Design and Fabrication of

MULTI-DRILL HOLDER

A Project Report

Submitted by

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in partial fulfillment of the requirement in the subject of

(ME1357) Design and Fabrication Project

Under the guidance of
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BONAFIDE CERTIFICATE

Certified that this project report entitled "**Design and Fabrication of a MULTI-DRILL HOLDER**" is the bonafide work of

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The Report of the project work submitted by the above students in partial fulfillment of the award of Bachelor of Engineering degree in Mechanical Engineering of Anna University were evaluated and confirmed to be report of the work done by them

(INTERNAL EXAMINER) (EXTERNAL EXAMINER)

SYNOPSIS

MULTI-DRILL HOLDER

The **MULTI DRILL HOLDER** (Eccentric Drive) is one which can be used to drill a number of holes at various large and even unsymmetrical layouts according to our requirements, where the conventional Multi spindle Drill Heads cannot be used. This is an improvement over geared drill heads and drill heads adopted with universal joints. This is an improvement over geared drill heads and drill heads adopted with universal joints.

The drill head is mounted on the drilling machine table. The drill head spindle is inserted in to the machine spindle. It is used to drill a number of holes in different layouts according deals with a proper idea of usage of eccentrics in the field of drilling. The report furnishes a cost estimation of all the components of the equipment by careful considerations of all factors such as cost of material, labour, machining and purchased components.

ACKNOWLEDGEMENT

At the very outset we are very much grateful to the GOD almighty for the blessings showered upon us to complete the project work.

We are highly indebted to our beloved principal, **Dr. Joseph V Thanikal, B.E., M.E., Ph.D., PDF., CEPIT**, for blessing us and providing the various facilities in completion of this project.

We convey our profound thanks and gratitude to **Dr. C. Sivanandan,** Professor & Dean of the Department of Mechanical Engineering, for providing us an excellent opportunity to carry out this mini-project.

We earnestly thank **Mr. B. Senthilkumar,** Project Guide without whose consent we would have been unable to proceed with our project.

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Last but not least, we convey our thanks to all the faculty members of the Department of Mechanical Engineering, our parents and our friends for the help during our project.

CONTENTS

CHAPTER-1

PROJECT PLANNING

The Concept of project work before starting every project, its planning is done. Planning is a very important task and should be taken up should be taken up with a great care, as the efficiency of the whole project largely depends upon its planning. While planning the project, each and every detail should be worked out in anticipation and all the relative provisions should be carefully considered in advance.

Project planning consists of the following steps:

a. **Project capacity:**

The capacity of the project must be decided, considering the amount of money which can be invested and the availability of material and machines.

b. **Design and Drawing:**

Having been decided about the project to be manufactured, it must be designed. The work of the design should be done very carefully considering all the relevant factors.

After designing the project its detailed drawings are prepared so that no doubts are left for future. detailed specifications of raw materials and finished products should be decided carefully along with the specifications of the machine required for their manufacture.

c. **Materials Requirement:**

The list of materials requirement is prepared from the drawings. This list is known as **"BILL OF MATERIALS"**. This passes to the store keeper and the required materials are taken from the store under permission of the store keeper.

d. **Operation Planning:**

Next work of planning is to select the best method of manufacture, so as to eliminate the wastage of materials, labour, machine, time etc.. Machine tools used to do the job are considered while planning the operation. After considering the above questions, a best method is developed and applied.

e. **Purchase consideration:**

It is difficult to manufacture all the components needed for the project in machine shop. The decision about a particular item whether to purchase or to manufacture, is taken by planning after making a thorough study of relative merits and demerits.

f. **Cost Estimations:**

The cost of the product can be estimated by adding the following:

1. Material Cost.
2. Labour Cost.
3. Over head expenses.

g. **Report:**

At the end of the project report is prepared for future references. The project report consists of all the items done during the project work.

CHAPTER-2

INTRODUCTION

The very essence of our economic life and growth is dependent in a great part upon the continued improvement of Electronic and Mechanical fields.

To aid these fields, we have designed **MULTI SPINDLE DRILL HEAD** [Eccentric Drive] which can be widely used to drill products like printed Circuit Boards, Engine heads and other Automobile components.

Extreme care should be there to drill multi holes at different layouts. The **MULTI SPINDLE DRILL HEAD** [Eccentric Drive] helps to achieve accurate and identical drilled layouts in mass production.

We have designed this **MULTI SPINDLE DRILL HEAD [Eccentric Drive]** model to drill five holes of various diameters in an un-symmetrical layout. In case of drilling large layouts in mass production, we can apply this type of drill head.

CHAPTER-3

History

The earliest drills were bow drills which date back to the ancient Harappans and Egyptians. The drill press as a machine tool evolved from the bow drill and is many centuries old. It was powered by various power sources over the centuries, such as human effort, water wheels, and windmills, often with the use of belts. With the coming of the electric motor in the late 19th century, there was a great rush to power machine tools with such motors, and drills were among them. The invention of the first electric drill is credited to Mr. Arthur James Arnot and William Blanch Brain, in 1889, at Melbourne, Australia. Wilhelm Fein invented the portable electric drill in 1895, at Stuttgart, Germany. In 1917, Black & Decker patented a trigger-like switch mounted on a pistol-grip handle.

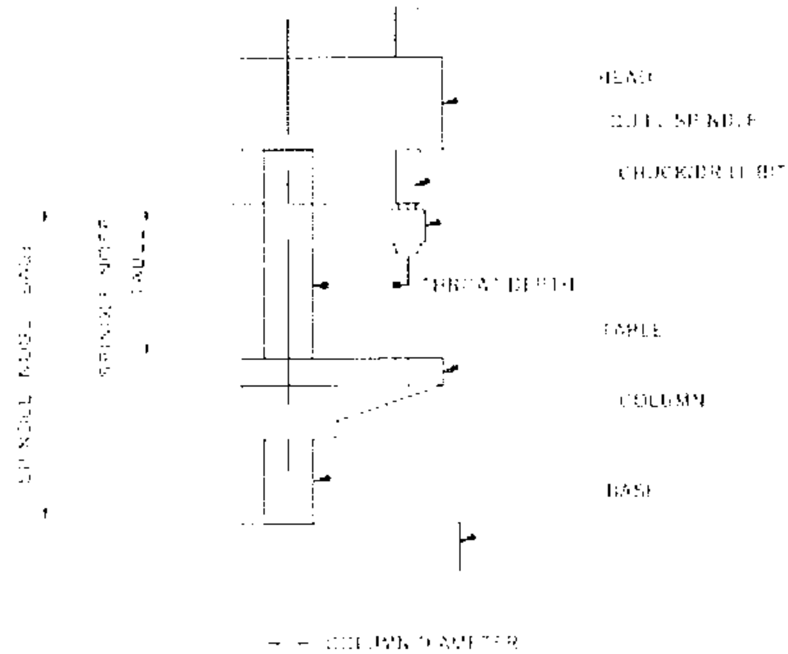
CHAPTER-4

BASICS OF DRILLING

Drilling Process:

The drilling machine (drill press) is a single purpose machine for the production of holes. Drilling is generally the best method of producing holes. The drill is a cylinderical bar with helical flutes and radial cutting edges at one end. The drilling operation simply consist of rotating the drill and feeding it into the workpiece being drilled.

The process is simple and reasonably accurate and the drill is easily controlled both in cutting speed and feed rate. The drill is probably one of the original machining processes and is the most widely used.

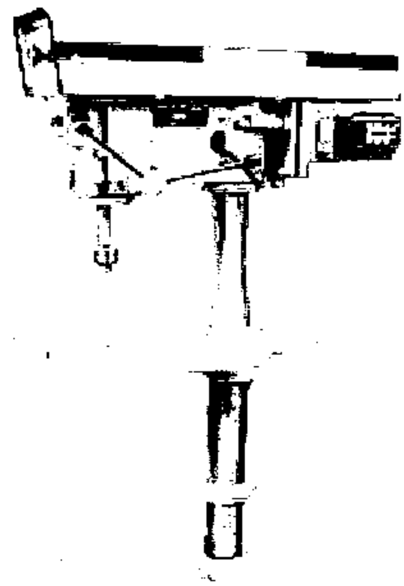


There are many different types or configurations of drilling machines, but most drilling machines will fall into four broad categories:

- Upright Sensitive.
- Upright.
- Radial, and
- Special Purpose.

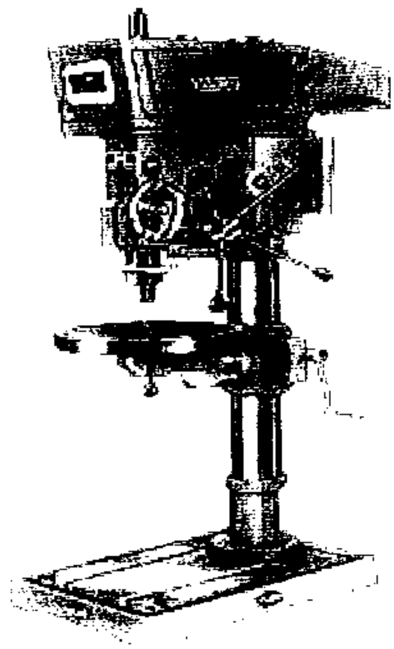
Upright Sensitive Drill Press:

The upright sensitive drill press is a light-duty type of drilling machine that normally incorporates a belt drive spindle head. This machine is generally used for moderate-to-light duty work. The upright sensitive drill press gets its name due to the fact that the machine can only be hand fed. Hand feeding the tool into the workpiece allows the operator to "feel" the cutting action of the tool. The sensitive drill press is manufactured in a floor style or a bench style.



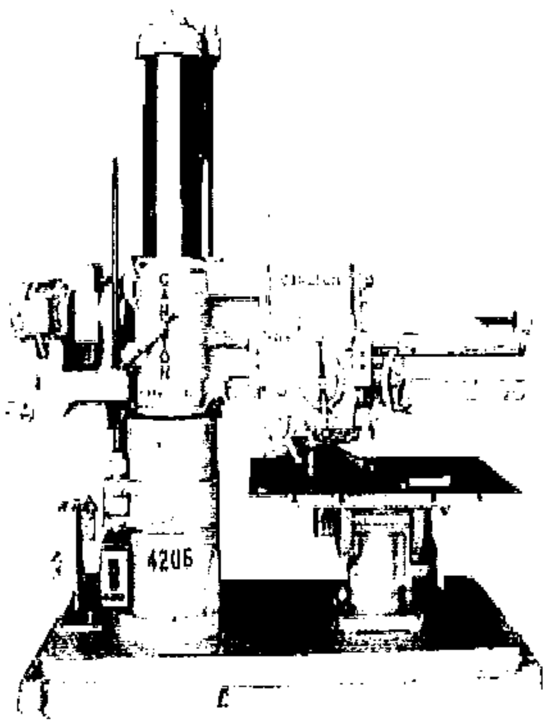
Upright Drill Press:

The upright drill press is a heavy duty type of drilling machine normally incorporating a geared drive spindle head. This type of drilling machine is used on large hole-producing operations that typically involve larger or heavier parts. The upright drill press allows the operator to hand feed or power feed the tool into the workpiece. The power feed mechanism automatically advances the tool into the workpiece. Some types of upright drill presses are also manufactured with automatic table-raising mechanisms.



Radial Arm Drill Press:

The radial arm drill press is the hole producing work horse of the machine shop. The press is commonly refered to as a radial drill press. The radial arm drill press allows the operator to position the spindle directly over the workpiece rather than move the workpiece to the tool. The design of the radial drill press gives it a great deal of versatility, especially on parts too large to position easily. Radial drills offer power feed on the spindle, as well as an automatic mechanism to raise or lower the radial arm. The wheel head, which is located on the radial arm, can also be traversed along the arm, giving the machine added ease of use as well as versatility. Radial arm drill presses can be equipped with a trunion table or tilting table. This gives the operator the ability to drill intersecting or angular holes in one setup.

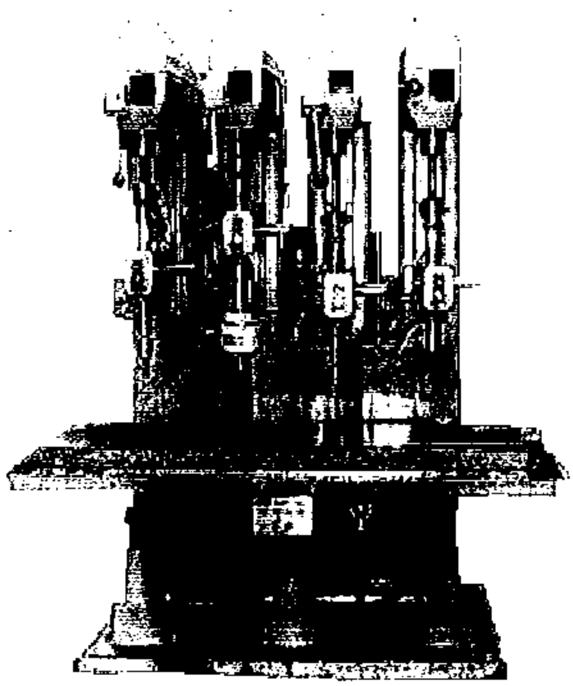


Special Purpose Machines:

There are a number of types of special purpose drilling machines. The purposes of these types of drilling machines vary. Special purpose drilling machines include machines capable of drilling 20 holes at once or drilling holes as small as 0.01 of an inch.

Gang Drilling Machine-

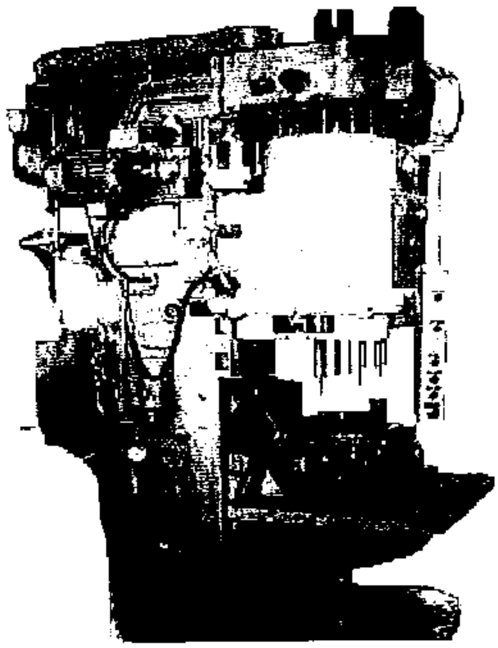
The gang style drilling machine or gang drill press has several work heads positioned over a single table. This type of drill press is used when successive operations are to be done. For instance, the first head may be used to spot drill. The second head may be used to tap drill. The third head may be used, along with a tapping head, to tap the hole. The fourth head may be used to chamfer.



Multiple Spindle Drilling Machine:

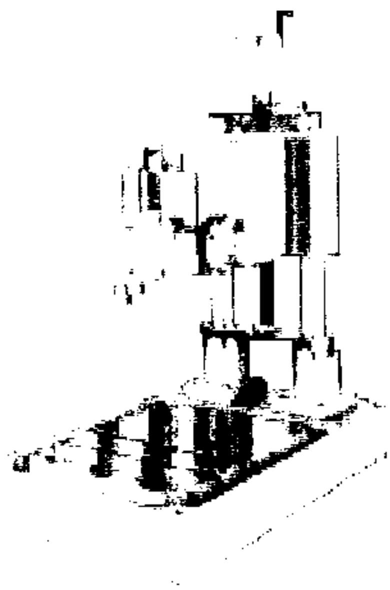
The multiple spindle drilling machine is commonly refered to as a multispindle drill press. This special purpose drill press has many spindles connected to one main work head.

All of the spindles are fed into the workpiece at the same time. This type of drilling machine is especially useful when you have a large number of parts with many holes located close together.



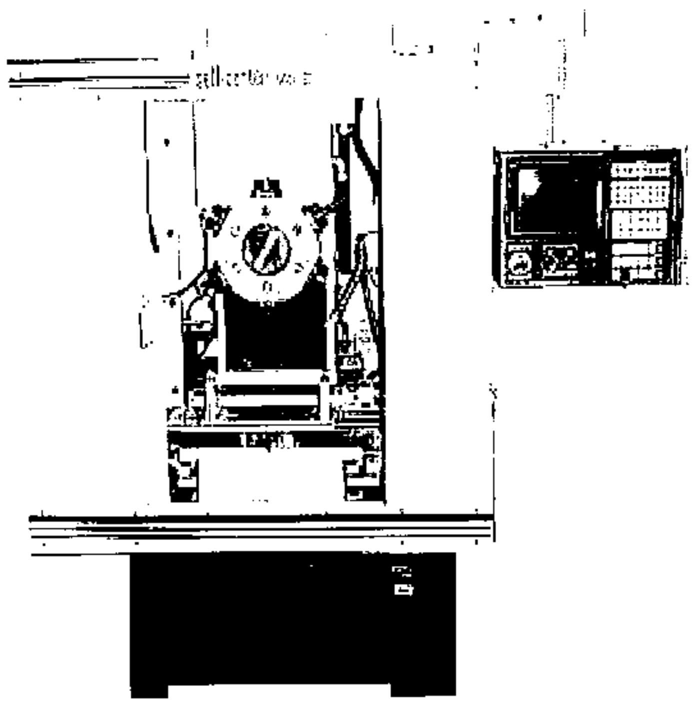
Micro Drill press:

The micro drill press is an extremely accurate, high spindle speed drill press. The micro drill press is typically very small and is only capable of handling very small parts. Many micro drill presses are manufactured as bench top models. They are equipped with chucks capable of holding very small drilling tools.



Turret Type Drilling Machine:

Turret drilling machines are equipped with several drilling heads mounted on a turret. Each turret head can be equipped with a different type of cutting tool. The turret allows the needed tool to be quickly indexed into position. Modern turret type drilling machines are computer-controlled so that the table can be quickly and accurately positioned.



CHAPTER-5
DRILLING OPERATIONS

- Drilling
- Counterboring
- Boring
- Countersinking
- Spot facing
- Tapping

Drill is used then the same effect can be achieved by stoning a small flat parallel with the axis of the drill bit.

For heavy feeds and comparatively deep Under normal usage, swarf is carried up and away from the tip of the drill bit by the fluting. The continued production of chips from the cutting edges produces more chips which continue the movement of the chips outwards from the hole. This continues until the chips pack too tightly, either because of deeper than normal holes or insufficient (removing the drill slightly or totally from the hole while drilling). Lubricants and coolants backing off (i.e. cutting fluid) are sometimes used to ease this problem and to prolong the tools life by cooling and lubricating the tip and chip flow. Coolant is introduced via holes through the drill shank.

Straight fluting is used for copper or brass, as this exhibits less tendency to "dig in" or grab the material. If a helical drill (twist holes oil-hole drills can be used, with a lubricant pumped to the drill head through a small hole in the bit and flowing out along the fluting. A conventional drill press arrangement can be used in oil-hole drilling, but it is more commonly seen in automatic drilling machinery in which it is the workpiece that rotates rather than the drill bit.

Counterbore can refer to a cylindrical flat-bottomed hole, which enlarges another hole, or the tool used to create that feature. It is usually used when a bolt or cap head screw is required to sit flush with or below the level of a workpiece's surface (By comparison, a countersink makes a conical hole and is used to seat a flathead screw). A very shallow counterbore, such as one machined on a cast part to provide a flat surface for a fastener head, may also be called a spotface.

The uppermost counterbores shown in the image are the same tool. The smaller top item is an insert, the middle shows another three-fluted counterbore insert, assembled in the holder. The shank of this holder is a morse taper although there are other machine tapers that are used in the industry. The lower counterbore is designed to fit into drill chuck, and being smaller, is economical to make as one piece.

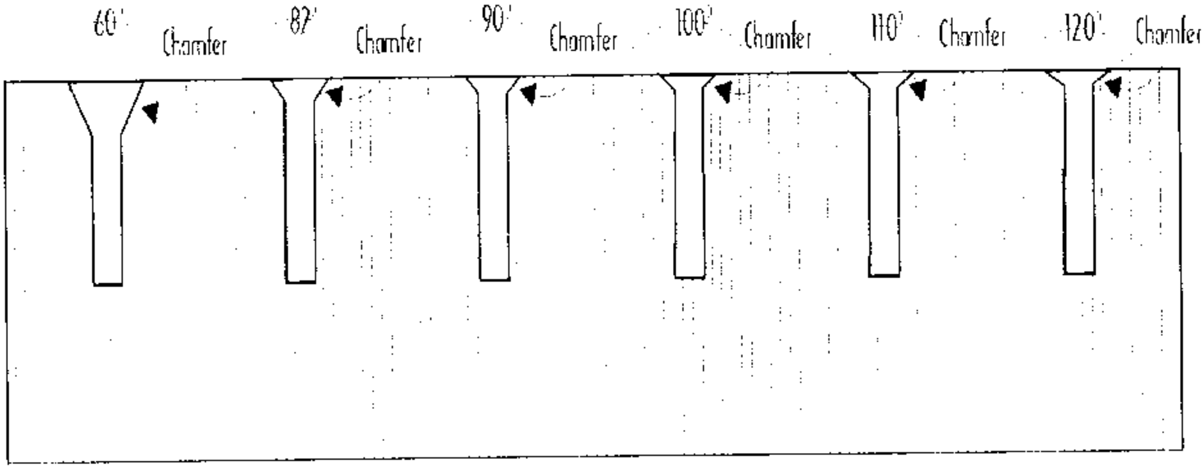
Counterbores are usually made with standard dimensions for a certain size of screw. The tip of the tool is called the **pilot**. Assuming the first, smaller-diameter hole has been drilled to the standard diameter for the particular screw size, the pilot will fit the hole with little clearance and will help to provide rigidity and hole center location (i.e., centerfinding). This is extremely helpful when running the cutter with a pistol-grip drill (to keep the tool from wandering) and on a drill press (for fast, easy return to coaxiality with the original hole center). The pilot matters little when running the cutter in a milling setup where rigidity is assured and hole center location is already achieved via X-Y positioning.

A **countersink** is a conical hole cut into a manufactured object, or the cutter used to cut such a hole. A common usage is to allow the head of a countersunk bolt or screw, when placed in the hole, to sit flush with or below the surface of the surrounding material. (By comparison, a counterbore makes a flat-bottomed hole that might be used with a hex headed capscrew.) A countersink may also be used to remove the burr left from a drilling or tapping operation thereby improving the finish of the product and removing any hazardous sharp edges.

The basic geometry of a countersink (cutter) inherently can be applied to the plunging applications described above (axial feed only) and also to other milling applications (sideways traversal). Therefore countersinks overlap in form, function, and sometimes name with chamfering endmills (endmills with angled tips). Regardless of the name given to the cutter, the surface being generated may be a conical chamfer (plunging applications) or a beveled corner for the intersection of two planes (traversing applications).

A countersink may be used in many tools, such as pistol-grip drills, drill presses, milling machines, lathes, and others.

Cross section of countersunk holes:



Machine Tapping

Tapping is essentially the internal threading of a hole. This may either be achieved by hand tapping by using a set of taps (first tap, second tap & final (finish) tap or using a machine to do the tapping, such as a lathe, radial drilling machine, bench type drill M c, pillar type drill M c, vertical milling machines, HMCs, VMCs. Machine tapping is faster, generally more accurate as human error is eliminated. final tapping is achieved with single tap.

Although in general machine tapping is more accurate, tapping operations have traditionally been very tricky to execute due to frequent tap breakage & inconsistent quality of tapping.

Tap related problems:

- Wearing of tap cannot be easily quantified (use of worn out taps)
- Use of tap with improper tap geometry for a particular application.
- Use of non standard/inferior quality taps.
- Chip clogging
- Tapping does not follow the pre-tap hole (misalignment)
- Mismatch of machine feed & tap feed may cause the tap to break in tension compression.
- Use of improper cutting fluid.
- No safety mechanism to limit torque below torque breakage value of tap.

Precautions to be taken while tapping:

- Taps have self feed (Taps once engaged get pulled into the job) due to helical angle & hence length compensation arrangement is required in tool holder to avoid breakage of tap.
- High carbon taps should not be used as they cannot sustain high speed. These were used for hand tapping earlier.
    - Only HS taps should be used.
    - In order to retract tap from the hole, the machine should be reversible.
    - Proper cutting compound should be used during tapping.

Tool holders for tapping operations:

Various tool holders may be used for tapping depending on the actual requirement of the user.

Tapping attachments: these may be normal (available is a range of tap sizes) or quick change

Quick change drilling & tapping chucks (variations available for both CNC & conventional tools)

Rigid tapping attachments (for CNC)

Generally the following features are required of tapping holders:

Twin chucking: tap is held both. on diameter as well as on the square thus giving it positive drive.

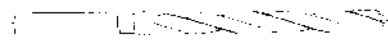
Safety clutch: The built in safety mechanism. operates as soon as the set torque limit is crossed & save the tap from breakage.

Float radial parallel: small misalignments are taken care of by this float.

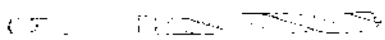
Length compensation: built in length compensation takes care of small push or pull to the spindle or feed difference.

CHAPTER-6

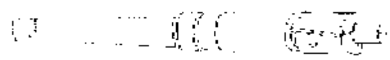
TYPES OF DRILL BITS



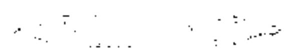
STRAIGHT SHANK DRILL



TAPER SHANK DRILL



SPOT FACE DRILL



CENTER DRILL

DRILL REAM COUNTERBORE COUNTERSINK

CHAPTER-7

DRILLING SPEEDS AND FEEDS

The notes below relate to HSS drills. For drills manufactured with more exotic material combinations much higher feed and speed rates are viable

Drilling feeds range from 0.03m to 0.5mm rev the feed rate being higher as the drill size increases from say 1mm to 60mm.

Table of drilling speeds:

Material	Drilling speed
	m min
Aluminium alloys	35-65
Brass Bronze	35-75
Copper	30-60
Malleable iron	20-40
Grey Cast iron	24-30
Nickel Monel alloys	12-20
Nimonic alloys	6-9
Mild Steel	20-30
Alloy Steel	12-18
Medium Carbon Steel	14-20
High Tensile Steel	5-13

Stainless Steel	6-15
Aus. Stainless Steel	6-10
Mart. Stainless Steel	12-20
Zinc Based alloy	45-75

Tapping /Clearance drill sizes

The tapping sizes are based on BS 1157:1975 and the clearance sizes are based on BS 4186:1967

Dia (Pitch)	Tapping Drill size	Clearance Drill Size		
		Close (H12)	Med (H13)	Free (H14)
mm	mm	mm	mm	mm
1.6(0.35	1.2	1.7	1.8	2.0
2.0 (0.40)	1.6	2.2	2.4	2.6
2.5 (0.45)	2.05	2.7	2.9	3.1
3.0 (0.50)	2.50	3.2	3.4	3.6
3.5 (0.60)	2.90	3.75	3.95	4.2
4.0 (0.70)	3.30	4.3	4.5	4.8
5.0 (0.80)	4.20	5.3	5.5	5.8
6.0 (1.0)	5.00	6.4	6.6	7.0
8.0 (1.25)	6.80	8.4	9.0	10.0
12.0	10.20	13.0	14.0	15.0

(1.75)				
14.0 (2.0)	12.00	15.0	16.0	17.0
16.0 (2.0)	14.00	17.0	18.0	19.0
20.0 (2.50)	17.50	21.0	22.0	24.0
24.0 (3.0)	21.00	25.0	26.0	28.0
30.0 (3.5)	26.50	31.0	33.0	35.0
36.0 (4.0)	32.00	37.0	39.0	42.0
42.0 (4.50	37.50	43.0	45.0	48.0
48.0 (5.0)	43.00	50.0	52.0	56.0
56.0 (5.5)	50.5	58.0	62.0	66.0
64.0 (6.0)	58.0	66.0	70.0	74.0
72.0 (6.0)	66.0	74.0	78.0	82.0

CHAPTER-8

DRILL PRESS

A drill press (also known as pedestal drill, pillar drill, or bench drill) is a fixed style of drill that may be mounted on a stand or bolted to the floor or workbench. A drill press consists of a base, column (or pillar), table, spindle (or quill), and drill head, usually driven by an induction motor. The head has a set of handles (usually 3) radiating from a central hub that, when turned, move the spindle and chuck vertically, parallel to the axis of the column. The table can be adjusted vertically and is generally moved by a rack and pinion; however, some older models rely on the operator to lift and reclamp the table in position. The table may also be offset from the spindle's axis and in some cases rotated to a position perpendicular to the column. The size of a drill press is typically measured in terms of *swing*. Swing is defined as twice the *throat distance*, which is the distance from the center of the spindle to the closest edge of the pillar. For example, a 16-inch drill press will have an 8-inch throat distance.

A drill press has a number of advantages over a hand-held drill:

- less effort is required to apply the drill to the workpiece. The movement of the chuck and spindle is by a lever working on a rack and pinion, which gives the operator considerable mechanical advantage.
- the table allows a vise or clamp to position and lock the work in place making the operation much more secure.
- the angle of the spindle is fixed in relation to the table, allowing holes to be drilled accurately and repetitively.

Speed change is achieved by manually moving a belt across a stepped pulley arrangement. Some drill presses add a third stepped pulley to increase the speed range. Modern drill presses can, however, use a variable-speed motor in conjunction with the stepped-pulley system; a few older drill presses, on the other hand, have a sort of traction-based continuously variable transmission for wide ranges of chuck speeds instead, which can be changed while the machine is running.

Geared head drill:

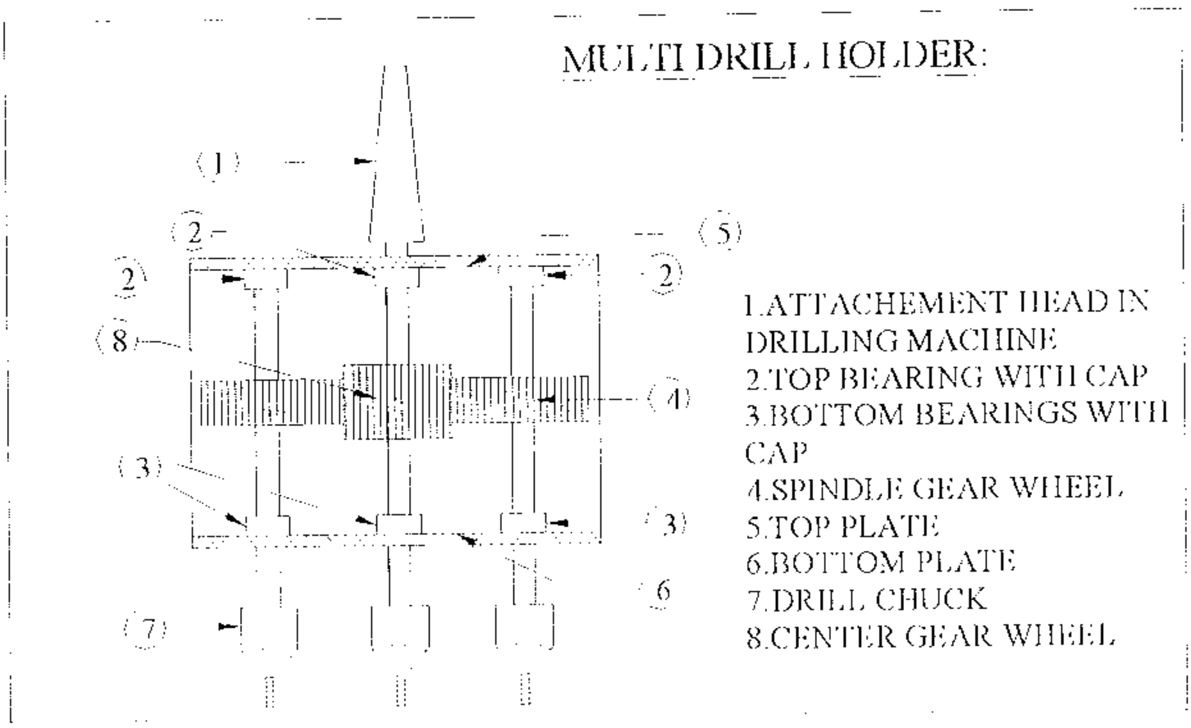
The geared head drill is identical to the drill press in most respects, however they are generally of sturdier construction and often have power feed installed on the quill mechanism, and safety interlocks to disengage the feed on overtravel. The most important difference is the drive mechanism between motor and quill is through a gear train (there are no vee belts to tension). This makes these drills suitable for use with larger drill bits.

Radial arm drill:

A radial arm drill is a geared head drill that can be moved away from its column along an arm that is radiates from the column. These drills are used for larger work where a geared head drill would be limited by its reach, the arm can swivel around the column so that any point on the surface of the table can be reached without moving the work piece. The size of work that these drills can handle is considerable as the arm can swivel out of the tables area allowing an overhead crane to place the workpiece on the fixed table. Vises may be used with these machines but the work is generally bolted to the table or a fixture

CHAPTER-9

LAYOUT OF MULTI-DRILL HOLDER



CHAPTER-10

DESCRIPTION OF COMPONENTS

1. **Base plate and pillars:**

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

2. **Main Eccentric:**

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

3. **Top Plate:**

It just holds the main eccentric and covers the top portion of the attachment.

4. **revolving Plate:**

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

5. **Drill holding eccentrics:**

The bottom pins of these eccentrics have provision for holding the drill bits of various sizes according to the design. The revolutionary motion of the revolving plate is converted into rotary motion of the drill bits through these eccentrics. The eccentricity provided is 5mm as same as that of Main eccentric.

6. **Slide Plate:**

The eccentric head arrangement rests over this slide plate which slides over the pillars provided with springs.

7. **Side Cover Plates:**

Side cover plates are bolted in between top plate and slide plate. The main purpose of the slide cover plates is to cover the arrangement of the eccentric heads.

CHAPTER-11

WORKING PRINCIPLE

Introduction to Drilling machine:

It is one of the most important machine tools in a workshop. As regards to its importance it is second only to the lathe. Although it was primarily designed to originate a hole, it can perform a number of similar operations. In a drilling machine holes can be drilled quickly and at low cost.

The hole is generated by the rotating edge of a cutting tool known as DRILL, which exerts a large force on the work clamped on the table. As the machine exerts vertical pressure to originate a hole it is loosely called as "Drill Press".

Operations performed in Drilling machine:

- Drilling
- Reaming.
- Boring.
- Counter Boring.
- Counter Sinking
- Spot Facing.
- Tapping.
- Grinding.
- Trepanning.

MULTI SPINDLE DRILL HEAD:

A Multi spindle drilling machine will drill a number of parallel holes simultaneously in a work piece. Multi spindle drilling machines are employed for work of a light character, especially repetition work, such as drilling small components for the Automobile and Aircraft industries.

A Multi spindle drilling machine has a number of drill spindles driven by a single motor. All the spindles holding the drills are fed in to the work piece at the same time. For this purpose, either the drill heads can be lowered onto the work piece or the work table is raised.

The Main eccentric is driven by the drilling machine spindle which is driven by a single motor. The several drill holding eccentrics are driven by the main Eccentric through a Revolving plate.

Eccentric is a mechanism which is usually used to convert rotary motion into sliding motion. It shall be noted that an Eccentric cannot convert reciprocating motion into rotary motion. Here we are converting the rotary motion into revolutionary motion and in to rotary motion. (ie) when the main spindle rotates, the rotary motion of the spindle is converted into revolutionary motion of the Revolving plate.

Through the Main Eccentric and the revolutionary motion of the Revolving plate is converted into rotary motion of the Drill holding Eccentrics. The conversion of the motion is achieved by the ECCENTRICITY provided in the eccentrics. [ECCENTRICITY is 15mm at all the eccentric spindles].

Drill bits can be fed by lowering the Drill head. The pillars provided with springs guide the Driller head in motion. Springs secure the Drill head with drill bits, from a rapid fall, while releasing the Drill head from the machine spindle.

It is designed to drill five holes of various diameters in unsymmetrical layouts. The art of ECCENTRICITY plays a major role in this principle.

CHAPTER-12

LIST OF MATERIALS

Part No.	Description	Material	No. Off
01.	Base Plate	M.S.	01
02.	Pillars	M.S.	03
03.	Gears	M.S.	04
04.	Main Eccentric	M.S.	01
05.	Top plate	M.S.	01
06.	Bearing - 6202 ROLLER BEARING		08
07.	Bearing cap	M.S.	08
08.	Stepped Shaft		04
09.	Drill Chuck		03

CHAPTER-13

Power calculations:

(All formulas are taken from hmt Production Technology from pg. no.-141)

Power required for drilling can be calculated from this formula:

N=(M*n) 974?

Where,
M-torque in kg.cm

n-number for revolutions of the drill min

?-efficiency of transmission

M=(Pz*d) 20

Pz=A*Ks

Where,
Ks-specific cutting force

A chip cross-section mm^2

A (d*s) 4

Where,
d-diameter of the drill

s-feed in mm rev.

s 0.20 mm rev .for 12mm drill

A (12*0.20) 4

A 0.6mm 2

From the graph, for ((ds) 4) & for C.I. material, we get

Ks 90kg mm2

Pz 90*0.6

= 54 Kgf

M = (54*1.2) / 2
M = 3.24 Kg.cm
N =(3.24*475) / 974*0.7
N=2.25Kw for drilling one hole .
Therefore for drilling three holes
N=2.25*3
=6.75

DESIGN OF SHAFT :
t max = 16*Mt*d /(pd^4)

t max-solid shaft subjected to torsion

for grey cast iron of grade 35 yield strength = 330N/mm^2
from psg design data book.

33Kgf/mm^2

shear stress = yield stress / 2
= 33/2
= 16.5Kg/mm^2

Taking Factor of safety = 1.5 shear stress becomes 11Kg/mm^2

Shear stress =1100Kg/cm^2

1100 =(16*3.24*d)/(pd^4)
d =2.4mm
As the gear required for multi-drill holder has teeths of 40 and 60 the shaft diameter required for it is 15 mm therefore the design is safe.as 15 > d.

DESIGN OF BEARING:

As per our design the shaft is made to 15 mm diameter so the roller bearing that suits the multi-drill holder is 6202.the specifications of the bearings is obtained from the psg design data book. pd^4)

GEAR DESIGN:

KNOWN DETAILS:

DRIVER GEAR Z_1=30 : N_1 =600rpm

DRIVEN GEAR Z_2 =40 : A =68mm (Approx. measured)

CALCULATIONS: (All formula are taken from PSG Design Data book pg. no. 8.22)

STEP 1:

Speed ratio, $i = N_1/N_2 = Z_2/Z_1$

$i = Z_2/Z_1 = 40/30 = 1.33$

STEP 2:

Module, $m = (2a)/(z_1+z_2)$

$m = (2*68)/(30+40) = 1.94mm$

$m = 2mm$ (std. valve from PSG Data Book pg. no.-8.2)

STEP 3:

Recalculating center distance, $a = m*((z_1+z_2)/2)$

$a = 2*((30+40)/2)$

$a = 70mm$

STEP 4:

Recalculating number of teeths in rack and pinion gears:

$Z_1 = (2*a)/(m(i+1)) = 30$

$Z_2 = i*Z_1 = 40$

STEP 5:

Pitch Diameter,d_1 = m*Z_1=2*30=60mm

d_2 = m*Z_2=2*40 =80mm

STEP 6:

Height factor f_0=1

Bottom clearance, c=0.2m=0.2*2=0.4mm

Tooth depth, h=2.25m=2.25*2=4.5mm

Tip diameter, d_{a1}= (Z_1+(2*f_0))m=64mm

d_{a2}= 84mm

Root diameter, d_{f1}= ((Z_1-(2*f_0))m)-2c=55.2mm

d_{f2}=75.2mm

RESULT:

Module, m = 2mm

Pitch diameter, d_1= 60mm

d_2 =80mm

Center distance, a = 70mm

Addendum=1*m = 2mm

Dedendum 1.25m = 2.5mm

Working depth 2m = 4mm

Minimum total depth 2.25m = 4.5mm

Tooth thickness 1.5708m = 3.14mm

Minimum bottom clearance 0.25m = 0.5mm

Fillet radius at root 0.4m = 0.8mm

CHAPTER-14

MANUFACTURING PROCESS

Steps involved in manufacturing the MULTI-DRILL HOLDER-

- Take 2 circular plates of 8mm thickness.
- Turn it to the required diameter.
- Figure over it for the required gear arrangements.
- Put the drill holes over it.
- Collect the idler and eccentric shaft and turn them for the required diameter.
- Now collect the bearings and prepare the bearing caps.
- Press the bearings in the caps and these bearings are loaded over the shafts with the corresponding gears.
- Now fix this shaft between the two plates by welding over the bearing caps.
- Finally a sleeve of Morse Taper-4 is made for connecting the system to the drilling machine spindle.
- The shafts at the bottom end are threaded over it to hold the drill chucks.

CHAPTER-15

TIME COMPARISON STUDY

Using single drill bit the time taken for various process are as follows:

To drill a single hole	10 seconds
Therefore, to drill three holes	30 seconds
Changing position of table or workpiece	- 10 seconds
Therefore, total time taken for drilling in a single workpiece	- 40 seconds

Using gang drill holder the time taken for various process are as follows:

To drill three holes	- 20 seconds
Total time taken for drilling in a single workpiece	- 20 seconds

There is no need to change the position of the table or that of the workpiece and this is one of the reasons for the drastic reduction in the time taken to drill all the three holes. At the maximum consideration, the time taken while using a gang drill holder will be only 25 seconds.

Calculation of the percentage of time saved:

Percentage of time saved for each workpiece	((40-25)/40) *100
	37.5%

Calculation of the percentage of production increased:

Time taken for drilling in 400 pieces:

Using single tool drill bit:	400*40	16000 seconds	4.5 hours
Using gang drill holder:	400*25	10000 seconds	2.8 hours

Time saved is about 1.7 hours, which is equal to 6120 seconds.

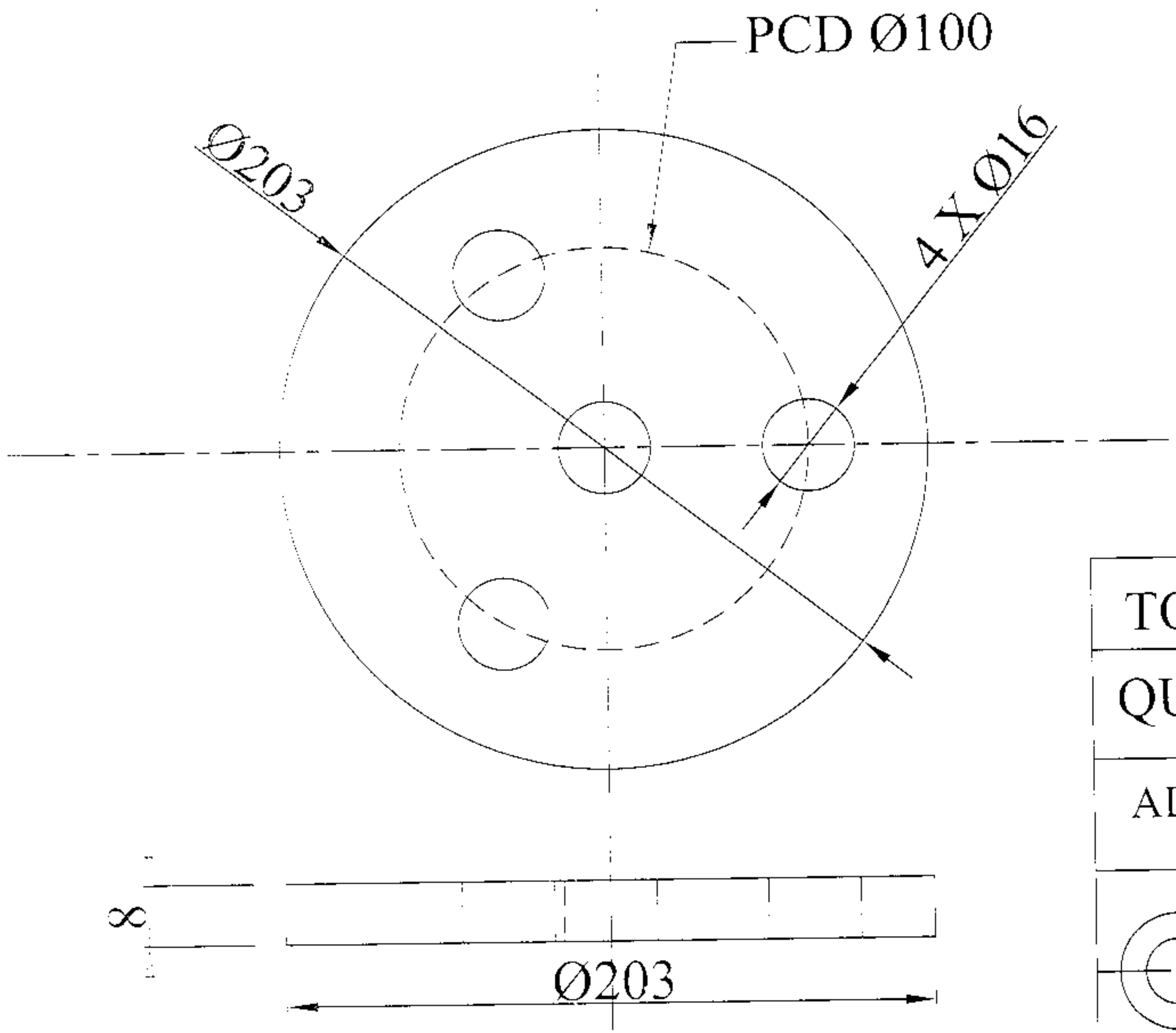
No. of workpieces that could be drilled in 6120 seconds	= 6120/25
	=245
Percentage increase in production	= (245/400) *100
	= 60%

Inference from the study:

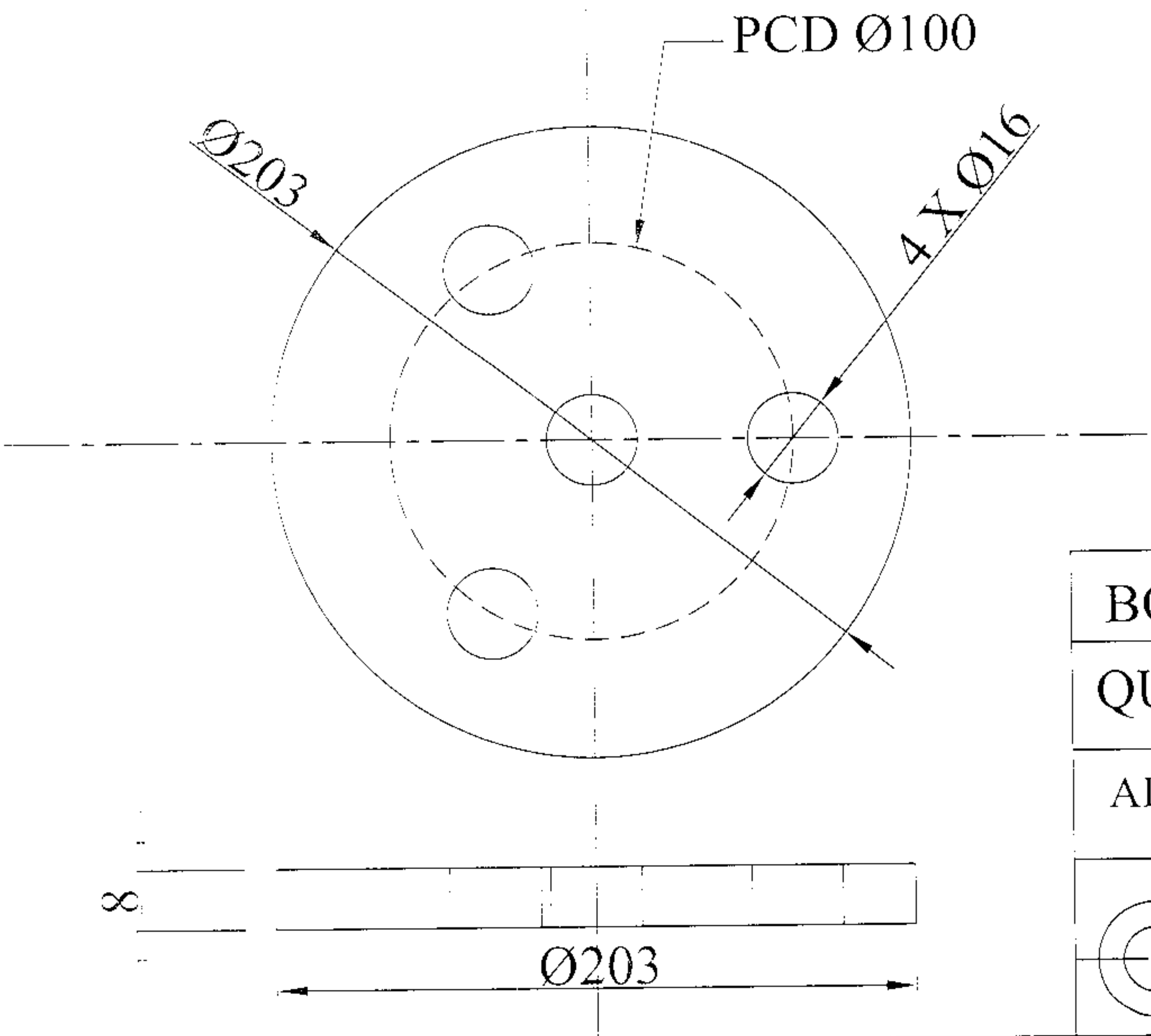
Based upon our time comparison study of the two processes, it was clear that the time taken in producing a finished product is drastically reduced while using a gang drill holder. That is, about 40% of the time required to complete the process using a single drill bit is reduced.

CHAPTER-16

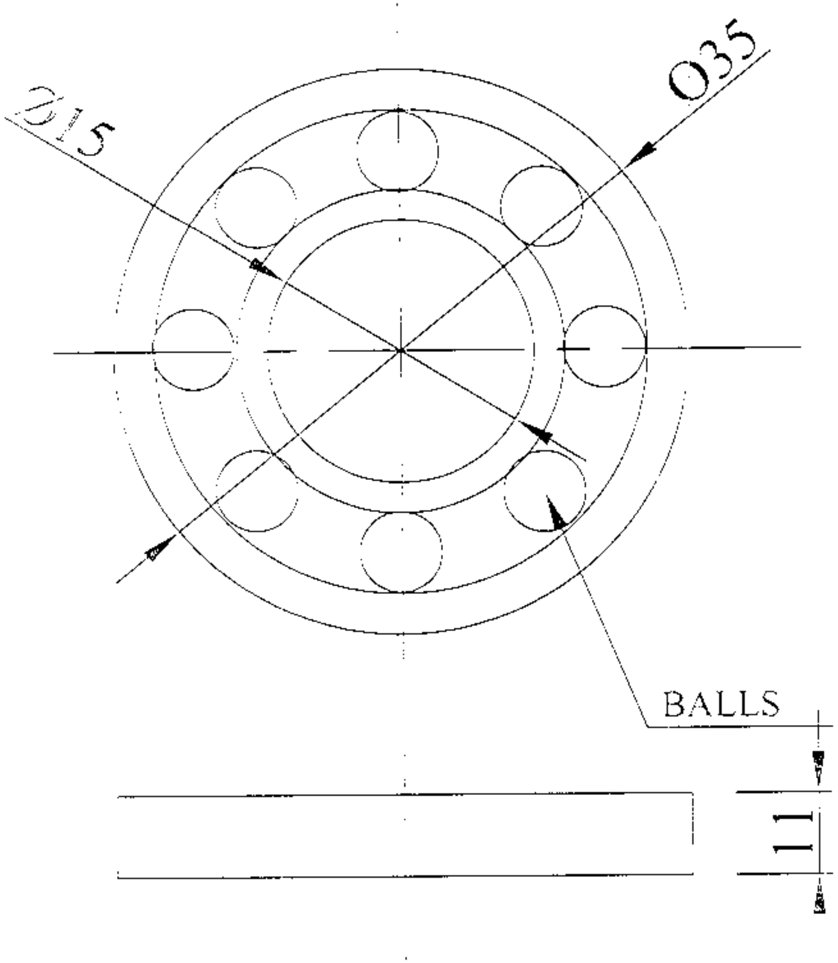
DRAWINGS

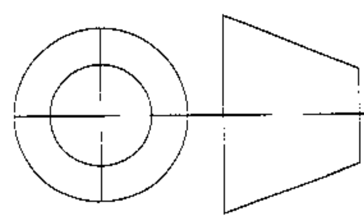


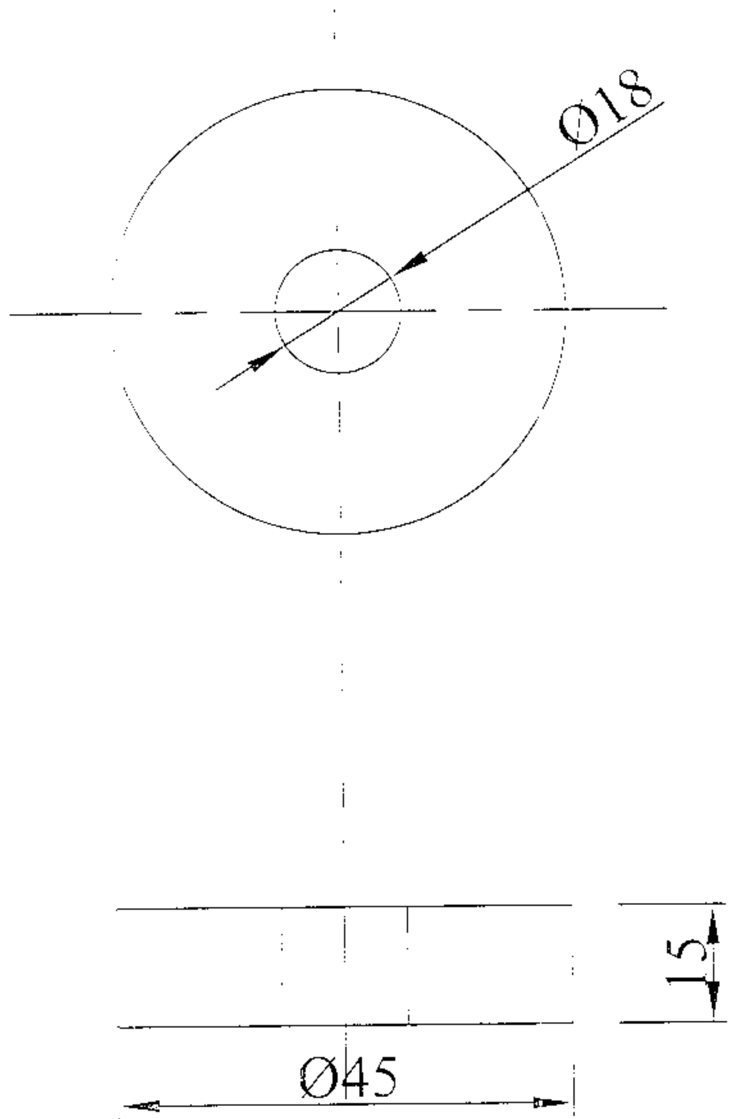
TOP PLATE	
QUANTY : 1	MAT : M.S
ALL DIMENSIONS ARE IN mm	
	NOT TO SCALE

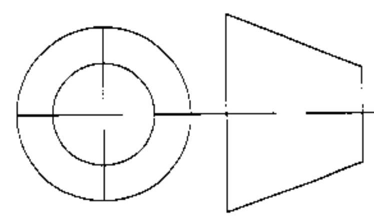


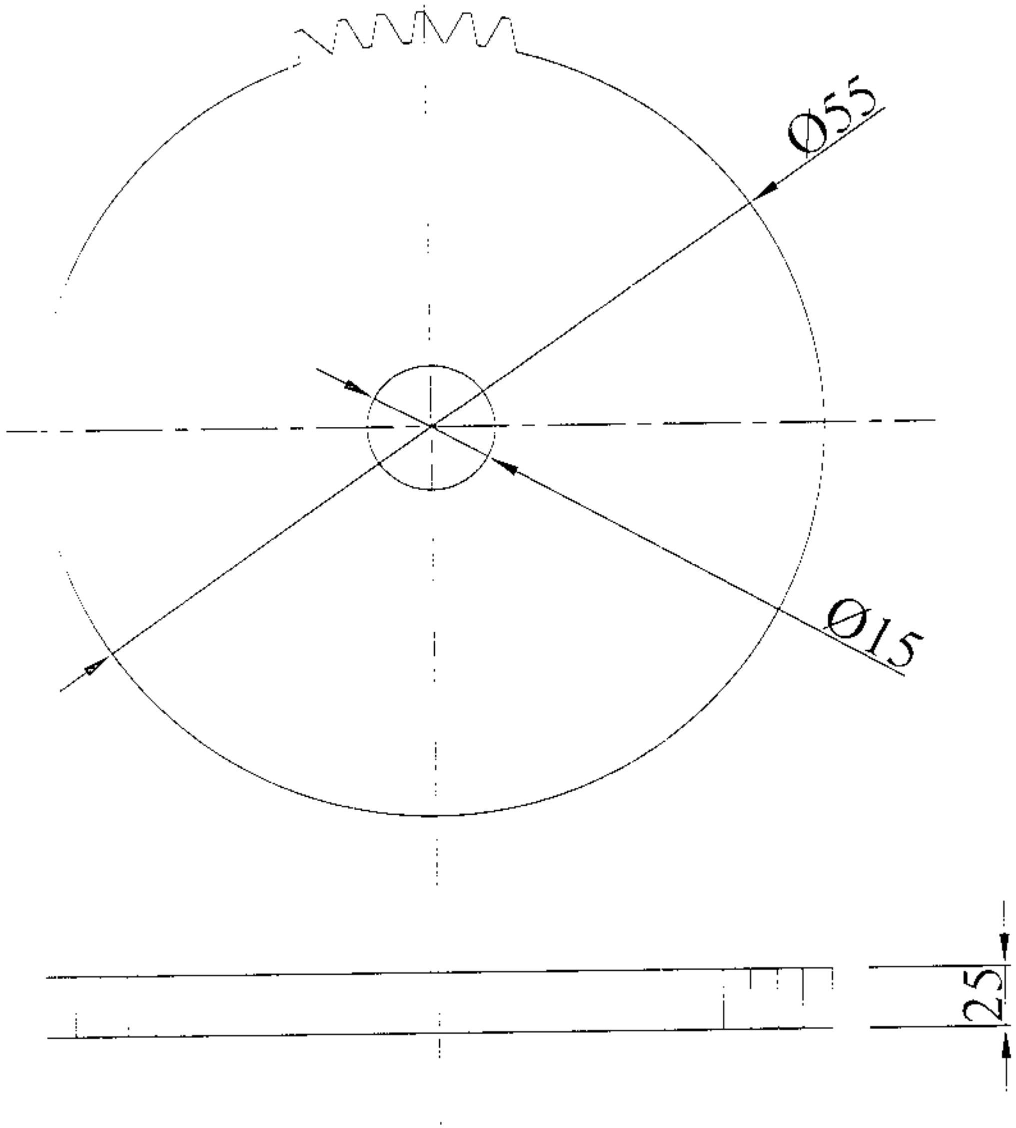
BOTTOM PLATE	
QUANTY : 1	MAT : M.S
ALL DIMENSIONS ARE IN mm	
	NOT TO SCALE



BEARING -6202	
MATERIAL:STEEL	
QUANTITY : 8	NOT TO SCALE
	ALL DIMENSIONS ARE IN mm

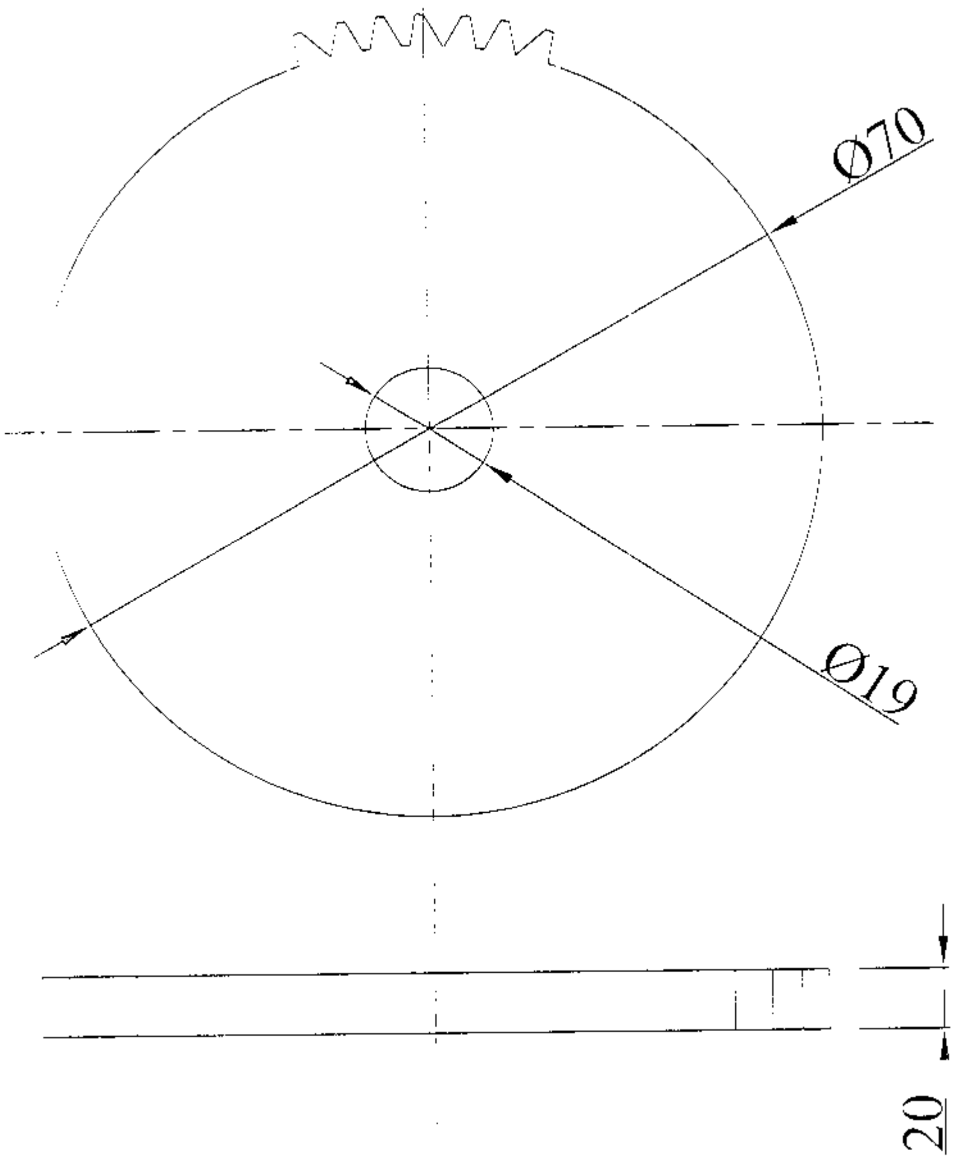


BEARING CAP	
MATERIAL : M.S	
QUANTITY : 8	NOT TO SCALE
	ALL DIMENSIONS ARE IN mm



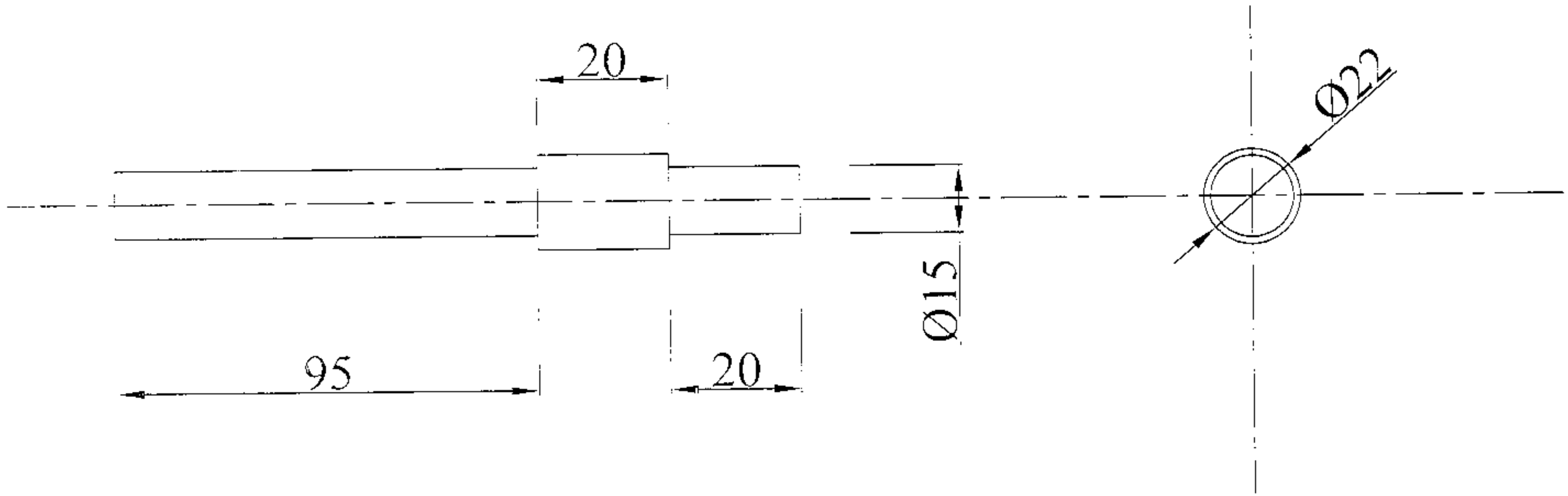
NO. OF TEETH :- 26

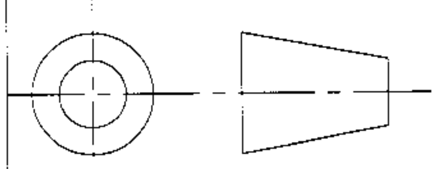
CENTER GEAR WHEEL	
MAT :- C.I	QUANTY : 1
ALL DIMENSIONS ARE IN mm	
	NOT TO SCALE

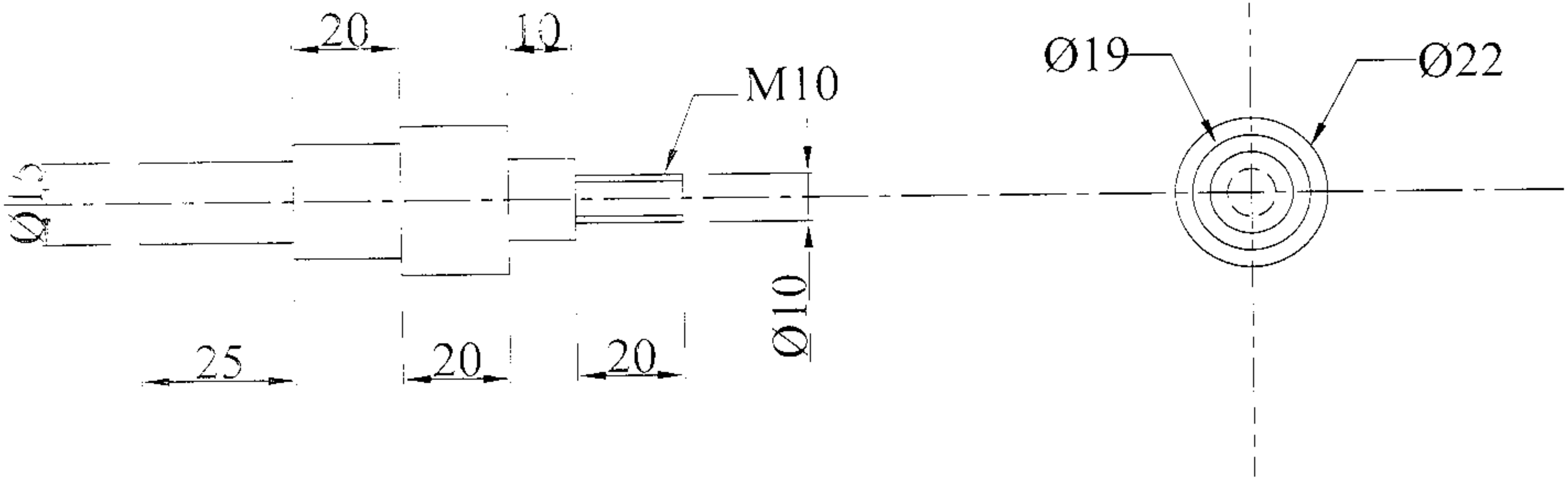


NO. OF TEETH :- 38

SPINDLE GEAR WHEEL	
MAT :- C.I	QUANTY : 3
ALL DIMENSIONS ARE IN mm	
	NOT TO SCALE



CENTER GEAR SHAFT	
MAT :- M.S	QUANTY : 1
ALL DIMENSIONS ARE IN mm	
	NOT TO SCALE



SPINDLE SHAFT	
MAT :- M.S	QUANTY : 2
ALL DIMENSIONS ARE IN mm	
	NOT TO SCALE

CHAPTER-17

COST ESTIMATION

Materials	Quantity in Nos.	Cost\Piece in Rs	Total Cost in Rs
Idler Gear	1	100	100
Eccentric gear	3	150	450
6202Ball Bearing	8	73	584
Bearing Cap	8	30	200
Center Shaft	1	80	80
Eccentric Shaft	3	80	240
Top & Bottom plate	1 each	50	100
Taper Shank	1	80	80
Drill Chuck	3	275	825
Labour		-	900
Others	-	-	300
		TOTAL	3859

CHAPTER-18

APPLICATIONS AND ADVANTAGES

APPLICATIONS:

In this type of machine number of holes is drilled in the work piece at a time. This machine is used in mass production. The work pieces drilled in this machine are as follows:

- Printed Circuit Boards.
- Pipe Flanges.
- Pump housings.
- Production works such as Drilling, Boring, Reaming and Tapping.

ADVANTAGES:

a. Can be used for very centre distances.
b. Presetting for definite depth is possible prior to mounting on machine.
c. Outputs shall be obtained at high precision..
d. High Productivity can be achieved.

This drill head shall be applied in Mass production process and mostly suited for drilling printed Circuit Boards, pipe Flanges, Pump housings.

CHAPTER-19

LIMITATIONS OF MULTI-DRILL HOLDER

The project MULTI-DRILL HOLDER is made only as a design purpose in order to find out its effective usage. Due to the financial constraint it is being made only for one particular pattern of work. MULTI-DRILL HOLDER does need more concentration of work alignment due to its standard PCD. It is not possible to make it for more number of holes due to its design constraint. Once the number drills get increased the weight of the attachment also increases which is not to hold such a heavy system by the spindle in drilling machine. During its manufacturing process it requires knowledge of gear design, since it works by the gear arrangement.

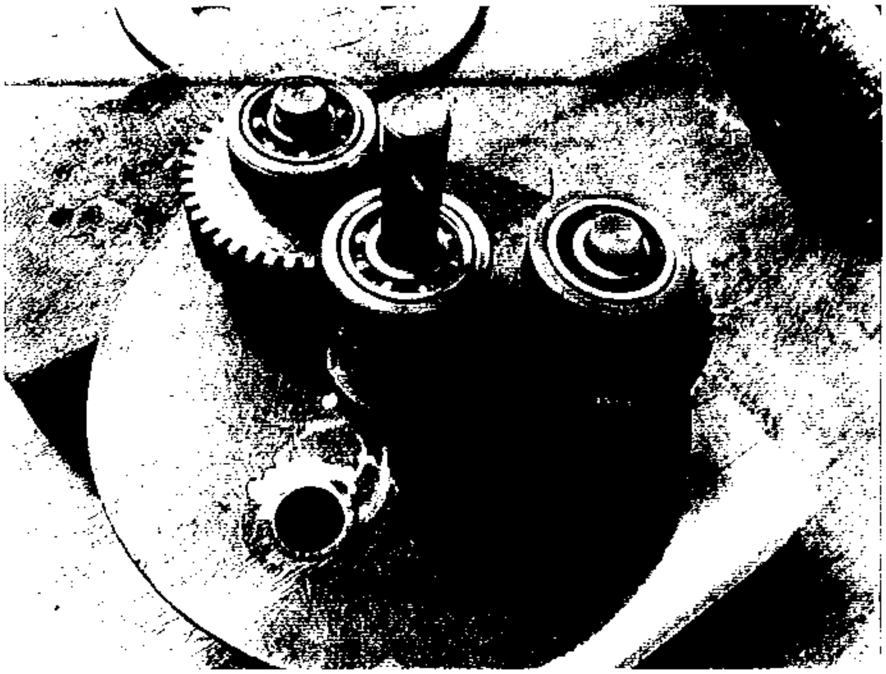
CHAPTER-20

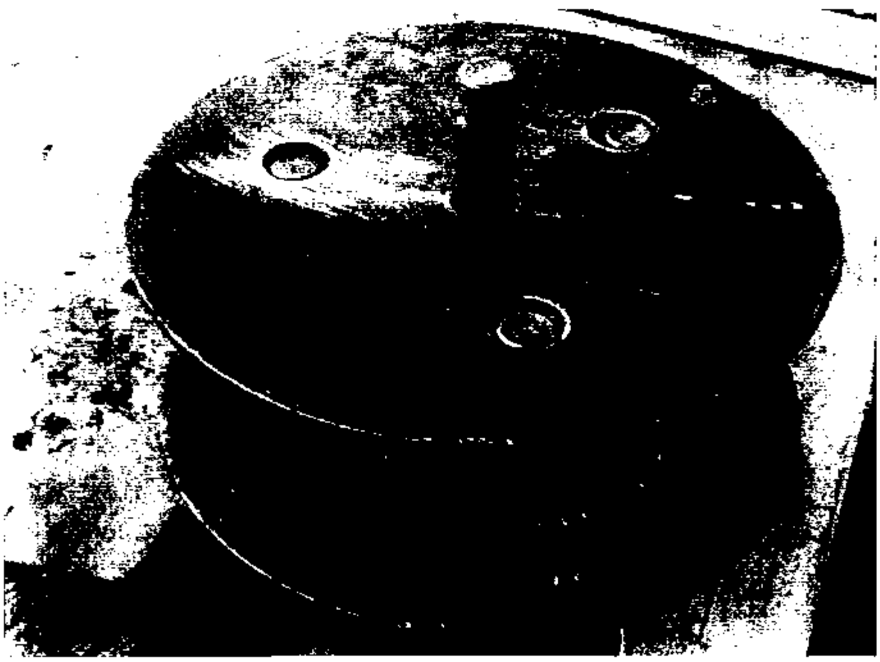
ADVANCEMENTS

The project MULTI-DRILL HOLDER can be improved as an attachment for special purposes in various aspects-

- By setting adjustable PCD (pitch circle diameter.
- By changing the arrangement of gears by good design work.
- Difference in the drill height over the work at various spots.
- Reducing the weight through using fiber made gears.
- Setting different speeds for each of the chucks through only one input.
- Reducing the manufacturing cost by removing un-necessary material.

CHAPTER-21
PHOTOS





CHAPTER-22
CONCLUSION

With the design and fabrication of the MULTI-DRILL HOLDER, it is seen from the time comparison study that the production is increased by around 60%. This was made possible by using the three drill bits to drill all the three required holes on the given pitch circle diameter at the same time.

As in this case, the time taken to finish the entire drilling operation on the workpiece is drastically cut by around 40%. This has direct influence on the working hours of the labourer. With the use of this attachment, demands of large scale production could be well met with

There are also some shortcomings in this work, like the holder can be used only for special purpose applications i.e. it does not suit for work pieces requiring holes at different locations rather than at the same pitch circle diameter. This implies that the attachment is helpful only for drilling holes in a single PCD.