MANUFACTURING OF SPARE PARTS FOR GHORASHAL 110 MW THERMAL POWER STATION

By

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A Project Report

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C E R T I F I C A T E

This is to certify that this work has been done by me and it was not submitted elsewhere for the award of any degree or diploma or for any publication.

Supervisor *Author*

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Tapan Kumar Paul

C O N T E N T S

CONTENT (Contd.)

ABSTRACT

In Bangladesh, Power Plants are installed with the help of foreign technology and assistance. All equipments and machineries of the plants are imported at CKD form. The foreign country provides a limited amount of spare parts. So the problem arises when more spare parts are needed, which should be imported from foreign countries and it is a lengthy and cumbersome process. This project has been taken as an attempt to solve the problem by manufacturing the spare parts locally. It will ensure the timely supply of the parts and save a lot of foreign exchange. The parts which are of high usage value, and easier to manufacture were selected for investigation and their working conditions were studied. The suitable material was chosen for the selected part to manufacture them locally. Detail drawings of the parts were drawn and manufacturing process was developed. The produced part was checked for quality standards and it was seen that they were within the acceptable limit. Economic analysis was also done to evaluate viability of manufacturing the part locally.

The overall analysis shows that the local manufacture of the spare part (packing ring) is quite feasible.

Chapter -- 1

I N T R O D U C T I O N

1.1 General Introduction

1.2 Location of Power Plant and its Importance in Bangladesh

1.3 Particulars of Machineries Used

1.4 Problems Concerning the Spare Parts

1.5 Aims and Objectives

Chapter – I

I N T R O D U C T I O N

1.1 General Introduction

With the increasing demand of electricity, as it is now expanding. The necessity of uninterrupted operation of Power Plants has become vital. The Power Plants in Bangladesh plays an important role for the national economy. Power plants installed so far are not sufficient to meet the present demand. So new power plants are commissioning every year to meet the growing demand of electricity.

Keeping in mind the growing demand of electricity, it is necessary to study in detail as regards its trends of development, Proper organisation, maintenance of machineries including the procurement of spare parts.

There are many types of machines in a power plant. The machines contain various fixed, rotary and movable parts. Some of these parts wear out quickly and are subjected to replacement after regular intervals. The life of different parts are not the same. So a study is necessary to have an idea about the life of the spare parts, frequency of replacement of these parts and mode of failure.

At present 90% of the parts are imported from the foreign countries and this makes the power sector industries entirely dependent on procurement and availability of these parts from foreign sources. Moreover, a large amount of hard currency is spent for the procurement of these parts. Sometimes difficulties arise in the process of procurement of these spares. These problems would be overcome if these can be manufactured locally.

Manufacturing of the parts would require availability of the materials, the sufficient manufacturing facilities like machines, skillness of the operator etc. Also the feasibility of manufacturing the parts should be considered on economic point of view.

1.2 Location of Power Plant and its Importance in Bangladesh

Ghorasal 110 MW Thermal Power Station is located on the bank of the river Shitalakshya at 60 km from Dhaka. Here there are two units of 55 MW each. In Bangladesh all of the Power Plants are installed with the help of foreign countries in respect of machineries and technology. This power plant is from Soviet Union. They have also installed another two units of 210 MW each and two other units of same capacity will be installed soon. Being a developing country, Bangladesh has turned her eyes to the expansion of the industrial sector whose success depends on the uninterrupted power supply, which is possible only by uninterrupted operation of power plants. So if power failure takes place the industries suffer from production. Bangladesh is an agricultural country, so for mechanised cultivation and irrigation electricity plays an important role. Also the development of a country is measured by the per capita power consumption. Thus power sector plays an important role in the national economy.

1.3 Particulars of Machineries used

Machineries used in a Thermal Power Plants are broadly classified into following groups:

i. *Machineries used in the turbine house:*
Turbo Generator, Oil circulating system, Governor, Condensel Pump, Condenser, Boiler Feed pump, Flush pump, Makeup water pump, Raw-water pump, Pressure reducing unit, Deaeration system, High pressure and low pressure heaters etc.

ii. *Machineries in the Boiler house:*
Furnace, water tubes, superheater, Air preheater, Economiser I.D. fans, F.D. Fans, chimney and several pumps.

iii. *Machineries in the cooling system:*
Circulating water pump, Gas cooling pump & some drain pumps.

iv. *Machineries used in the water treatment plants:*
Several pumps & filters.

v. *Machineries used for supplying compressed air at sub-station:*
Air compressor & pressure reducing system.

vi. *Machineries in the workshop:*
Lathe, shaper, drill, pipe bender, milling machine, grinder, welding set.

vii. *Hydrogen generating unit.*
Electrolyser, receivers, some pumps and pipe lines.

At present the machineries of Ghorasal 110 MW Thermal Power Station are imported from Soviet Union.

1.4 Problems Concerning the Spare Parts

As the spare parts are imported from foreign countries it is a very lengthy process from the placement of an order, its approval from the government to the supply of the same to the power plant. Sometime unnecessary delay occurs for the approval of purchasing those parts. Also new developments are always taking place in the design of machineries, equipments & spare parts, so the supplying country cannot supply the necessary parts in time. As a result continuous maintenance of production equipments has become extremely difficult and thus adversely affecting smooth operation of the power plant and badly influencing the daily generation capacity of the whole country.

Adverse fluctuation in exchange rates have pushed up costs of imported spare parts.

The following suggestions can be given for ameliorating the above problems:

i. *Unnecessary delays should be minimized for the approval of purchasing these parts.*

ii. *The spare parts may be manufactured locally.*

1.5 Aims & Objectives

Aims and objectives of manufacturing the spare parts locally are as follows:

i. *Selection of spare parts which are not so complicated from manufacturing point of view so that they can be manufactured using local technology.*

ii. *Selection of suitable materials for the selected parts.*

iii. Determination of the operations that will be required to manufacture the parts.

iv. Analysis of economic feasibility for manufacturing the parts locally.

v. Better utilisation of our potential manpower and other resources and to save the important foreign currency.

Chapter – II

SELECTION OF SPARE PARTS AND STUDY OF THEIR WORKING CONDITIONS

2.1 Selection Criteria of Spare Parts

2.2 Working Conditions of Spare Parts

Chapter — II

SELECTION OF SPARE PARTS AND STUDY OF THEIR WORKING CONDITION

2.1 Selection Criteria of Spare Parts:

In a Thermal Power Plant, there are numerous consumable spare parts. The construction of the parts are quite different from each other. Some of the spares are simple and some are very complicated. Some criteria for the selection of spare parts are listed below:

i. The parts which are critical

ii. Fast replaceable items

iii. Simplicity in construction

iv. The availability of raw materials at reasonable cost

v. The available technology and high usage value.

For the present work the parts which are critical, easy to fabricate, raw materials available are regarded as the selection criteria of the parts.

2.2 Working Condition of the Spare Parts:

There are different types of machineries available in a Thermal Power Plant. The working temperatures and pressures are different at different machines. So the spare parts which are needed to replace, work at different working conditions. A list of selected consumable parts with their working condition and approximate price are given in the Table 2.2.1.

Table - 2.2.1

Sl.No.	Name of the Spare parts	Name of the parent machine	Approximate price (Tk.)	Working condition (Temperature, pressure, RPM)	Annual Consumption
1	Packing Ring	Feed Water Pump	10,562.00	Temp. 160°C Press.6-160 kg/cm² RPM : -	12
2.	Gasket	Feed Water Pump	12,100.00	Temp. 160°C Press.160 kg/cm² RPM : -	4
3	Gear Gasket	Feed Water Pump	12,100.00	Temp. 160°C Press. 160 kg/cm² RPM : -	4

Sl. No.	Name of the Spare parts	Name of the parent machine	Approximate price (Tk.)	Working condition (Temperature, pressure, RPM)	Annual Consumption
4.	Thread Bush	Feed Water Pump	43,390.00	Temp. 160^{0}C Pres. 160 kg/cm^2 RPM : 2970	1
5.	Discharge Disc	Feed Water Pump	45,890.00	Temp. 160^{0}C Pres. 160 kg/cm^2 RPM : -	1
6.	Front Jacket	Feed Water Pump	27,555.00	Temp. 160^{0}C Pres. 6 kg/cm^2 RPM : 2970	1
7.	Back Jacket	Feed Water Pump	22,475.00	Temp. 160^{0}C Pres. 160 kg/cm^2 RPM : 2970	1
8.	Protective Bushing	Condensot Pump	930.00	Temp. 70^{0}C Pres. 10 kg/cm^2 RPM : 960	1
9.	Protective Ring	Condensal Pump	787.00	Temp. 70^{0}C Pres. 10 kg/cm^2 RPM : 960	2
10.	Charging Plate	ABCA Compressor	632.00	Temp. 70^{0}C Pres. 40 kg/cm^2 RPM : -	26
11.	Packing Ring	ABCA Compressor	545.00	Temp. 70^{0}C Pres. 40 kg/cm^2 RPM : -	10
12.	Gasket	ABCA Compressor	16,032.00	Temp. 70^{0}C Pres. 40 kg/cm^2 RPM : -	10

Chapter – III

MATERIAL SELECTION FOR SPARE PARTS TO BE MADE LOCALLY

Chapter – III

MATERIAL SELECTION

3.1 Material Selection Criteria.

The following factors are to be taken into consideration in selecting material for the production of a specific part:

i. *Functional requirements*
ii. *Machinability*
iii. *Availability*
iv. *Cost.*

Functional Requirements.

The functional requirements are satisfied by certain mechanical and physical properties such as:

i. *Strength*
ii. *Hardness*
iii. *Toughness*
iv. *Ductility*
v. *Impact resistance*
vi. *Weight*
vii. *Resistance to wear, corrosion, friction & heat*
viii. *Electrical & thermal conductivity.*

Machinability:

Machinability concerns the relative ease with which a metal is cut by sharp tools in various operations such as turning, drilling, milling, broaching, threading, reaming, or sawing. Machinability involves the concepts of tool life and surface finish and is influenced in an important way by cutting speed, tool geometry, the cutting fluid employed, the rigidity of the workpiece, and mechanical condition of the machine tool. The characteristics of metal which influence machinability are its composition, special additions, treatment and structure. The chemical composition has a major influence, since it affects the microstructure and mechanical properties.

The selected material should be easily machinable. This requirement is related to some mechanical properties such as sufficient ductility and low hardness to permit the use of certain metal cutting tools.

For the present work, the material was selected on the basis of the following considerations:

i. Raw materials should be adequately available

ii. Cost of raw material should be low.

iii. The selected raw material should met the desired functional requirement at the minimum cost.

iv. The material should be such that it can be easily machined with existing facilities at the minimum cost.

A specific material may not have the capability to meet fully with all the desired requirements for a specific part. In many cases it may be seen that the material best suited to a given part is not available, is too expensive, or is too difficult to manufacture. The low priced material may incur high machining cost than a more expensive material. For this reason a compromise may be necessary among all the necessary requirements in selecting material to produce a part at minimum cost.

5.2 Analysis for selection of materials

The selected part to be manufactured in the present work is the Packing Ring for the Feed Water Pump. Keeping in mind the working condition and the Functional requirement of the Packing Ring it is obvious that the material selected should have good corrosion resistance, moderately high strength, good ductility etc. Also from the manufacturing point of view it should be easily machinable at low cost. The material should be adequately available. Some materials like copper base alloys, Nickel and its alloys, Aluminium and its alloys, chromium and its alloys can fulfill the condition of good corrosion resistance, but they are too expensive relative to copper base alloy like brass. Also the Aluminium base alloy has low strength and also its strength at high temperature decreases which is the working temperature (100°C) of the specified part. But brass is easily machinable at low cost. Considering the requirements of good corrosion resistance, good castability, moderate strength and ductility, good machinability and above all low cost the "Leaded Brass" is selected for the raw material of the spare parts having the following composition:

Copper	:	65%
Zinc	:	34%
Lead	:	1%

The material of the given part was brass, but its exact composition was not known. Though its exact composition may be found out by chemical test it was not done due to lack of time for the project. So keeping in mind the functional requirements the above composition was taken.

3.3 Availability of the Selected Material:-

Raw material for the manufacturing of Packing Ring has been selected as Leaded Brass. Brass blanks are available in the form of rolled stock, hot extruded, hot forged, castings, or of brazed or welded.

The selection of a suitable blank depends on the following factors:

i. Shape and size of the finished part

ii. The construction and quality of the part.

iii. Scale of production

iv. Manufacturing cost of the part.

The blank should have the shape and size as much closer as possible to those of the finished part. According to the [illegible] standard, [illegible] metallurgical industries produce brass in the form of round, square, and rectangular bar stock, plates, forged, extruded and special rolled stock and as casting. Since the part is to be produced in a ring as casting brass is suitable material for the part, because the shape and size could be attained as much closer to the finished part. If a flat rectangular plate is taken then much more material is to be

removed and also the price of the stock would be high as compared to casting since the scrap will be high.

Chapter – IV

PROCESS PLANNING IN MANUFACTURING THE PARTS LOCALLY

Chapter — IV

PROCESS PLANNING IN MANUFACTURING THE PARTS LOCALLY

4.1 Aims and Scope of Process Planning

The task of process planning is to translate design data to work instructions to produce a part or a product. It is the systematic determination of the methods by which a product is to be manufactured, economically and competitively. It synthesizes into a plan of manufacturing which includes such factors as the volume of output needed, the operations, tools and equipments necessary and estimated manufacturing costs for manufacturing the products. The plan provides specifications for the proposed manufacturing process on process sheets which designate in appropriate detail, the proper sequence of operations and the facilities and tools required.

Generally the process planning procedure includes the following steps:

i. *Analysis of part drawing and specification*

ii. *Listing of basic operations*

iii. *Selection of processes*

iv. *Determination of sequence of operations*

v. *Selection of proper machinery with allied tooling*

vi. *Selection of cutting tools and cutting conditions*

vii. *Specifying the gaging*

viii. *Estimated operation times*

ix. *Document the process plan.*

The following functions are necessary to generate a process plan:

i. *Selection of raw materials or blanks:*
   - *Shape*
   - *Dimension*
   - *Weight*
   - *Material*

ii. *Selection of processes and sequence of machining operations*

iii. *Machine tool selection*

iv. *Auxiliary functions:*
   - *Fixtures*
   - *Tools*
   - *Manufacturing specifications*
   - *Measuring instruments*

v. *Manufacturing times:*
   - *Feeds and speeds*
   - *Setup time*
   - *Lead time*
   - *Processing time*

vi. *Text generation : To produce the tabulated process plan.*

vii. *Process plan output*

   - *Process plan header*
   - *Process plan parameters*

The manufacturing process should be designed so that the specific capacities of machine tools and cutting tools are fully and correctly employed.

One of the most effective methods for speeding up production engineering is concurrent work of product design and process engineers.

4.2 Factors Affecting Process Design

The following factors directly influence the manufacturing process for machining operations-

i. The shape and size a process can produce
ii. Dimensional and geometric tolerances to be obtained
iii. Required surface finish

iv. Material removal rate
v. Material of the part and its heat treatment
vi. Planned production of the part
vii. Production capacities of the plant
viii. Relative cost
ix. Other cutting characteristics/constraints

4.3 Production Process

The production process of the parts depend on the lot size and type of product. The production process of manufacturing the parts for job shop or batch production is quite different from that of the process for mass production. The process for batch production have been discussed here.

The basic requirements of the job which could be obtained from the detailed drawings of the part are to be determined before the actual operations for the batch production is achieved. To produce a workpiece by machining one should consider the followings:

i. Size and shape of the workpiece
ii. Tolerance
iii. Surface finish

iv. Material from which part is to be machined

v. Number of pieces to be produced in a batch

Detail drawings of Packing Ring are shown in Fig. 4.5.1.

Production processes for Packing Ring are shown in Process Sheet 4.5.1.

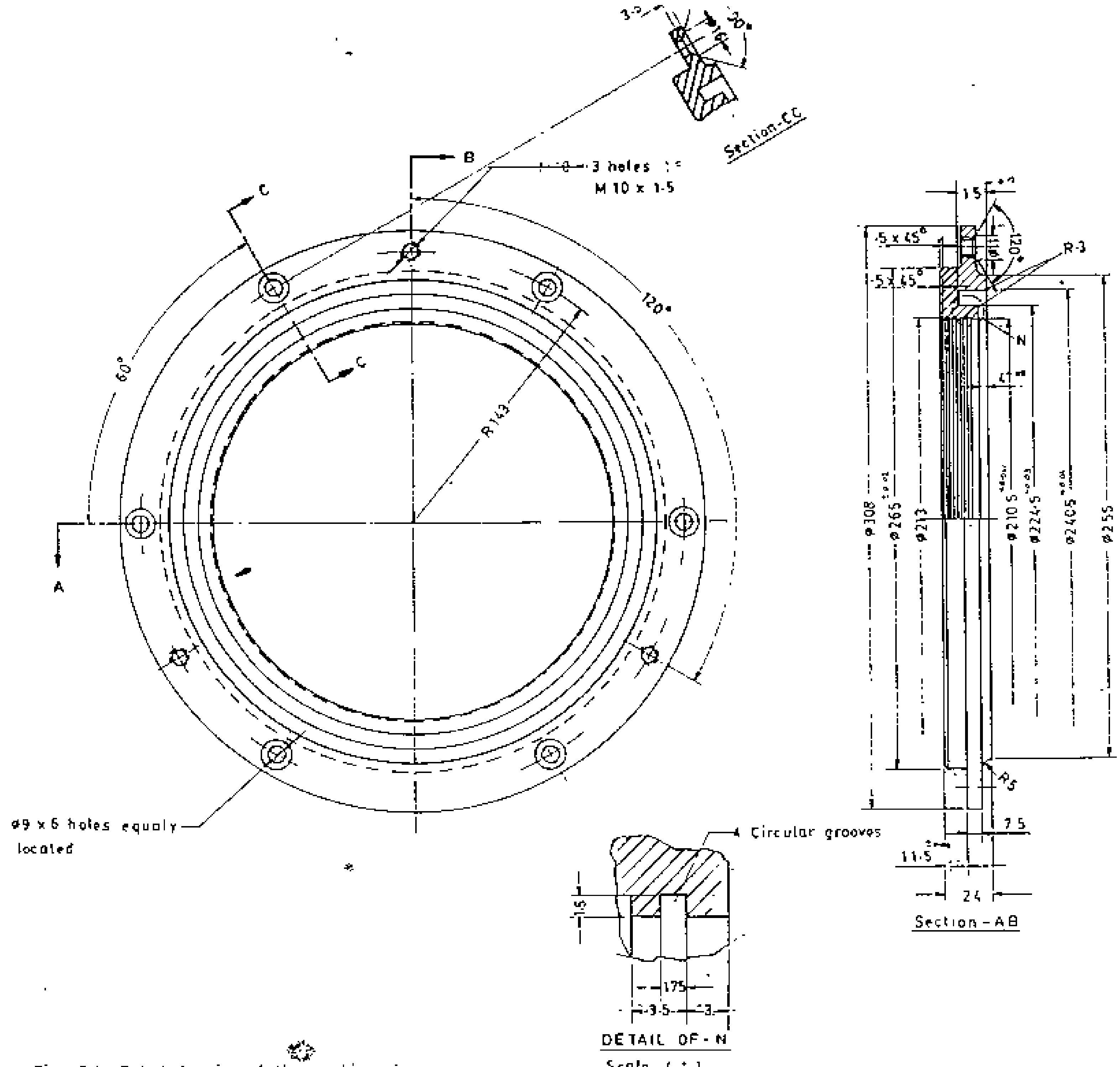
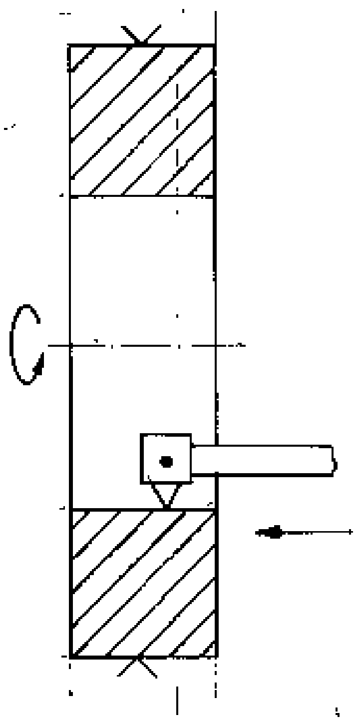
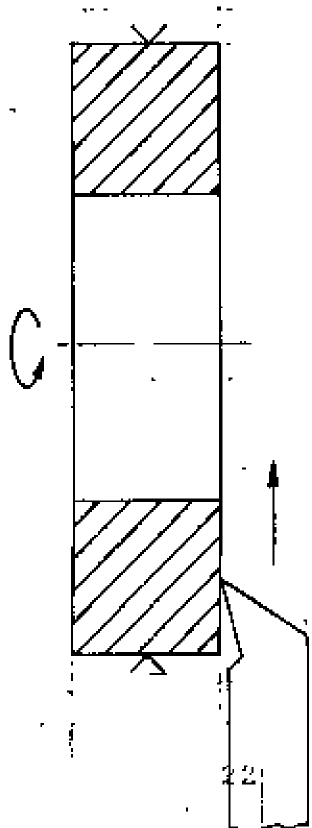


Fig 4.3.1 Detail drawing of the packing ring

SCALE - 1:2

Process sheet 4.3.1

Master operation sheet for packing ring production

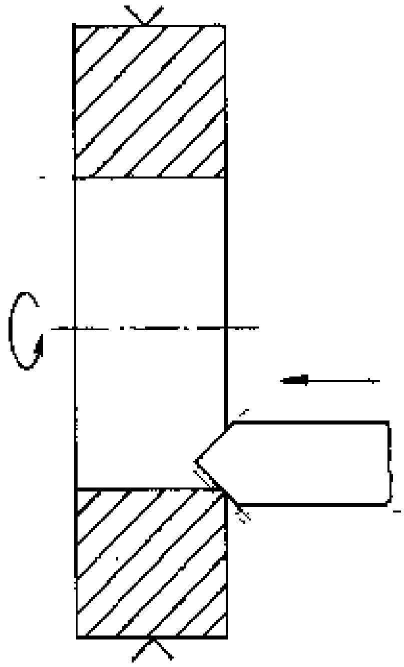
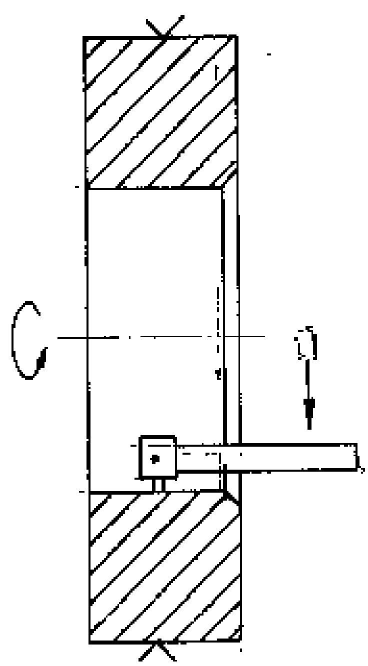
Sl. No.	Name of the operation	Sketch	Machine & Tools	Depth of cut (in.)
1	2	3	4	5
1.	Boring		Lathe, Boring tool	0.04
2.	Facing		Lathe, Single point HSS tool	0.04

Process sheet 4.3.1 (Contd.)
Master operation sheet for packing ring production

R.P.M.	Speed sfpm	Feed ipr	Tool travel inch	Machining time, min.
6	7	8	9	10
124	300	0.01	1.181 (3 passes)	2.857
124	350	0.01	2.126 (3 passes)	5.144

Process sheet 4.3.1 (Contd.)

Master operation sheet for packing ring production

Sl. No.	Name of the operation	Sketch	Machine & Tools	Depth of cut (in.)
3.	Chamfering		Lathe HSS tool with φ 45°	–
4.	Grooving		Lathe, HSS parting tool, width 1.75 mm	–

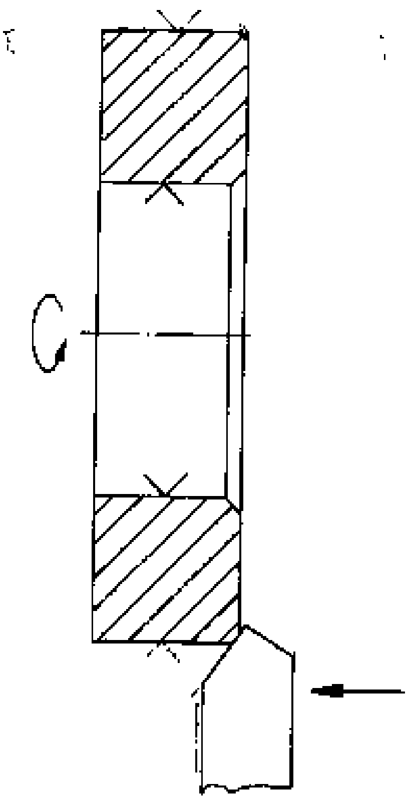
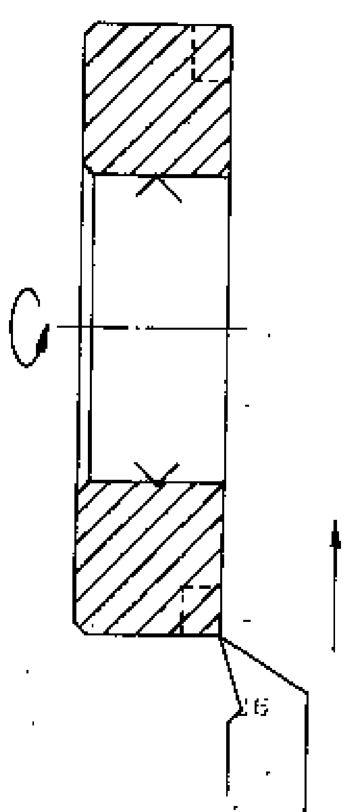
Process sheet 4.3.1 (Contd.)

Master operation sheet for packing ring production

R.P.M.	Speed sfpm	Feed ipr	Tool travel inch	Machining time, min.
124	300	0.01	0.02 (Single pass)	0.016
124	275	0.01	0.06 (single pass, four grooves to be cut)	0.15

Process sheet 4.3.1 (Contd.)

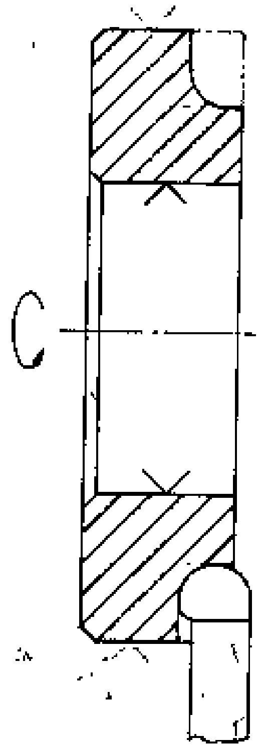
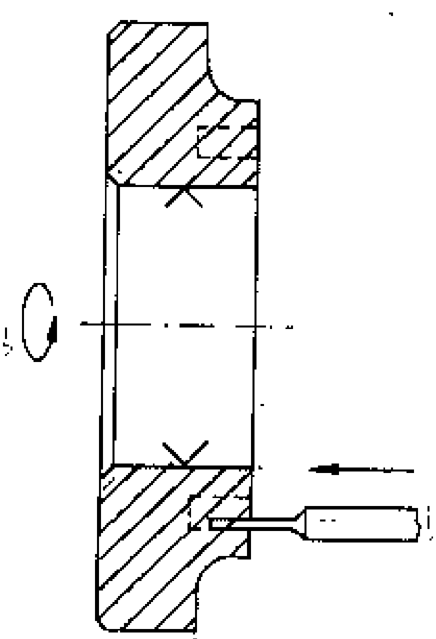
Master operation sheet for packing ring production

Sl. No.	Name of the operation	Sketch	Machine & Tools	Depth of cut (in.)
5.	Turning		Lathe, Straight turning tool (HSS)	0.04
6.	Turning		Lathe, Single point HSS tool	0.07

Process sheet 4.3.1 (Contd.)
Master operation sheet for packing ring production

R.P.M.	Speed sfpm	Feed ipr	Tool travel inch	Machining time, min
76	300	0.01	1.062 (5 passes)	4.196
76	275	0.013	0.886 (5 passes)	2.690

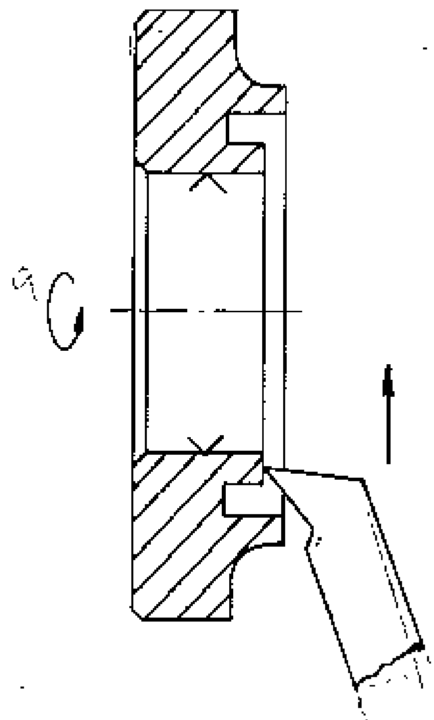
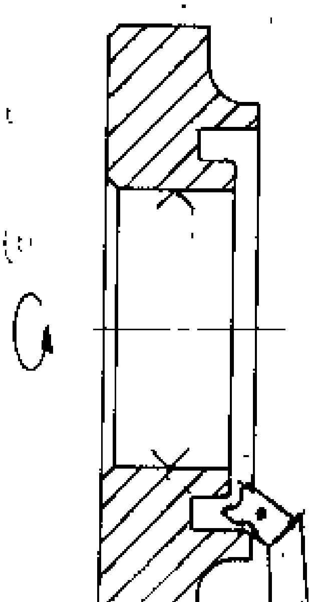
Process sheet 4.3.1 (Contd.)
Master operation sheet for packing ring production

Sl. No.	Name of the operation	Sketch	Machine & Tools	Depth of cut (in.)
7.	Turning (Radial)		Lathe, Curved-edge HSS form tool, R = 5 mm	–
8.	Grooving		Lathe, Cut off or parting tool (HSS) 3 mm width	0.12

Process sheet 4.3.1 (Contd.)
Master operation sheet for packing ring production

R.P.M.	Speed sfpm	Feed ipr	Tool travel inch	Machining time, min.
97	275	0.005	0.197 (single pass)	0.406
97	250	0.02	0.591 (3 passes)	0.913

Process sheet 4.3.1
Master operation sheet for packing ring production

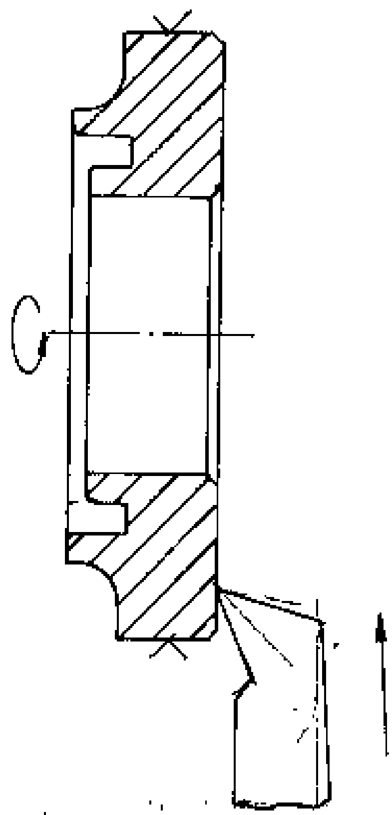
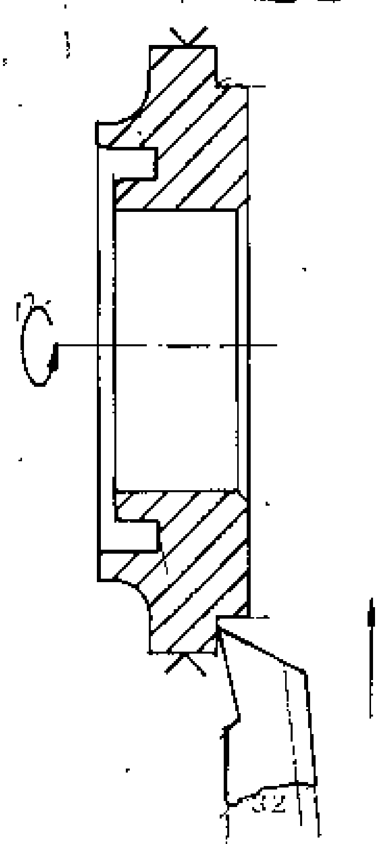
Sl. No.	Name of the operation	Sketch	Machine & Tools	Depth of cut (in.)
9.	Facing		Lathe, Single point HSS tool	0.09
10.	Radial cut		Lathe, HSS radial form tool	-

Process sheet 4.3.1 (Contd.)
Master operation sheet for packing ring production

R.P.M.	Speed sfpm	Feed ipr	Tool travel inch	Machining time, min
97	250	0.015	0.276 (2 passes)	0.379
97	275	0.015	–	–

Process sheet 4.3.1

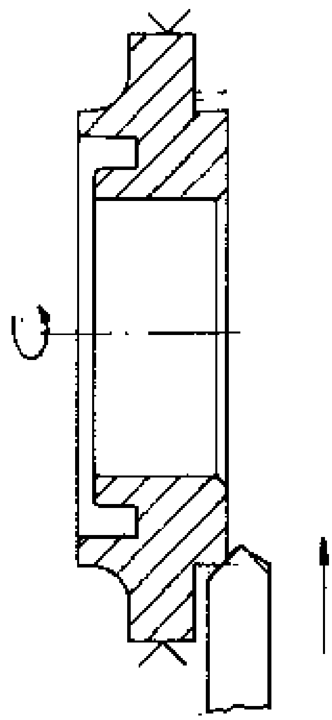
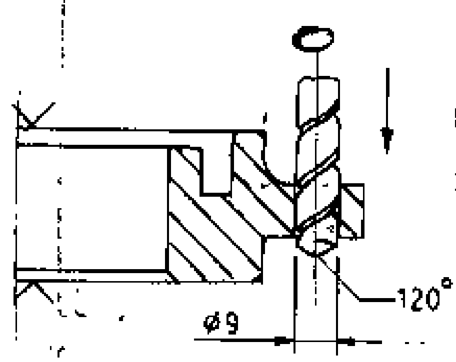
Master operation sheet for packing ring production

Sl. No.	Name of the operation	Sketch	Machine & Tools	Depth of cut (in.)
11.	Facing		Lathe, HSS single point tool	0.04
12.	Turning		Lathe, Single point HSS tool	0.12

Process sheet 4.3.1 (Contd.)
Master operation sheet for packing ring production

R.P.M.	Speed sfpm	Feed ipr	Tool travel inch	Machining time,min.
97	300	0.01	1.929 (3 passes)	5.966
97	275	0.025	0.846 (4 passes)	1.396

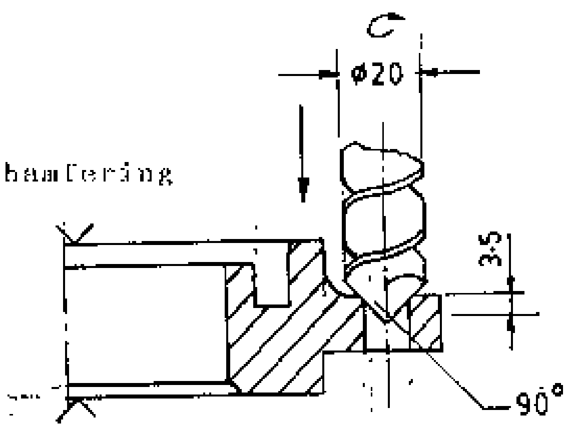
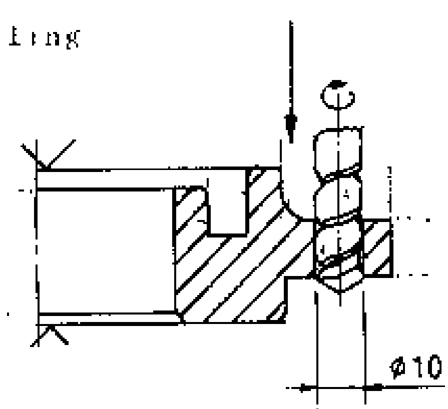
Process sheet 4.3.1
Master operation sheet for packing ring production

Sl. No.	Name of the operation	Sketch	Machine & Tools	Depth of cut (in.)
13.	Chamfering		Lathe, HSS tool $\varphi = 45^{\circ}$	--
14.	Drilling		Drill m/c HSS drill bit ϕ 9mm Point angle 120°	--

Process sheet 4.3.1 (Contd.)
Master operation sheet for packing ring production

R.P.M.	Speed sfpm	Feed ipr	Tool travel inch	Machining time,min.
97	275	0.01	0.02 (single pass)	0.02
1360	150	0.008	0.492 (6 holes to be drilled)	0.271

Process sheet 4.3.1
Master operation sheet for packing ring production

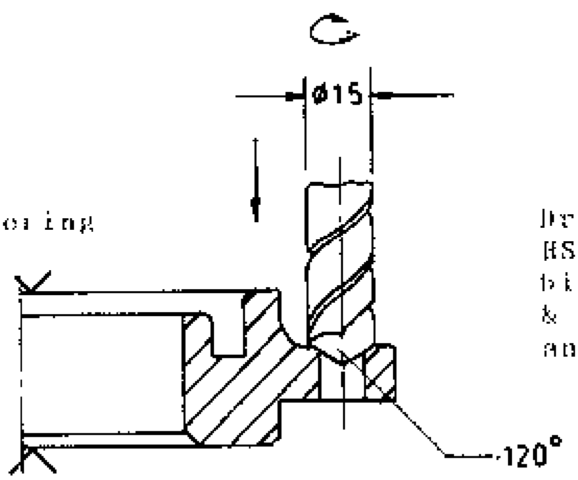
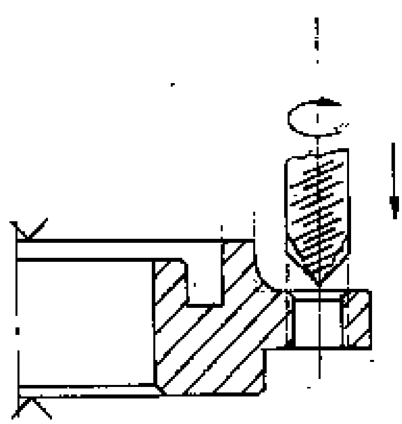
Sl. No.	Name of the operation	Sketch	Machine & Tools	Depth of cut (in.)
15.	Chamfering		Drill m/c HSS drill bit ф 20mm & point angle 90°	-
16.	Drilling		Drill m/c HSS drill bit ф 10mm & point angle 120°	-

Process sheet 4.3.1 (Contd.)
Master operation sheet for packing ring production

R.P.M.	Speed sfpm	Feed ipr	Tool travel inch	Machining time
1360	250	0.016	0.138 (6 holes to be chamfered)	0.038
1360	150	0.008	0.492 (3 holes to be drilled)	0.136

Process sheet 4.3.1

Master operation sheet for packing ring production

Sl. No.	Name of the operation	Sketch	Machine & Tools	Depth of cut (in.)
17.	Chamfering		Drill m/c HSS drill bit Φ15mm & point angle 120°	-
18.	Tapping		Manual Tap M10 x 1.5	-

Process sheet 4.3.1 (Contd.)
Master operation sheet for packing ring production

R.P.M.	Speed sfpm	Feed ipr	Tool travel inch	Machining time
1360	200	0.01	– (3 holes to be chamfered)	–
–	–	–	–	1.0

Chapter — V

ECONOMIC ANALYSIS

5.1 Cost Factors

5.2 Standard Time and Machining Time

5.3 Determination of Cost of Production for the Packing Ring

Chapter — V

ECONOMIC ANALYSIS

5.1 Cost Factors

Complete costs incurred in the manufacturing enterprise are usually segregated into two broad groups: manufacturing cost (the cost of actual fabrication of the product, elements of which are material, labor, factory expense, and manufacturing engineering), and nonmanufacturing cost (those further costs incident to business operations such as selling or distribution, legal, financial, and administration expenses).

Manufacturing Costs:

Elements of manufacturing cost are:

i. Material cost (direct and indirect)
ii. Labor cost (direct and indirect)
iii. Manufacturing overhead.

Direct material costs are the costs for materials that are directly traceable to the finished product.

Indirect material includes purchased materials used in quantities too small to be readily identified with units of product, such as solder, lubricant, coolant etc., and is usually considered as shop supplies and included in cost as a part of the manufacturing overhead rate.

Direct labour cost is all factory labour identifiable with the conversion of materials into finished goods, and usually includes only those people who work directly on the product or on machines that produce it. Indirect labour cost includes payments to or on behalf of direct employees for overtime and nightwork premiums; for vacations, holidays, and other absences; for insurance, retirement benefit, and other "fringe" costs. Indirect labour may be included in cost either as a markup of direct labour or as part of manufacturing overhead.

Manufacturing overhead consists of all expenditures considered applicable to manufacturing operations which cannot be assessed directly to cost of the product but are apportioned to cost through the use of overhead rates. Some of the more significant types of manufacturing expense are employment costs (salaries and fringe costs) of expense employees, supplies, expense tools, repairs, depreciation, taxes, insurance, heat, light and power. Overhead rates are compiled by relating the expense to a distribution base. This base may be labor-hours, machine-hours, units of product or other practical units.

Besides, administration, selling and distribution, transportation and finance expenses are common to all manufacturing firms.

Total Cost:

If manufacturing costs are added together with the Administration, Selling and Distribution, and Finance expenses, the resulting figure is known as total cost.

To summarise:

	Direct Materials
Add	Direct Labour
Add	Direct Expenses
Gives	PRIME COST
Add	Factory Indirect Expenses
Gives	MANUFACTURING COST
Add	Administration Expenses
Add	Selling and Distribution Expenses
Add	Finance Expenses
Gives	TOTAL COST

5.9 Standard Time and Machining Time

When the tools have been selected feeds, speeds, setup times, cut times, tool changing times, and tool life have to be determined. These parameters will be affected by the material to be cut, the cutting tool, machining parameters, and the design of the machine tool. The cutting speed, feed and depth of cut to be used can be obtained in various handbooks.

Standard time is the time required for machining a workpiece in accordance with the capacities of the machine tools. The standard time (per piece) is determined from the following formula.

$$T_p = T_m + T_h + T_t \left(\frac{T_m}{T_l} \right)$$

where T_p = Standard time (per piece), min.

T_m = Machining time, min.

T_h = Work handling time, min.

T_t = Tool changing time, min.

T_l = Tool life.

T_m is the time during which machining is being performed to change the size and form or the state of the workpiece surfaces.

T_h is the time required to control the machine tool, for loading and unloading the workpiece, to make measurements and for advancing and retracting the tools for certain elements.

The sum of $T_m + T_h$ is called the cycle time. T_t is the time required for changing the dull tools and in sharpening the tools.

T_l is the tool life and is obtained from a modified Taylor equation:

$$T_l = \frac{c}{v^{\alpha} f^{\beta} d^{\gamma}}$$

where,

- v = cutting speed
- f = feed rate
- d = depth of cut
- c = machinability factor
- α = speed exponent
- β = feed rate exponent
- γ = depth of cut exponent.

The factors c, , , are obtained from experiments and are published in handbooks.

For batch production, (Ref. 16)

10 - 20%	of T_p	=	Machining time
60 - 80%	of T_p	=	Auxiliary time
6 - 8%	of T_p	=	time required for rest
2 - 4%	of T_p	=	time required for adjustment

In lathe work T_m can be calculated by the formula

$$T_m = \frac{L}{n\ f} \times i \quad \text{min.}$$

where,

L = Tool travel in the direction of the feed motion, inch.
n = Speed of workpiece (spindle), rpm.
f = feed rate, inch per rev., ipr.
i = number of passes, or cuts.

Again, Tool travel is made up of

$$L = l + \Delta$$

where,

l = length of machined surface in the direction of feed motion, inch.
Δ = tool overtravel and approach, inch.
= .04 – .06 inch.

In drilling T_m can be calculated from the formula

$$T_m = \frac{L}{n\ f} \quad \text{min.}$$

where,

L = Tool travel in the direction of feed motion, inch
n = spindle speed, rpm
f = feed rate ipr.

In calculating L, tool overtravel should be considered so that the taper point of the drill bit clears off the workpiece.

5.3 Determination of Cost of Production for Packing Ring

1. Material Cost:

Cost/kg of normal brass (as cast) = Tk.100

Volume of the workpiece for Packing Ring =

$$\frac{\pi}{4}(d_1^2 - d_2^2)L$$

$$= \frac{\pi}{4}(314^2 - 204^2)\frac{30}{1000} = 1342.56 \text{ cm}^3.$$

(Stock allowance is taken as 3mm on all sides for casting brass)

Weight of the workpiece = 1342.56 x 8.5

= 11411.76 gm.

(Density of brass 8.5 gm/cm^3)

Cost of material/piece = $\frac{11411.76}{1000}$ x 100 = Tk.1141.18

2. Machining Cost:

Lathe operation (Turning, Facing, Boring, Grooving Chamfering)	= 24.133 min.
Drilling operation (Drilling, Chamfering)	= 0.445 min.
Tapping (Manually)	= 1.00 min.
Total	= 25.578

$$\text{Total time required/piece} = \frac{25.578}{0.10} = 255.78 \text{ min.}$$

$$= 4.263 \text{ hr.}$$

(Machining time = 10% of total time)

Lathe and Drilling machine OH	= Tk.35/hr.
Direct labour	= Tk.12.5/hr.
Total	= Tk.47.5/hr.

∴ Cost/piece = 47.5 x 4.263 = Tk.202.50

Manufacturing overhead = Tk.30/hr.
(Based on the information available from the Accounts Dept. of Power Station)

Manufacturing OH/piece = 30 x 4.263 = Tk.127.89

Manufacturing cost/piece = Material cost + labour cost + Manufacturing OH.

(1141.18 + 202.50 + 127.89) = Tk. 1471.57

Other Non Manufacturing Cost:

Administration cost/day (Based on the information available from the Accounts Dept. of Power Station)	= Tk.400.00
Miscellaneous cost/day	= Tk. 50.00
Total =	Tk.450.00

$\therefore$ Manufacturing cost/piece $= \frac{450 \times 4.263}{8}$

$= 239.79$ (8 hrs. a day)

$\therefore$ Total cost/piece = (Manufacturing cost/piece + Non manufacturing cost/piece)

= (1471.57 + 239.79)

= Tk.1711.36

The imported cost of the Packing Pipe/Piece is Tk.10862.00, but for the production of the same work part locally is Tk.1711.36, so the local manufacture of the spare parts can save Tk.9150.64 per piece.

For eight hour of working day and 26 working days a month.

Annual production $= \frac{12 \times 26 \times 8}{4.263}$

= 585 pcs

Annual savings = 585 x 9150.64 = Tk.5353124.4

Since a large number of different spare parts could be produced locally, so the machines (Lathe & drill) may be engaged throughout the year in producing similar parts and a net savings of TK.5553124.4 could be achieved.

Chapter — VI

CONCLUSIONS AND SCOPE OF FUTURE WORK

Chapter – VI

CONCLUSIONS AND SCOPE OF FUTURE WORK

6.1 Conclusions:

From the present work the following conclusions can be drawn:

1. The Gland Packing Ring for the Feed Water Pump was selected on the basis of simplicity in construction and availability of raw material so that it became possible to produce it by using our local manufacturing technology.

2. The raw materials for the parts were selected by considering the following factors:

   a. Functional requirements
   b. Cost
   c. Availability
   d. Machinability

   In this work it was seen that the cost of the raw material is the most prominent among the cost factors so in selecting the material it was given the foremost priority.

3. For the actual production of the selected spare parts two possible manufacturing methods were studied and batch production was chosen because the consumption rate of the selected part is not so high. In the present work the master process sheet for the manufacturing of the Packing Ring was developed, where sequence of operations together with their sketches and cutting conditions were precisely described. From the regular study of this practice an efficient manufacturing process was developed for higher productivity and the quality of the product was improved.

4. Considering the constant input variables, constant production rate and constant consumption rate, the economic analysis for the production of Packing Ring was done. In calculating the machining time the tool approach and overtravel were ignored for simplicity in calculations. The manufacturing overhead and the administrative expenses were based on the informations supplied by the accounts department of Ghorashal Power Station. It was observed that the net profit of Taka 55.55 lac can be obtained per year. The figure is abnormally high, but it can be

justified by the fact that these spares are imported from the same company of Soviet Union and their price is very high.

5. Thermal Power Plants require a lot of spare parts of different materials and their manufacturing processes are quite different. From this project it was seen that it is not possible to manufacture all the parts locally due to the limited technical facilities and lack of experience of the engineers and technicians. But the manufacturing process, material composition and the heat treatment of some parts are such that they can be manufactured using local technology.

6. The item Packing Ring was produced and it was observed that its tolerance limit was not exceeded and it can serve the purpose accurately as recommended by the Power Station personnel. So the local manufacture of spare parts for the Thermal Power Plants in Bangladesh is technologically feasible.

7. The implementation of manufacturing the spare parts locally have facilitated the utilization of local resources e.g. man, machine, material which is very important in a developing country like Bangladesh.

8. So with a view to save a huge amount of foreign exchange and to ensure timely supply of spare parts the local manufacture of the parts can be considered economically feasible for the country. The study indicates that the spares which could be manufactured with local technology should be done without delay.

6.2 Scope of Future Work:

The feasibility study for the manufacturing of spare parts was carried on some limited conditions so there exists a greater scope for development and improvement when the conditions are relaxed. the scope for developing the project in future work are as follows:

i. The study can be extended for other parts of the plant.

ii. The parts may be selected for manufacturing in order of their importance.

iii. The actual material composition of the parts can be determined by destructive tests.

iv. Materials can be selected by detail analysis of all the criteria such as availability, functional requirements, machinability, cost, etc., and a compromise should be done to select a suitable material at low cost. It is not necessary to have an exact compositon of the original part for local manufacture.

v. Process planning may be computerized to get an efficient manufacturing method from the data available for the similar parts. If the part is a new one, the plan can be used with some change.

vi. The productivity can be analysed by the time-motion study in which case the manufacturing time can be standardized.

vii. The quality of a new product can be improved by finding out the faults of the existing product, so for future study this project could be the milestone.

viii. Economic order quantity, reorder point and Break-even point can also be found for both the raw materials and the finished goods to keep the cost of the spares minimum.

ix. The study may be done in other industries which also uses imported spare parts for its machineries.

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