreds of publications are available. The remarks below are intended to place the current paper in the framework of this literature rather than to provide a comprehensive review.

With respect to the machines, production lines can be classified into two groups: unreliable machines with fixed cycle time and reliable machines with random processing time. This work addresses the first group.

With respect to the machine efficiency, production lines with unreliable machines can be further divided into two groups: balanced (i.e. the machines have identical up-and downtime distributions) and unbalanced. This work addresses the balanced case and then extends the results to the unbalanced one.

Buffer capacity allocation in production lines, similar to those addressed here, has been first considered in the classic papers by Vladzievskii (1950, 1951).

Sevastyanov (1962) and Buzacott (1967). A review of the early work in this area is given by Buzacott and Hainan (1978). In particular, Buzacott (1967) showed that the coefficient of variation of the downtime strongly affects the buffering.

In addition, Buzacott associated the buffer capacity allocation with the average downtime and stated that buffering beyond review-downtime can hardly be justified.

These results are conform and further quantified in the present work.

Conway et al. (1988) also connected buffer allocation with downtime. They showed that one-downtime buffering was sufficient to regain about 50% of production losses if the downtime was constant sted that random (exponential) downtime may require a twice larger capacity to result in comparable gains. This suggestion is further explored in the current paper.

Varying types of wheel are available, and the different grades of compound are scaled similar to sandpaper.

2.2 Tricks of the Trade:

Sand the inside of the part with emery paper. This will show you exactly where the dent is. Using a piece of end grain wood as a block gently beat out the dent with a hammer. Clean your buffing wheels with a wheel rake Offer the jagged blade to the edge of the spinning.

Wheel, and work it across the face until the wheel looks bright and fluffy once more. This action, done periodically, will remove entrapped metal particles, which could scratch a more delicate part.

Eliminating ‘Swirl’ Marks Swirl marks caused by buffing in the final stages can easily be removed by wetting the part with a damp cloth, then dusting with a powder such as:- Whiting, Talcum Powder or Corn Starch, then buff on your wheel again until the swirls disappear.

One wheel for one compound applying different compounds to the same wheel only causes problems, because you end up with a mixture of abrasive surfaces, and metal deposits left over from the more abrasive operation. These microscopic particles only scratch the surface, destroying any benefit gained by the finer compound.

2.3 Choosing the Right Wheel:

There are different types of wheels and these have different effects on the compound they are used with. For example, the sisal wheel is a coarse 'rope like' fiber, which frays out to make a sort of brush. These fibers have a very beneficial effect on scratched and rougher surfaces, almost stroking them smooth. When used with a course 'emery' compound, they 'cut' the metal down very rapidly. You could use this compound on a spiral sewn wheel and it would work, but the job would take much longer because the softer spiral sewn wheel is not going to thrash the metal so aggressively.

As you progress through the buffing compounds, you will change your buffing wheel, ending up using the softest polishing wheel, the canton flannel with the least abrasive.

Compounds are made from a mixture of fine abrasive fillers and a sort of greasy wax. The compound is melted, by friction heat, as the bar is pressed to the revolving wheel.

This applies a thin layer of abrasive, 'glued' onto the cloth wheel, making it similar to an emery paper, only much faster!

2.4 Specialized Buffing Compounds:

Once the basics of buffing have been mastered, using the standard buffing compounds, consideration should be given to using more specialized compounds for particular applications.

If you are doing the same job over and over, then you should experiment with different wheels and compounds to tailor make your own system. What suits one person's application, won't suit another.

2.5 The Spiral Sewn Wheel:

Spiral sewn wheels are the workhorse of most buffing and polishing jobs. Because the plies of cotton cloth are sewn together spirally, the wheel becomes much harder and more pressure can be exerted on it.

This is especially useful when 'cutting' the metal. The faces of these wheels are pre-raked to accept compound immediately.

2.6 The Loose Cotton Wheel:

The main purpose of a loose cotton wheel is to polish and cut in a similar manner to the Spiral sewn wheel, except that this wheel, not being tightly stitched together, will 'mush' or collapse, allowing the cotton to get into awkward places more easily. If you have an object with fine details and awkward crevices, then this is the wheel to use.

2.7 The Finger Buff:

An aggressive wheel, designed to buff irregular con-toured metals, especially useful for buffing of check-err plate. The treated sewn cloth fingers penetrate into crevices etc. and at the same time reduce friction eat buildup, so reduces the possibility of distorting thin metal panels etc. Use with Greaseless or black emery compounded wheel comes with a 5/8" hole in the metal center. ½" inserts are available.

3. SYSTEM DEVELOPMENT

3.1 Introduction:

Buffing is a finishing operation similar to polishing, in which abrasive grains are not glued to the wheel but are contained in a buffing compound that is pressed into the outside surface of the buffing wheel while it rotates. As in polishing, the abrasive particles must be periodically replenished. As in polishing, buffing is usually done manually, although machines have been designed to perform the process automatically.

This operation makes the surface smooth producing a high luster and mirror finish if desired. This is done with the use of buffing wheels and buffing compounds.

3.2 Construction:

The Multi-purpose Buffing machine comprises of the following parts.

3.2.1 Motor:

The motor is an single phase AC, capacitor run motor 0.25 Hp (185watt) , 4000 rpm. The motor is mounted on the machine frame by motor supports and is coupled to the spline shaft by means muff coupling

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Figure 3.1 Motor

3.2.2 Muff Coupling:

The muff coupling connects the motor shaft to the main spline shaft of the machine.

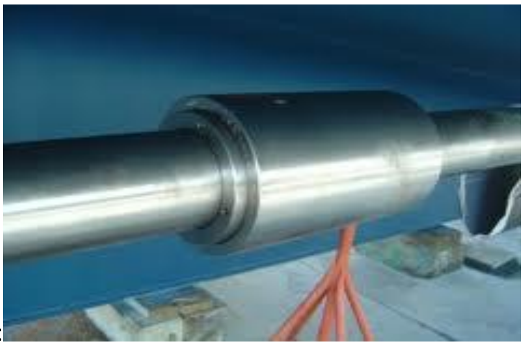
:

Figure 3.2 Muff Coupling

3.2.3 Ip Bearing Housing:

The Ip_bearing housing holds the ball bearing 6004 zz in which the main spline shaft of machine is housed. The Ip_bearing housing is bolted to the boom at the rear end where as hinge pins for the feed handle are mounted on the front end. In the center the plates for the motor support are welded.

Figure 3.3 Ip Bearing Housing.

3.2.4 Buffing Wheel Spindle Assembly:

The buffing wheel spindle assembly mainly comprises of two sub assemblies one to rotate the buffing wheel and other to feed the rotating buffing wheel against the work-piece.

The buffing wheel rotating sub-assembly comprises of the main spline shaft held in ball bearing at the top end in Ip_bearing housing, the spline hub is mounted on this shaft which is press fitted in the carrier hub, which carries the wheel spindle. The Buffing wheel is mounted on the wheel spindle by means of the spindle nut 1&2.

The buffing wheel feeding sub-assembly comprises of the feed handle, thrust bearing holder1&2, thrust bearings, helical compression spring with both end ground and the thrust bearing housing. The thrust bearing housing is bolted at its rear end to the boom, where as at the front end the front end the thrust bearing is mounted. Thrust bearings are mounted so that when the wheel is fed in downward direction the carrier may rotate freely without a friction that may result due to deflection of spring. The spring is provided for return stroke of the carrier hub.

3.2.5 Cross Feed Table Assembly:

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The cross feed table assembly again comprises of two subassemblies, one for the wobbling motion of the work-piece to ensure uniform buffing all over, and second to translate this sub-assembly. Iterances on work pieces are specified in the manufacturing drawings. The process charts are prepared & passed on to the manufacturing stage .The parts are to be purchased directly are specified &selected from standard catalogues.

Mounted on the eccentric pin mounted on the table disk which is centrally mounted on the table shaft held in table shaft bearing housing. The table shaft carries the bevel gear mounted on its lower end which is driven by the bevel pinion mounted on the bevel pinion shaft held in the pinion shaft bracket.

The table slide enables to move the wobbling set up in lateral direction by means of moving table shaft bearing housing to and fro using the table feed screw and nut arrangement.

3.2.6. Frame:

The frame comprises of the boom, base plate and support plate. The base plate is the base member that supports the entire machine assembly, where as the boom supports the ip bearing housing, thrust bearing housing, and the table slide plates.

3.3 Working:

When the motor is started it rotates the spline shaft by means of the muff coupling, it thus drives the spline hub which is mounted in the carrier hub that carries the buffing wheel at its lower end. When the feed handle is pressed in the upward direction it presses the carrier hub in the lower direction against helical compression spring. Thus the buffing wheel is imparted rotary motion as well as translation in the downward direction.

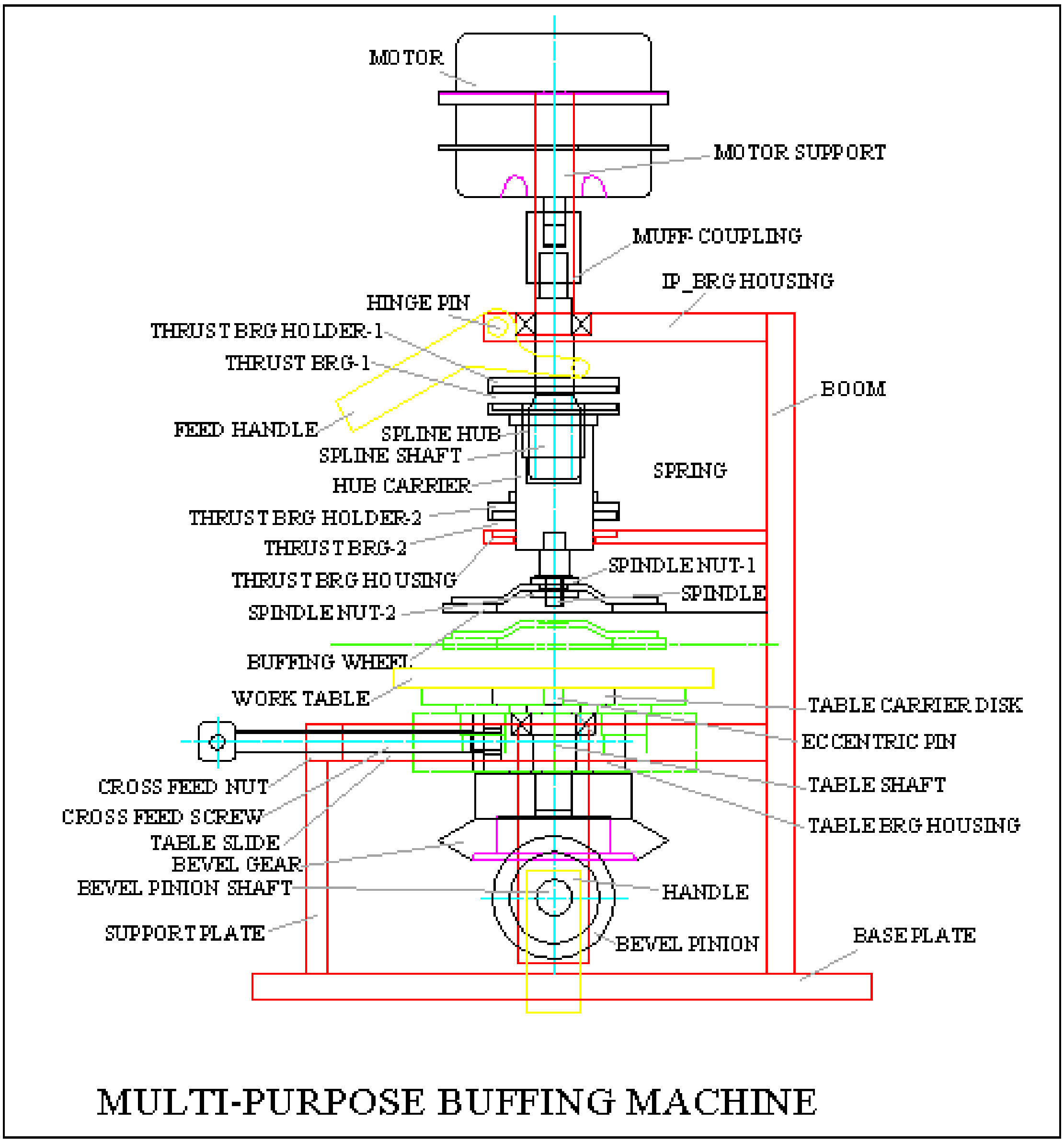

Figure 3.4 Working Of Multi-Purpose Buffing M/C.

The cross feed table assembly again comprises of two subassemblies one for the wobbling motion of the work-piece to ensure uniform buffing all over, and second to translate this sub-assembly in lateral direction.

Wobbling set up comprises of the table shaft, eccentric disk, eccentric pin, table shaft bearing housing, bevel gear, bevel pinion, bevel pinion shaft, handle, and pinion shaft bracket and work table. Work table is mounted on the eccentric pin mounted on the table disk which is centrally mounted on the table shaft held in table shaft bearing housing.

The table shaft carries the bevel gear mounted on its lower end which is driven by the bevel pinion mounted on the bevel pinion shaft held in the pinion shaft bracket.

The table slide enables to move the wobbling set up in lateral direction by means of moving table shaft bearing housing to and fro using the table feed screw and nut arrangement.

3.4 Design Methodology:

3.4.1 Design of Buffing Machine:

In our attempt to design a special purpose machine we have adopted a very a very careful approach, the total design work has been divided into two parts mainly;

- System design
- Mechanical design

System design mainly concerns with the various physical constraints and ergonomics, space requirements, arrangement of various components on the main frame of machine no of controls position of these controls ease of maintenance scope of further improvement; height of m/c from ground etc. In Mechanical design the components are categorized in two parts.

- Design parts
- Parts to be purchased.

For design parts detail design is done and dimensions thus obtained are compared to next highest dimension which are readily available in market this simplifies the assembly as well as post production servicing work.

3.4.2 System Design:

In system design we mainly concentrate on the following parameter:

3.4.2.1 System Selection Based On Physical Constraints:

While selecting any m/c it must be checked whether it is going to be used in large scale or small scale industry In our case it is to be used in small scale industry So space is a major constrain .The system is to be very compact. The mechanical design has direct norms with the system design hence the foremost job is to control the physical parameters.

3.4.2.2 Arrangement of Various Components:

Keeping into view the space restriction the components should be laid such that their easy removal or servicing is possible moreover every component should be easily seen & none should be hidden every possible space is utilized in component arrangement.

3.4.3 Components of Systems:

As already stated system should be compact enough so that it can be accommodated at a corner of a room. All the moving parts should be well closed & compact A compact system gives a better look & structure.Following are some example of this section

- Design of machine height
- Energy expenditure in hand operation
- Lighting condition of m/c

3.4.4 Chances of Failure:

The losses incurred by owner in case of failure of a component are important criteria of design. Factor of safety while doing the mechanical design is kept high so that there are less chances of failure. Periodic maintenance is required to keep the m/c trouble free.

3.4.5 Servicing Facility:

The layout of components should be such that easy servicing is possible especially those components which required frequent servicing can be easily dismantled.

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3.4.6 Height of m/c from Ground:

Fore ease and comfort of operator the height of m/c should be properly decided so that he may not get tired during operation .The m/c should be slightly higher than that the level also enough clearance be provided from ground for cleaning purpose.

3.4.7 Weight of Machine:

The total wt of m/c depends upon the selection of material components as well as dimension of components. A higher weighted m/c is difficult for transportation & in case of major break down it becomes difficult to repair their original shape when the force is released. In other words it is also termed as a resilient member.

3.5 Motor Selection:

Thus selecting a motor of the following specifications.

Single phase AC motor

Capacitor motor

Power = 0.25 hp=185 watt

Speed= 4000 rpm

3.6 Design of Spline Shaft:

3.6.1 Material selection:

Ref :- PSG (1.10 & 1.12) + (1.17)

Table 3.1 Design Of Spline Shaft.

DESIGNATION	ULTIMATE TENSILE STRENGTH N/mm^2	YEILD STRENGTH N/mm^2
EN 24	800	680

ASME CODE FOR DESIGN OF SHAFT.

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 form various relations.

$= 0.18 \times 800$

$= 144\ N/mm^2$ OR

$fs_{max} = 0.3\ fyt$

$= 0.3 \times 680$

$= 204\ N/mm$

Considering minimum of the above values;

$fs_{max} = 144\ N/mm^2$

Shaft is provided with key way; this will reduce its strength. Hence reducing above value of allowable stress by 25%

$fs_{max} = 108\ N/mm^2$

This is the allowable value of shear stress that can be induced in the shaft material for safe operation.

TO CALCULATE WORM WHEELSHAFT TORQUE

POWER = $2\ \pi NT/ 60$

Motor is 185watt power, run at 1440 rpm, connected to Spline shaft by muff coupling.

$T = 60 * P\ /2 \times \pi \times N$

$= \frac{60 \times 185}{2 * \pi * 1440}$

$T = 1.23$ N-m

Considering 25% overload T design = 1.25 x 1.23 = 1.54 N-m

3.7 Check For Torsional Shear Failure of Shaft:

Assuming minimum section diameter on input shaft = 16 mm as the muff coupling is to be mounted on shaft and minimum bore size that can be machined with dimensional tolerances is 16mm

$d = 16$ mm

$Td = \pi/16 \times fs_{act} \times d^3$

$fs_{act} = 16 \times Td / \pi \times d^3$

$= 16 \times 1.54 \times 10^3 / \pi \times (16)^3$

$fs_{act} = 1.914$ N/mm^2

As $fs_{act} < fs_{all}$

I/P shaft is safe under torsional load.

3.7.1 Design Of Splines:

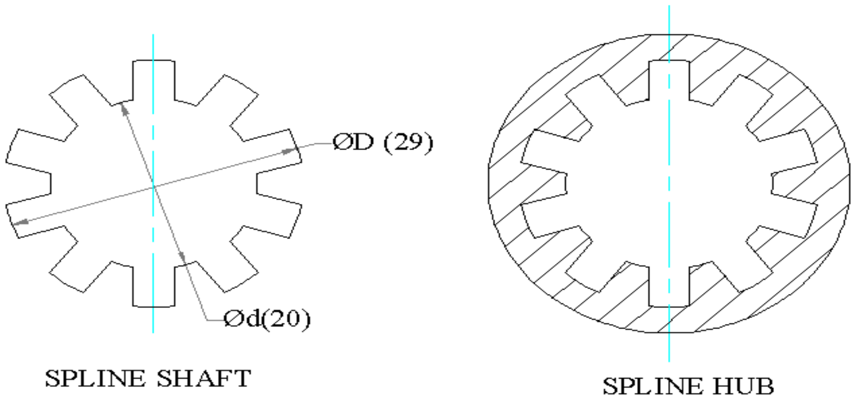

Figure 3.5 Design Of Splines

Material of Shaft EN24

Sult = 800 N/mm^2

Sylt = 680N/mm^2

fs_{all} = 108 N/mm^2

D = Major diameter of splines = 29

d = Minor diameter of splines = 20

L =Length of hub = 30

n= No. of splines =10

Torque transmission capacity of spines is given by;

$T_{capacity} = (1/8) p_m L n (D^2 - d^2)$

Where; p_m = permissible pressure in splines =6.5 N/ mm^2

T = (1/8)x 6.5 x 30 x 10 x $(29^2 - 20^2)$ =107.493 x 10^{3}N-mm

As; $T_{capacity}$>T design (1.54 N-m)

Spline shaft is safe.

3.7.2 Design Of Muff Coupling:

Muff Coupling can be considered to be a hollow shaft subjected to torsional load.

Internal Diameter = Di = Φ 16 mm

Outside Diameter = Do = Φ 30 mm

Material selection.

Table 3.2 Design Of Muff Coupling:

Designation	Ultimate Tensile strength N/mm^2	Yield strength N/mm^2
EN 24	800	680

As Per ASME Code;

fs_{max} = 108 N/mm^2

Check for torsional shear failure:-

$$T = \frac{\pi \times fs_{act}}{16} \times \frac{Do^4 - Di^4}{Do}$$

$1.54 \times 10^3 = \pi \times fs_{act} \times \quad 30^4 - 16^4$

$\qquad\qquad 16 \qquad\qquad 30$

$fs_{act} = 0.316 \ N/mm^2$

As; $fs_{act} < fs_{all}$

Hub is safe under torsional load.

3.7.3 Design Of Carrier Hub :

Carrier hub can be considered to be a hollow shaft subjected to torsional load.

Internal Diameter = Di = Φ 29 mm

Outside Diameter = Do = Φ 44 mm

Material selection.

Table 3.3 Design Of Carrier Hub :

Designation	Ultimate Tensile strength N/mm^2	Yield strength N/mm^2
EN 24	800	680

As Per ASME Code;

$fs_{max} = 108 \ N/mm^2$

Check for torsional shear failure:-

$T = \pi \times fs_{act} \times \quad Do^4 - Di^4$

$\qquad 16 \qquad\qquad Do$

$1.54 \times 10^3 = \pi \times fs_{act} \times \quad 44^4 - 29^4$

$\qquad 16 \qquad\qquad 30$

$fs_{act} = 0.24 \ N/mm^2$

As; $fs_{act} < fs_{all}$

Hub is safe under torsional load.

3.8 Design (Selection of Spline Shaft Ball Bearing):

In selection of ball bearing the main governing factor is the system design of the drive *i.e.* the size of the ball bearing is of major importance; hence we shall first select an appropriate ball bearing first select an appropriate ball bearing first taking into consideration convenience of mounting the planetary pins and then we shall check for the actual life of ball bearing .

Figure 3.6 Ball Bearing

3.9 Types of Buffing Wheel:

3.9.1 Spiral Sewn vs. Loose Cotton:

Spiral Sewn buffs are sewn spirally from the center of the buffing wheels to close to the edge. The stitching style makes these buffing wheels tough and great for cutting and course buffing. Spiral sewn buffing wheels generally should be used with either Black Emery or Brown Tripoli. Loose cotton buffing wheels have a circle of stitches close to the center of the buffing wheel allowing the individual plies more freedom.

These buffing wheels are very flexible and soft making them great for getting into hard-to-reach areas and applying a finish.

Figure 3.7 Buffing Wheel

3.9.2 Felt Wheels and Felt Bobs:

Felt wheels and Felt Bobs are made of compressed wool fibers and work with all compounds. They can be used for any finishing operation and are used to maintain sharp edges and flat surfaces making them favorites of folks who work with knives. Felt bobs come in a variety of shapes and are great for getting into hard-to-reach areas and removing residue left from buffing.

3.10 Abrasive Technical Information:

Abrasive finishing combines a harder than work piece abrasive mineral combined with a bonded or coated product that is rubbed or moved with pressure across the work piece surface. Abrasive finishing can produce a visual or mechanical finish on metals, composites, stone, glass or wood products

The abrasive finishing processes can be achieved by hand, portable equipment, manual or automated machinery. Processes include grinding, polishing, buffing, lapping and honing.

Factors that affect Abrasive finishing:

- Abrasive minerals type, size, shape ad hardness
- Bonding types
- Cutting speed
- Machinery

Ceramic Abrasives is a man made non metallic crystalline structure produced by heating and cooling ceramic matrixes. Ceramic abrasives are very tough, hard and long lasting with a life of 2-3 times that of aluminum oxide. Ceramic abrasives are used on hard metals and long abrasive life requirements. Higher pressures are required to fracture the ceramic abrasives.

Zirconia Alumina is a man made aluminum oxide enhanced with approximate 20% zirconium oxide. The zirconia increases the strength of the aluminum oxide by stress induced transformation toughening.

Zirconia is stronger, tougher with life up of 1-1/2 to 2 times that of aluminum oxide. Zirconia is blocky or cubic in structure and is a good choice when longer life or tougher abrasives are required. Most applications are in the coarser grits between 24 and 120 grits.

Diamond and cbn abrasives are naturally occurring and can be produced synthetically in a high pressure and high temperature process. Most diamonds that are mined are used industrially and most diamonds used in industry are synthetic. Diamond abrasives are used because of their hardness which is a 10 on the Mohs scale and because of their thermal conductivity. Diamonds have a face cubic structure. The diamond abrasives are used in hard grinding wheels, powders and coated abrasives and are used on hard steels, ceramics and interrupted cutting of composites.

Emery abrasive is a naturally occurring aluminum oxide mixed with other minerals such as silica. The black color material is mined. The hardness ranges between 6-8 on the Mohs scale. The softer abrasive is used in emery boards, emery cloth, and polishing abrasives reducing polishing line depth. Buffing abrasives utilize the fine grades of aluminum oxide and silicon carbide abrasives.

Buffing also uses fine graded calcined alumina, Tripoli, iron oxide and chrome oxides abrasives that are carried by greaseless or tallow based materials forced into the buffing wheels(which acts as the abrasive carrier) or sprayed onto the buffs of automated systems.

3.11 Abrasive size:

Abrasive size, referred to as grits, affects the amount of work achieved as well as the finish produced. Coarse abrasive sizes range between 8-60 grit. Coarser grits remove significant material and leave coarser finishes. The coarser grit sizes are a good choice for large weld removal, de-flashing, and de-gating castings, and removal of large amounts of stock.

Medium abrasive sizes range between 80-150 grits. Medium grits will also remove a fare amount of material and leave finer and paintable surfaces. They are also good for spot weld removal, radiusing, deburring and finer weld removal. Finer abrasive sizes range between 180-400 and super fine up to1200 grits, The material removal is less but are capable of maintaining good rms finishes.

3.12 Grit Sizes For Coated Abrasives And Related Rms Finish Capabilities:

When producing coated abrasives products (belts, discs, paper) the abrasive manufacturers of American, Europe, and Asia have slightly different abrasive grain size standards. The ISO standard FEPA designated with a P is the European designation and the CAMI is the American. Below is the size range variances and approximate finish capabilities. The RMS (root means squared surface measurement) average range is calculated at 1/2 life abrasive on coated products. Belt grease and lubricants will reduce RMS readings

3.13 Spring:

A spring is an elastic object used to store mechanical energy. Springs are elastic bodies (generally metal) that can be twisted, pulled, or stretched by some force. A spring is a flexible element used to exert a force or a torque and, at the same time, to store energy.

The force can be a linear push or pull, or it can be radial, acting similarly to a rubber band around a roll of drawings.If springs are of very small diameter and the wire diameter is also small then the springs are normally manufactured by a cold drawn process through a mangle.

However, for very large springs having also large coil diameter and wire diameter one has to go for manufacture by hot processes. First one has to heat the wire and then use a proper mangle to wind the coils.Two types of springs which are mainly used are, helical springs and leaf springs. We shall consider in this course the design aspects of two types of spring.

Figure 3.8 Helical Spring

It is made of wire coiled in the form of helix having circular, square or rectangular cross section.

Terminology of helical spring:

The main dimensions of a helical spring subjected to compressive force are shown in the figure.

They are as follows:

d = wire diameter of spring (mm)

D_i = inside diameter of spring coil (mm)

D_o =outside diameter of spring coil (mm)

D = mean coil diameter (mm)

Therefore

$$D = \frac{D_i + D_o}{2}$$

There is an important parameter in spring design called spring index. It is denoted by letter C. The spring index is defined as the ratio of mean coil diameter to wire diameter. Or

C = D/d

In design of helical springs, the designer should use good judgment in assuming the value of the spring index C. The spring index indicates the relative sharpness of the curvature of the coil.A low spring index means high sharpness of curvature. When the spring index is low ($C < 3$), the actual stresses in the wire are excessive due to curvature effect.

Such a spring is difficult to manufacture and special care in coiling is required to avoid cracking in some wires.

When the spring index is high ($C > 15$), it results in large variation in coil diameter. Such a spring is prone to buckling and also tangles easily during handling. Spring index from 4 to 12 is considered better from manufacturing considerations.

Therefore, in practical applications, the spring index in the range of 6 to 9 is still preferred particularly.

3.14 Used Materials And Their Properties

The materials used in this project are detailed as follows:

- **Ferrous Materials**

A) Mild steel – EN – 4 to EN – 6
Carbon – 0.15% to 0.35%
Tensile strength –1200/1420MPA
Yield strength – 750/1170 MPA

B) C30 Carbon – 0.25% to 0.35%
Tensile strength – 620 MPA
Yield strength – 400 MPA
Izod Impact Value – 55 Nm
% Minimum Elongation – 21
Typical composition — Carbon – 0.25% to 0.35%
Manganese – 0.60% to 0.90%
BHN – 207

C30 material is generally used for cold formed levers, hardened and tempered tie rods, Cables, Sprockets, Hubs and Bushes –Steel Tubes.

C) 40C8 Carbon – 0.25% to 0.35%
Tensile strength – 620 MPA
Yield strength – 400 MPA
Izod Impact Value – 55 Nm

4. PERFORMANCE ANALYLSIS

4.1 Problem Definition:

In the present method the wheel is fed at an inclination of 5 to 15 degrees, where only a part of the wheel comes in contact thereby producing marks on the buffed surface, due to this flatness of the surface machined is not guaranteed, so also even machining of the surface is not possible, the present method thus offers the following disadvantages;

- Flatness not guaranteed, Surface machined is not necessarily flat.
- Tool marks on the surface machined.
- Uneven buffing on surface.
- Time consuming, not suitable for mass production.
- Dimensional inaccuracies may be produced.
- Surface finish not guaranteed.
- Parallelism of surfaces machined is not guaranteed.

4.2 Solution:

The Multi-purpose buffing machine is an exact solution to the above problem where the buffing wheel spins at high speed in a plane perpendicular to the surface to be machined, which ensures the flatness of the surface machined and also the parallelism of the opposite surfaces of job being machined. The depth of cut is governed by the sliding motion of cutter carrier in the downward direction where as the wobbling action achieved by the combined rotary and eccentric motion of the work table ensures that even machining takes place all over the surface. To ensure that the complete surface is machined the table slide is provided.

Buffing Machine:

- Always apply the workpiece to the lower portion of the buffer, never the top.
- Never allow the top edge of the work to be caught by the buffer.
- Allow the buffer to reach full speed before stepping into the buffing position.
- Grip the workpiece as lightly as possible.

- Do not push workpiece against buffer with excessive force.
- Buff only on the down stroke side.
- Maintain a working angle not in excess of 90 degrees to the down stroke side of the buffer.

Buffing is the process used for a high luster shine on various materials. The terminology of cloth impregnated wheels processes for shine is buffing. There is a complete section (section 4, chapter 10) that explains buffing processes, materials, *etc.*

Buffing / polishing

Finishing processes that utilizes abrasive belts are referred to as polishing and processes that use cloth wheels with compound applied is buffing. Polishing generates a brushed or lined finish where buffing removes the lines and creates a bright luster finish. When a finish requires buffing, polishing is in most cases the first refinement processes to level surfaces, remove welds or surface imperfections (pits,scale and scratches). The process of buffing will most always include polishing prior to buffing. Buffingis a rotating cloth wheel that is impregnated with fine abrasive compounds thatproduces a bright-luster finish on metal and composites.

Buffing wheels are constructed of various types and sizes of cloth, sisal or synthetic materials that hold a tallowed rouge or greaseless based matrix of specialized fine abrasive referred to as compound. The compound is sprayed or pressured into the rotating buffing wheel. The buff acts as the carrier of the

The two basic buffing processes in manufacturing are:

4.3 Tangential Buffing:

It is the traditional hand buffing process which also can be automated. The part surface is positioned 90 degrees to the buff. The buff width is generally designed to be sized to the part. Tangential buffing creates high heat because of the higher required buff pressure applied to the work piece. The tangential buffing process works well with parts that can be easily repositioned and uses buffs that range from 12” to 18” diameter running at 1700 rpm/s. The process is just ok for contouring, it works well for harder metals (steel and stainless) and harder ceramic composites. The process is a good choice for robotic automated processes. Mush buffing is done with parts that are not easily repositioned. The process uses large diameter buffs up to 24” and run at approximately 800 rpm/s. The slow speed allows the buff to conform or mush around the part, running cooler resulting in less damage of the part or buff. The automated buff lengths are up to 16 to 18 feet.

Compound penetrations down into the buffs are important. Mush buffing is a good cost effective process for softer metals (Aluminum, Brass, Copper, and Zinc) and softer composites.

Buffing is generally a multiple step process including surface polishing, the cut buff process and the finish buff process.

Surface polishing by abrasive belts or discs are required to level surfaces. remove scratches, pits, scale and polish the surface smooth enough so the cut buff can remove the polishing lines. The first polishing step should be done with the finest abrasive possible that efficiently removes the weld, levels, or refines the surface imperfections. From that point on, the subsequent process, are working to remove the first polishing scratch lines. Each finer polishing step should be crossed polished 90 degrees from the previous polishing process. A 320 grit to a 400 grit polishing generally the courses surface prep that a cut buff process can efficiently remove.

There can be up to 3 polishing steps to prepare a surface for a cut buff. Soft metals and composites take less steps, Castings take more steps than forgings, hot rolled materials take more steps than cold rolled, stampings and machined parts take less steps than raw materials, welds need to be removed with finer abrasives instead of coarser grinding so not to create excessive additional polishing steps

Mass finishing is used extensively to remove the first polish line and reducing cost and processes of future polishing steps. Mass Finishing is a good process on certain smaller size and complex shaped parts setting up a fine finish prior to cut buffing as well as possible eliminating the cut buff process.

The Cut buff is the coarse buff process. The cut buff removes the fine polishing lines, producing a smoother line finish that the finish/color buff can remove. The cut buff is the more difficult buff process requiring more time and effort to accomplish and causing higher operator fatigue. Buffs wheels are constructed of cloth, treated cloth, sisal, and synthetic materials. The buff is sewn and constructed in many different ways. Stiffer buffs are better for cutting and finishing flat surfaces.

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5. CONCLUSION

5.1 Conclusion:

Hence by using multipurpose buffing machine we can do buffing operation on different types of metals with ease of operation.

While concluding this part, we fill quite contended in having completed the project assignment well on time. We had enormous practical experience on the manufacturing schedules of the working project model. We are therefore, happy to state that the inculcation of mechanical aptitude proved to be a very useful purpose. We are as such overwhelmingly elated in the arriving at the targeted mission.

Undoubtedly the joint venture has had all the merits of interest and zeal shown by all of us the credit goes to the healthy co-ordination of our batch colleague in bringing out a resourceful fulfillment of our assignment described by the university.

Although the design criterion imposed challenging problems which however were welcome by us due to availability of good reference books. The selection of choice of raw materials helped us in machining of the various components to very close tolerances and thereby minimizing the level of wear and tear.

In this report, we developed a branch and bound approach which is coupled with quick,the design of control architecture was an important aspect of study because a strong interaction between the many different parts was needed. We are satisfied with our project.

5.2 Future Scope:

Nowadays, greater attention is given to the performance measures such as surface roughness and dimensional accuracy of the products by the industry. Even if the dimensions of a finished component are well within the tolerance limits, still there is lot of possibilities for rejecting the component for the lack of surface finish. The vice versa is also true. The surface roughness of any manufacturing process has become critical because of increased quality demands. Moreover, surface finish determines mechanical properties such as wear, corrosion, lubrication, electrical conductivity and fatigue behavior. Surface roughness is an important measure of the quality of a product and also greatly influences the production cost. Surface finish obtained at low cutting feeds is better than higher cutting feeds.

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