A PRIMER ON COMPUTER AIDED MACHINE DRAWING

FOR

III SEMESTER BE (ME / IP / IM / AU / MA / MI /AE)

90

VISVESVARAYA TECHNOLOGICAL UNIVERSITY
BELGAUM-590 014

2007

A PRIMER
ON
MACHINE DRAWING

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EDITORIAL COMMITTEE

FOREWORD

Normally, human thoughts are interlinked with the language they know. Thinking in the language of Technical Graphics or Engineering Drawing, the engineering problems can be more clearly visualized and graphic images can help to find solutions with great ease. The designs are thought in the mind of designer in terms of visual images.

The realms of the academe and industry are complementary, but distinct. There are many areas where one is ahead of the other. For example, industry is ahead in areas such as, manufacturing engineering, productivity, safety, codes, standards, etc.; while the academe is ahead in: knowledge transfer, research and development, etc. In many cases, there is a time lag between the developments and identification of requirements of the two sectors. while the Industry has adopted the computers in their design and manufacture, educational institutes are lagging behind. Computer Aided Machine Drawing is one such area, where the technology is used for better transformation of creative ideas into concepts.

Dr. K. Balaveera Reddy, Vice-Chancellor, Visvesvaraya Technological University, Belgaum, has provided leadership in many innovative educational initiatives to enhance effectiveness and efficiency of the Technology Learning Processes. The preparaton of this primer of computer Aided Machine Drawing for III Semester B.E. (ME / IP / IM / AU / MA / MI / AE) by a team of expert faculty members, all of whom have had experience in teaching this subject for many years, is a major step towards making the students understand the usage of computers in machine drawing, making them productive in their profession. It provides a Just-in-Time response to needs of industry and has been prepared in an excellent learner-friendly format.

I am confident that this primer will be enthusiastically received by all the stakeholders in Technology Education.

Chennai
Date : 27.03.2007

Dr. N. Siva Prasad
Professor of Mechanical Engineering
IIT, Madras

PREFACE

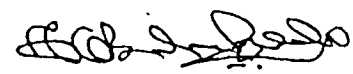
Keeping abrest of the technological developments and imparting technical education, it was the dream of Visvesvaraya Technological University, Belgaum, to introduce 'Computer Aided Machine Drawing Course' in the undergraduate mechanical engineering science curriculum. A Committee was constituted by the University for the preparation of **A Primer on Computer Aided Machine Drawing**. The Committee thoroughly discussed the need, feasibility of introducing CAMD course and finally prepared course material.

A set of carefully designed problems and exercises on relevant topics are included in order to impart a thorough understanding of the subject. The primer reviews the basic commands for computer aided machine drawing. The topics on sections of solids give the insight into the sectional view that aid in understanding the assembly. The orthographic projections based on Bureau of Indian Standards convention provide the tool for laying out the views of the assembly. Thread forms and fasteners help to understand the connecting elements. Joints and Couplings introduce the simple machine elements, illustrating the concept of location and connectivity.

Assembly are choosen to give the 3D modelling concepts and obtaining the orthographic and sectional views, which are essential for communicating the designs.

The editorial committe acknowledges the permission granted by the concerned companies and publishers for using their softwares/icons, etc. Also, the committee thanks all those who have lent support in bringing this primer.

Although enough care has been taken in the preparation of the primer in an user-friendly manner, yet some errors might have crept in. Healthy suggestions/comments are welcomed in this regard.



Editorial Chairman
Prof. K. Balaveera Reddy
Vice-Chancellor
VTU, BELGAUM

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SYLLABUS

COMPUTER AIDED MACHINE DRAWING
(Common to ME / IP / IM / AU / MA / MI / AE)

Sub Code : 06ME36
Hours / Week : 04
Total Hours : 52

IA Marks : 25
Exam Hours : 03
Exam Marks : 100

1. Introduction to Computer Aided Sketching

Review of graphic interface of the software. Review of basic sketching commands and navigational commands. Starting a new drawing sheet. Sheet sizes. Naming a drawing. Drawing units, grid and snap. **2 Hours**

PART A

Unit -1. Sections of Solids :

Sections of Pyramids, Prisms, Cubes, Tetrahedrons, Cones and Cylinders resting only on their bases (No problems on, axis inclinations, spheres and hollow solids) **4 Hours**

Orthographic views :

Conversion of pictorial views into orthographic projections of simple machine parts with section. (Bureau of Indian Standards conventions are to be followed for the drawings) Hidden line conventions. Precedence of lines. **4 Hours**

Unit -2. Thread forms :

Thread terminology, sectional views of threads. ISO Metric (Internal & External), BSW (Internal & External), square, Acme and Sellers thread, American Standard thread.

Fasteners :

Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assemly) simple assembly using stud bolts with nut and lock nut. Flanged nut, slotted nut, taper and split pin for locking, counter sunk head screw, grub screw, Allen screw. **8 Hours**

PART B

Unit -3. Keys & Joints :

Parallel, Taper, Feather Key, Woodruff key

Riveted joints :

Single and double riveted lap joints, butt joints with single/double cover straps (Chain and zigzag using snap head rivets).

Cotter joint (socket and spigot), knuckle joint (pin joint) for two rods. **8 Hours**

Unit -4. Couplings :

Split Muff coupling, Protected type flange coupling, Pin type flexible coupling, Oldham's coupling and Universal coupling. **8 Hours**

PART C

Assembly Drawings
(Part drawings should be given)

1. Plummer block (Pedastal Bearing)
2. Petrol Engine piston
3. I.C. Engine connecting rod
4. Screw jack (Bottle type)
5. Tailstock of lathe
6. Machine vice
7. Tool Head of shaper

18 Hours

Text Books :

1. 'A Primer on Computer Aided Mahine Drawing-2007', Published by VTU, Belgaum.
2. 'Machine Drawing', N.D.Bhat & V.M.Panchal, Published by Charotar Publishing House, 1999.
3. 'Machine Drawing', N.Siddeshwar, P.Kannaih, V.V.S. Sastri, published by Tata Mc.Grawhill, 2006.

Reference Book :

1. "A Text Book of Computer Aided Machine Drawing", S. Trymbakaa Murthy, CBS Publishers, New Delhi, 2007.
2. 'Machine Drawing', K.R. Gopala Krishna, Subhash publication.
3. 'Machine Drawing with Auto CAD', Goutam Pohit & Goutam Ghosh, 1st Indian print Pearson Education, 2005.
4. 'Auto CAD 2006, for engineers and designers'. Sham Tickoo, Dream Tech 2005

Note :

Internal Assessment : 25 Marks

All the sheets should be drawn in the class using software. Sheet sizes should be A3/A4.
All sheets must be submitted at the end of the class by taking printouts.

Scheme of Examination :

Two questions to be set from each Part-A, part-B and Part-C.
Student has to answer one question each from Part-A and Part-B for 20 marks each and one question from Part-C for 60 marks.

PART-A 1X20	=	20 Marks
PART-B 1X20	=	20 Marks
PART-C1X60	=	60 Marks
Total	=	100 Marks

CHAPTER – 1

INTRODUCTION

1.1 MACHINE DRAWING

It is one of the branches of engineering drawing. Its name is derived based on its industrial application. It helps to understand the concepts of sectioning, standard proportions of fasteners, joints, bearings, couplings, assembly of machine tool parts etc. Recent innovations of various softwares are helping to achieve speed and accuracy.

1.2 SIZE OF DRAWING SHEET

In general, for manual drawing A1 size drawing sheets are in use. But in case of Computer Aided Machine Drawing, in general A3 size format may be used. However, A4 size format may also be used wherever the size of drawing is fitting in that format.

1.3 LAYOUT OF THE DRAWING SHEET

Before a drawing is created, the drawing sheet is to be laid out. It can be laid out in portrait or landscape orientation. The following are the steps to prepare the layout of the drawing sheet for manual drawing ;

1. Position the drawing sheet on the drawing board by aligning the bottom or top edge of the paper with the scale of the drafting machine or T-square. Fix the sheet by a small piece of adhesive tape on each of the corner of the paper (avoid drawing pins as they would damage the drawing board on multiple use).
2. Draw the borders if the paper is not prebordered in the drawing space. To do this, measure the border length (20 mm or10 mm depending on the drawing sheet size) from each side of the paper and make a very light marks with a hard grade pencil. Draw the border lines through these marks using the scale on the drafting machine or set squares and soft-grade (HB) pencil to produce thick (0.7 mm) black line.
3. Create a title block of required size (maximum of 180 mm x 65 mm) on the right bottom corner of the drawing sheet using soft-grade pencil to produce a thick (0.7 mm) black line.

Divide the title block into number of parts measuring the distances from the left vertical borderline. Place very light pencil marks and through these marks, draw lines using straight edge and soft-grade (HB) pencil to produce thick (0.7 mm) black lines. A layout of a drawing paper with a title block and part list is shown in Fig. 1.1

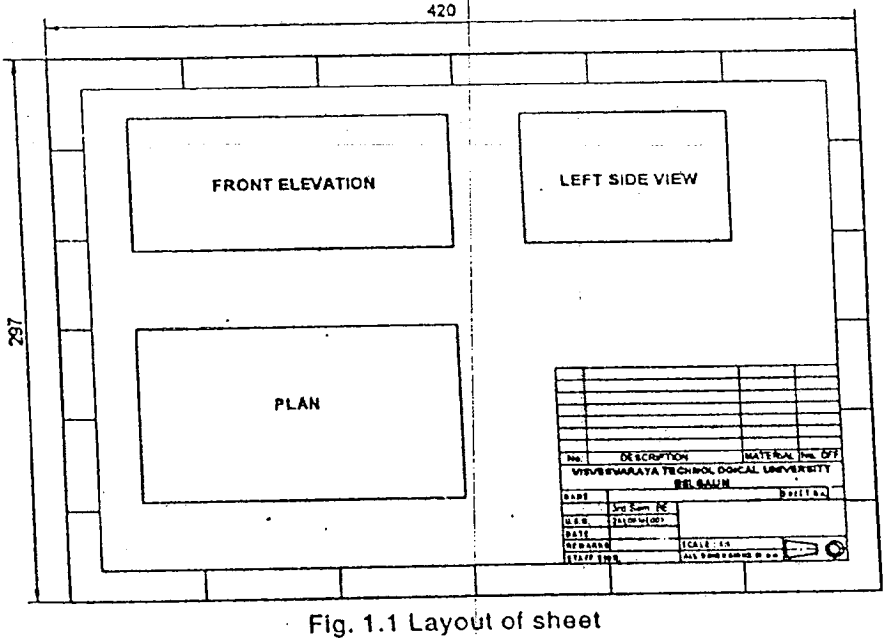


Fig. 1.1 Layout of sheet

1.4 TITLE BLOCK

The title block should be within the drawing space located at the bottom right hand corner. The direction of viewing of the title block should correspond in general with that of the drawing. Title block should preferably consist of one or more adjoining rectangles. These may be sub-divided into boxes for the insertion of specific information such as

(i) Name of the firm
(ii) Title of the drawing
(iii) Drawing number
(iv) Scale
(v) Projection symbol (first angle or third angle)
(vi) Initials of staff designed, drawn and approved

Title blocks used in industry and classroom drawings are shown in Fig. 1.2 and Fig. 1.3 respectively.

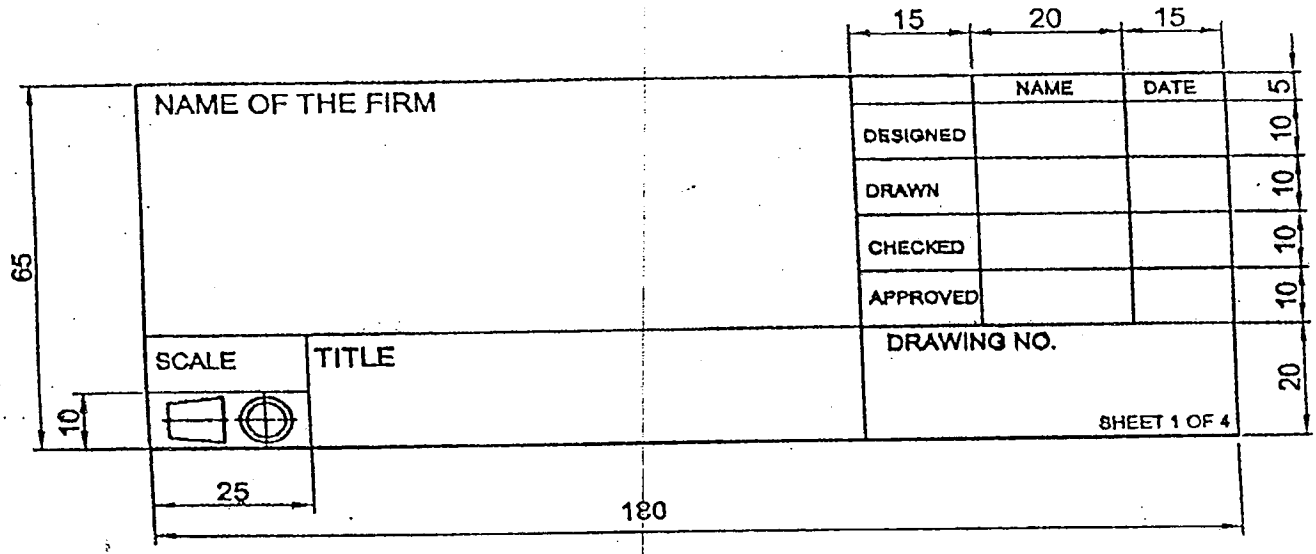


Fig. 1.2 Title block used in industry

No.	DESCRIPTION	MATERIAL	No. OFF
VISVESVARAYA TECHNOLOGICAL UNIVERSITY BELGAUM			
NAME		SHEET No.	
	3rd Sem. BE		
U.S.N.	2KL06ME001		
DATE			
REMARKS		SCALE : 1:1	
STAFF SIGN.		ALL DIMENSIONS IN mm	

Fig. 1.3. Title block used in class room drawings

1.5 BILL OF MATERIAL

The bill of material is a complete list of all the associated parts constituting the assembly or a sub assembly presented on the drawing. Generally the bill of material is placed above the title block as shown in Fig. 1.1. The bill of material consists of the following details.

a) Part number
b) Name of the part (Description)
c) Material
d) Quantity (No. off)

The sequence of entries in the bill of material is from the bottom to the top so that it is easy to include some more parts in the list. The details of each part are arranged column wise. The part number indicates the number given to the part in the drawing; material indicates the material details of the part like CI (Cast Iron), CS (Cast Steel), Fe410W-Martensitic stainless steel water hardened, Brass, Aluminium, etc.

Table 1.1 Bill of material

8	Washer	Fe 410 W	4
7	Nut	Fe 410 W	4
6	Bolt	Fe 410 W	4
5	Fabric Bush	Fabric	4
4	Key	Fe 410 W	2
3	Shaft	Fe 410 W	2
2	Flange No.2	CI	1
1	Flange No.1	CI	1
Part no	**Description**	**Material**	**NO. OFF**

The total number of the part required for the particular assembly is noted in the last column. An example of bill of material used on a particular drawing is shown in Table 1.1.

1.6 SOFTWARE

The following are a few computer software packages, which can be used for preparing machine drawing. SOLID EDGE, AUTOCAD, CATIA, IDEAS, IRONCAD, MECHANICAL DESK TOP, PRO-E, SOLIDWORKS. The Generic Layout of Drafting Software is given in Appendix-I. Appendix-I presents the layout of typical packages used for preparing drawings by employing computer. Some commonly used 'menus' and 'tool bars' of solid edge are discussed here in.

1.6.1 Graphic Interfaceof The Software

A graphic interface that takes advantage of the computer graphics capabilities to make the commands easier to use. It frees the user from learning complex command languages. In machine drawing a window based commands are used instead of text based commands to make it user friendly.

1.6.2 Menus

The standard menu used by different software packages basically consist of various commands for drawing, modifying, dimensioning, etc. These commands may vary from one package to another. The supporting user manual of the packages gives the details of the various menus. The typical menus such as File, Edit, View, Insert, Format, Tools, Inspect, Application, Manage, Window, Help are shown in figure 1.4 to 1.18.

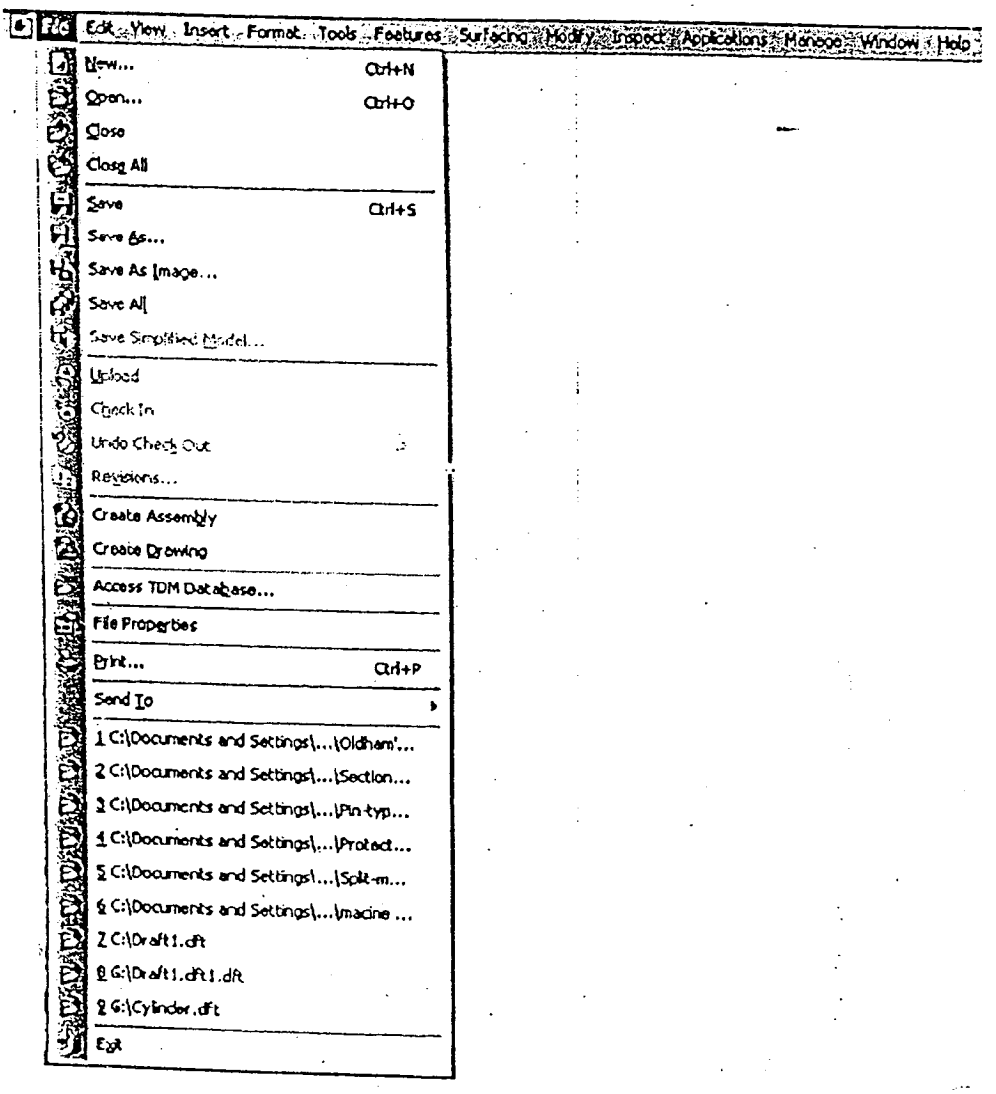


Fig. 1.4 File

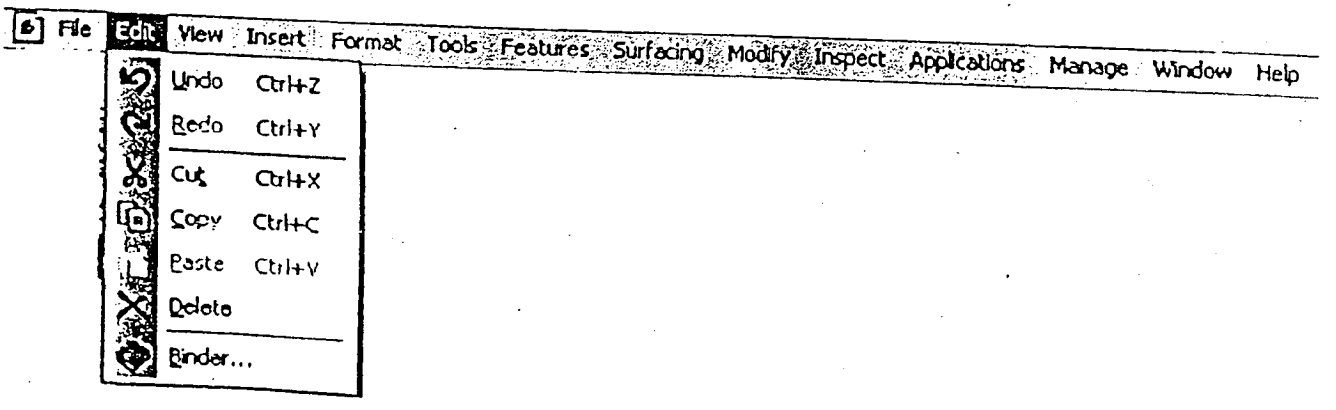


Fig. 1.5 Edit

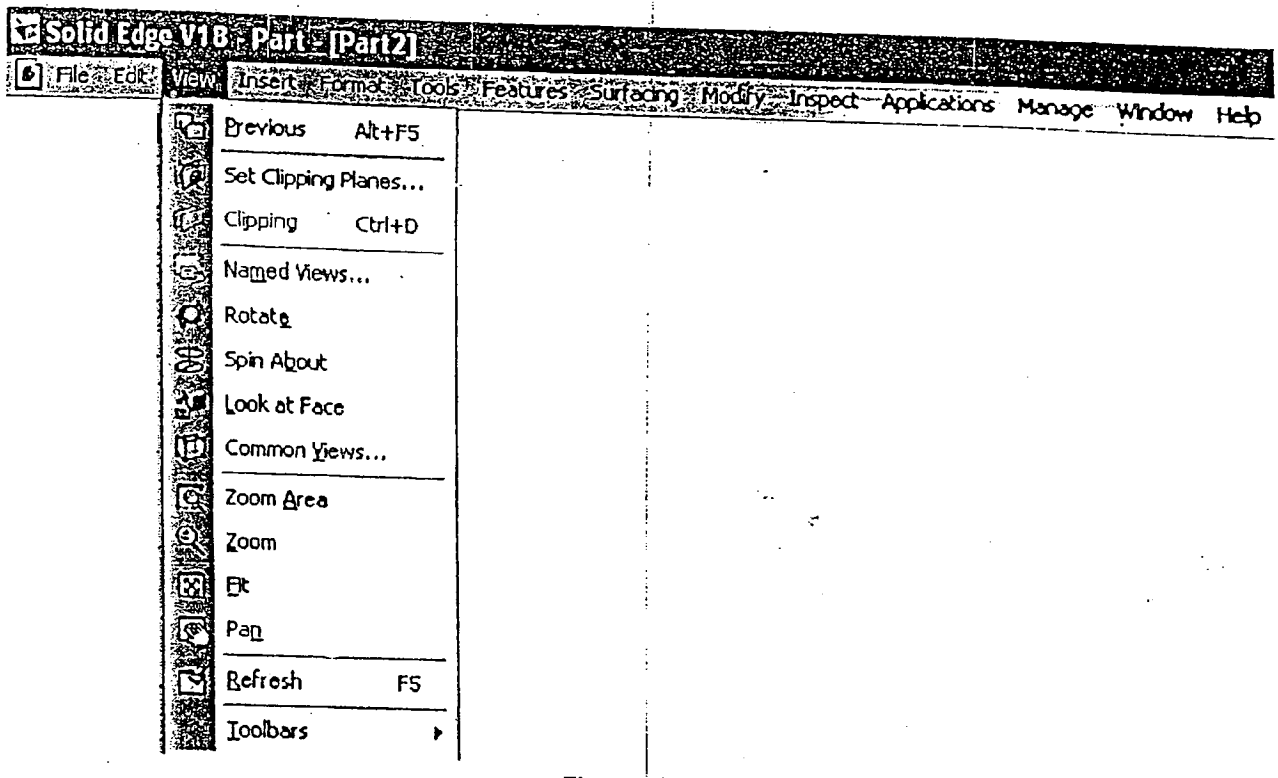


Fig. 1.6 View

Fig. 1.7 Insert

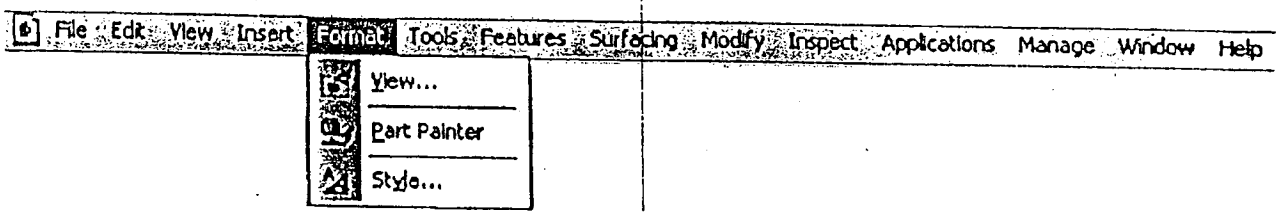


Fig. 1.8 Format

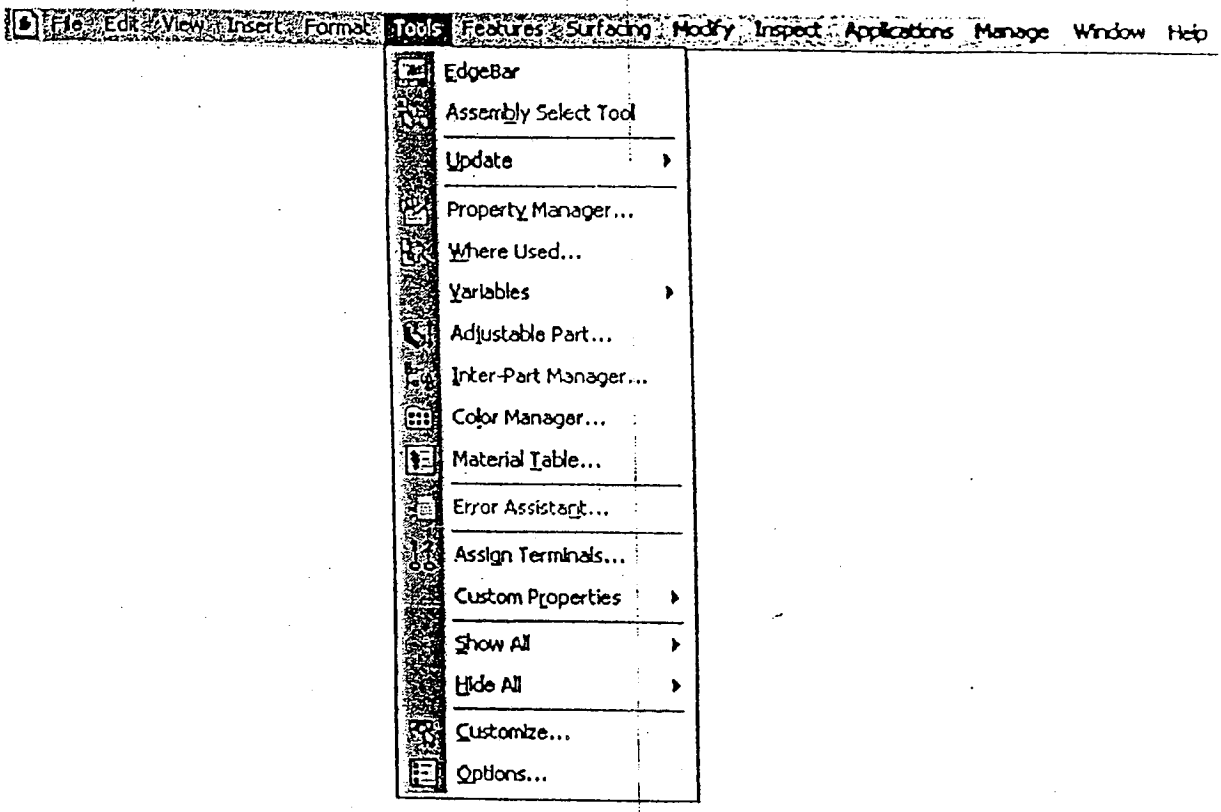


Fig. 1.9 Tools

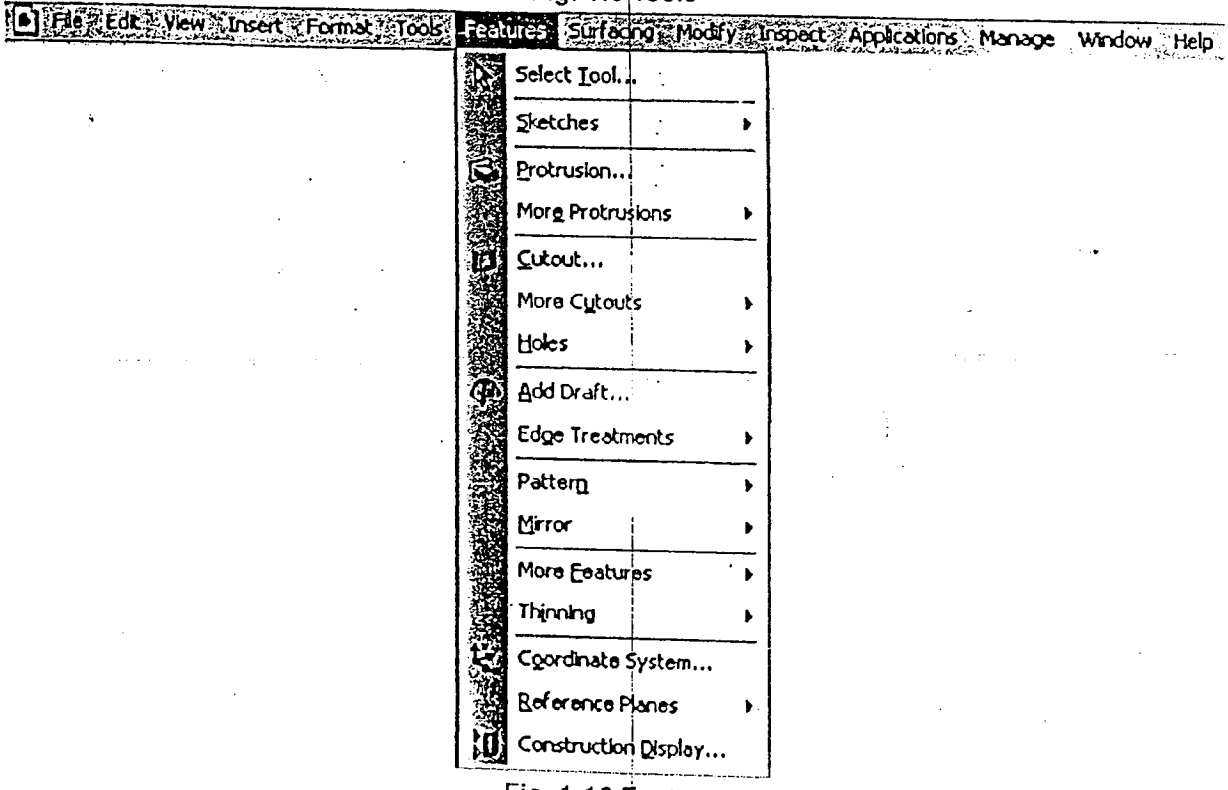


Fig. 1.10 Features

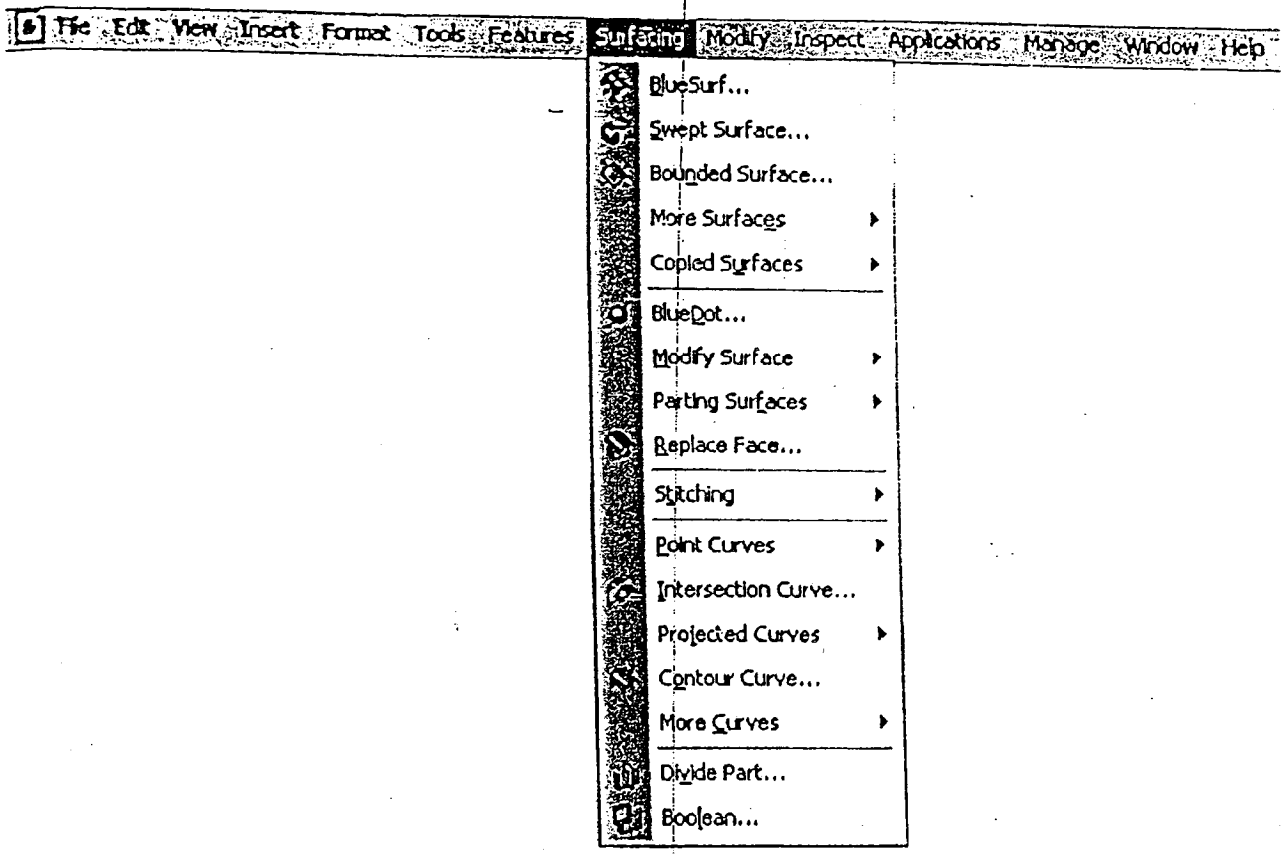


Fig. 1.11 Surfacing

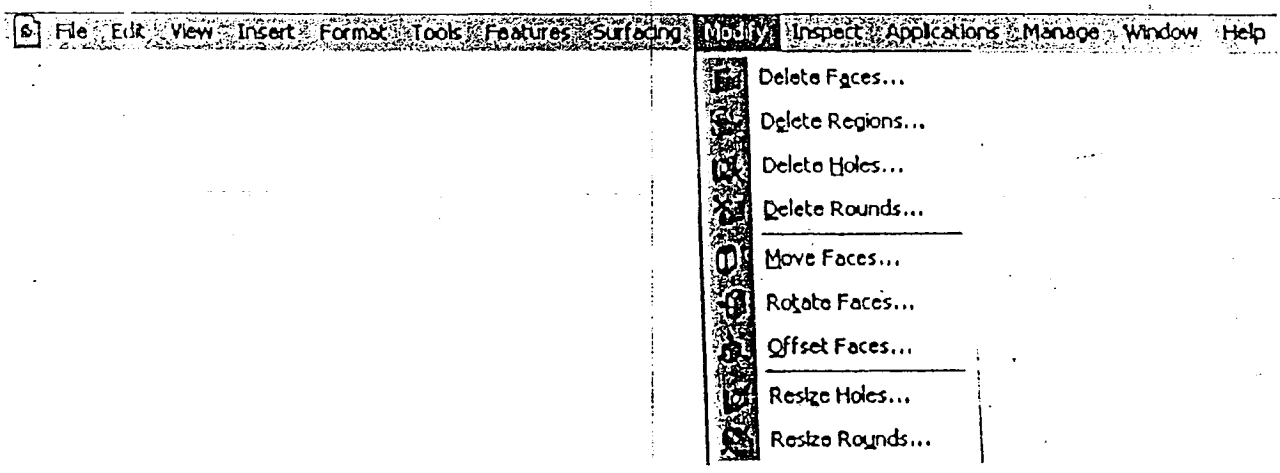


Fig. 1.12 Modify

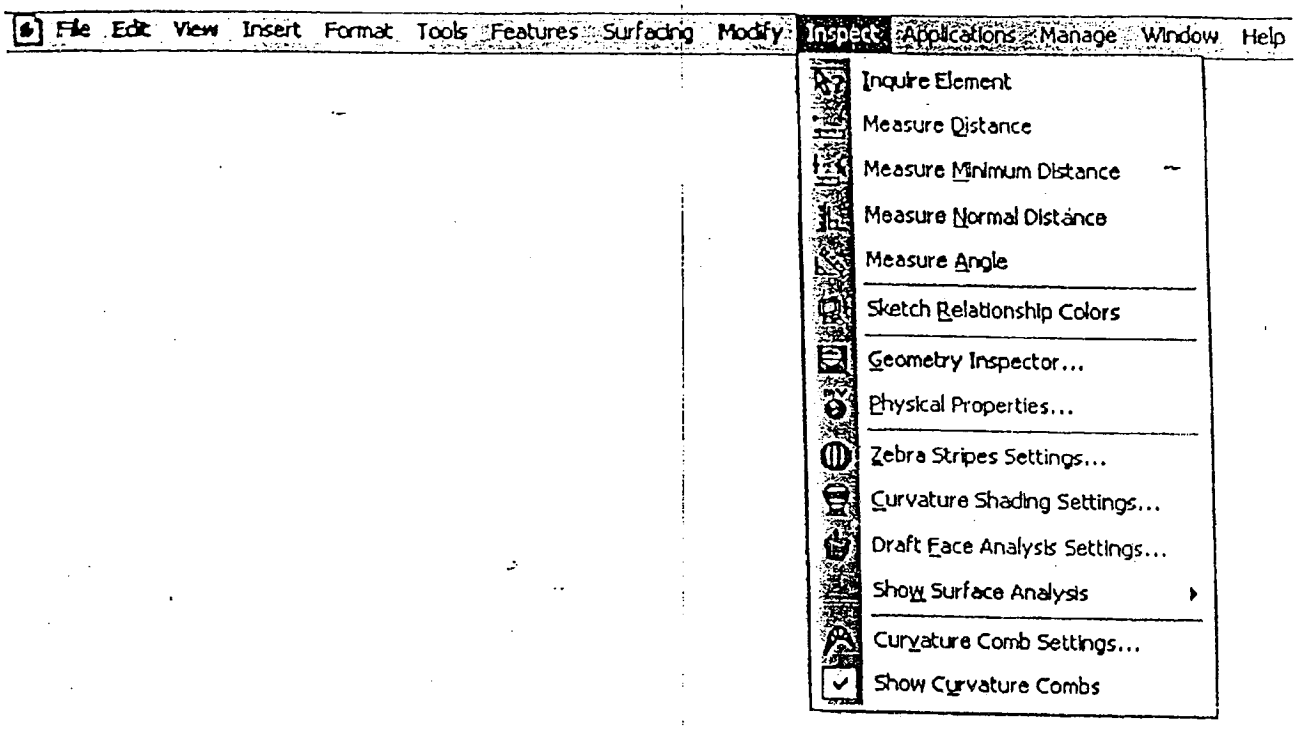


Fig. 1.13 Inspect

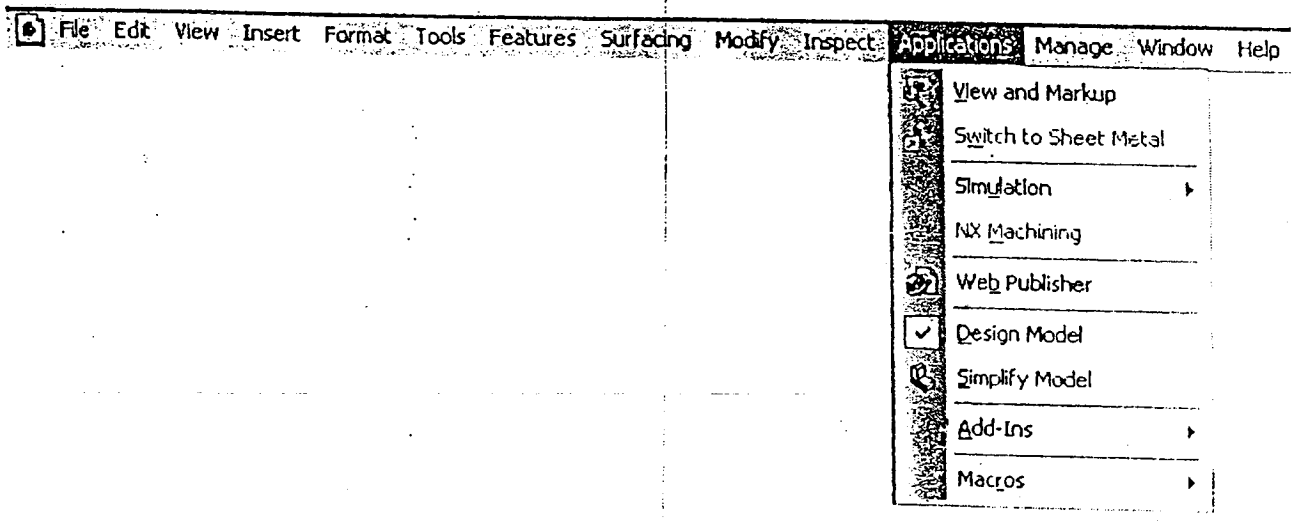


Fig. 1.14 Applications

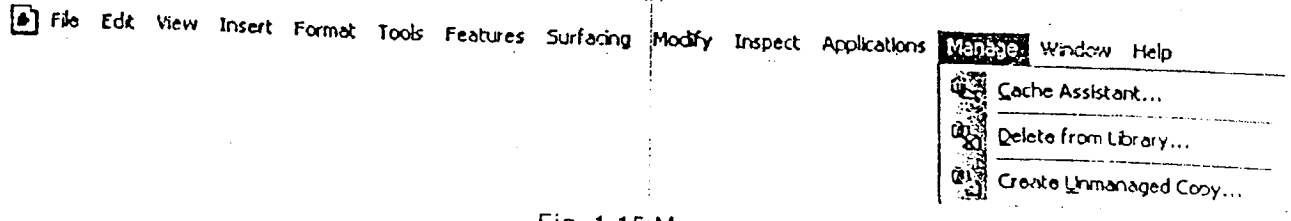


Fig. 1.15 Manage

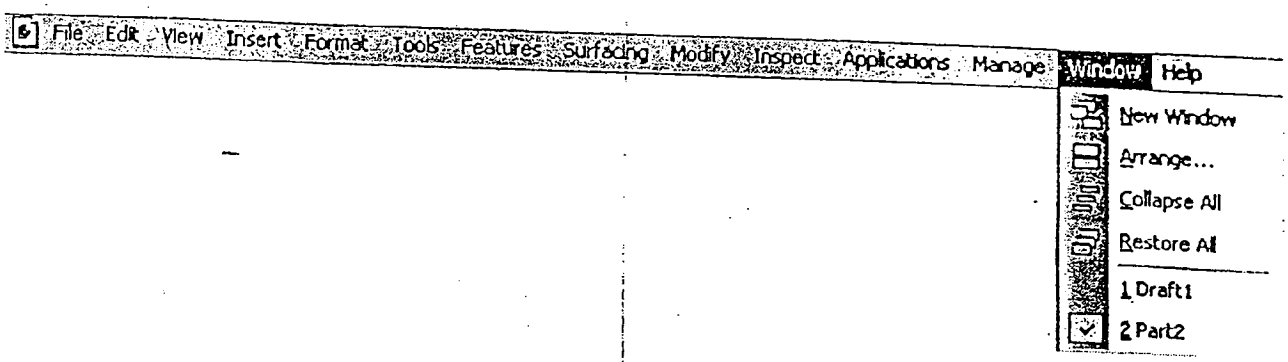


Fig. 1.16 Window

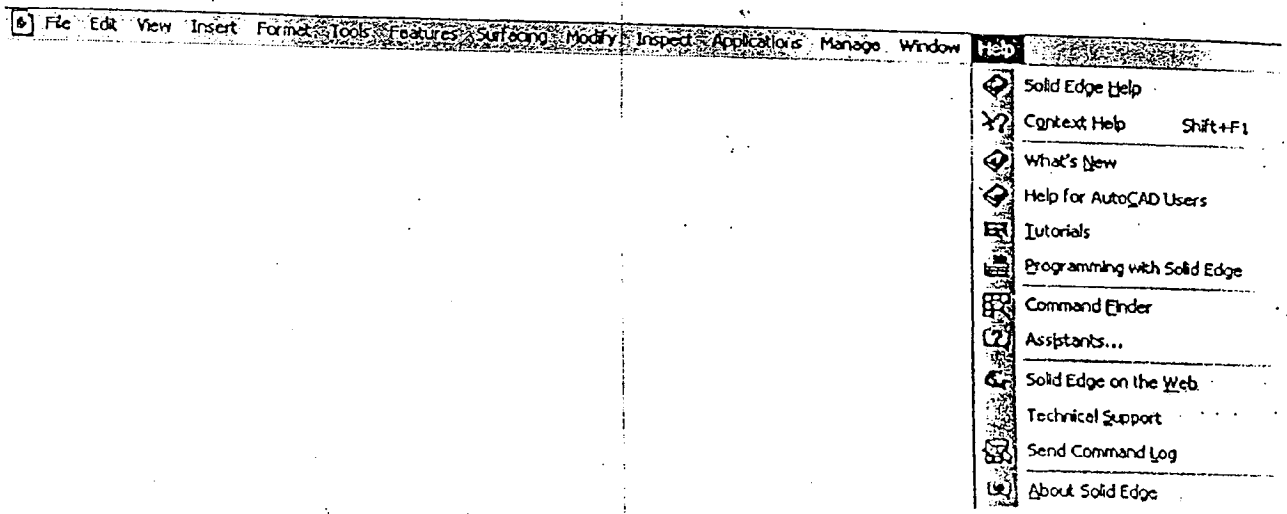
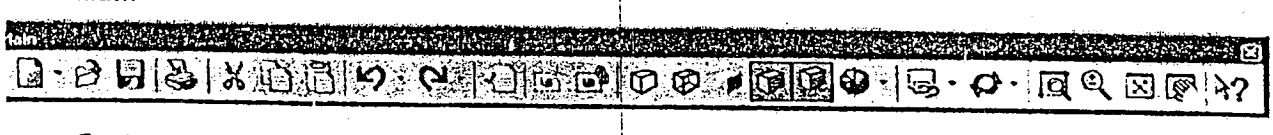


Fig. 1.17 Help

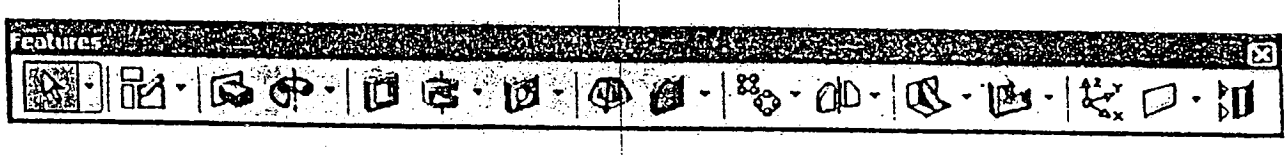
1.6.3 Tool Bars

Commonly used Tool Bars are represented in figure 1.18a and b.

Main



Features



Surfacing

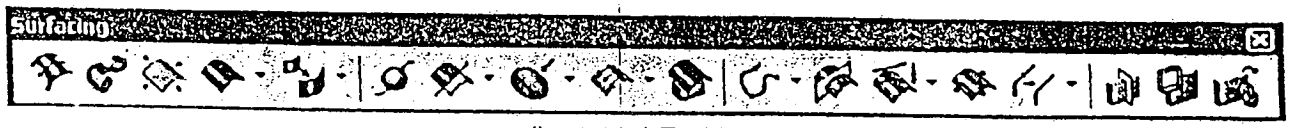
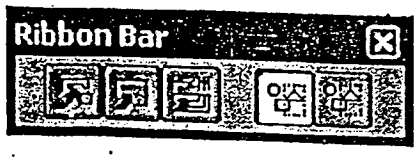


Fig. 1.18a) Tool bars

Ribbon Bar



Prompt Bar

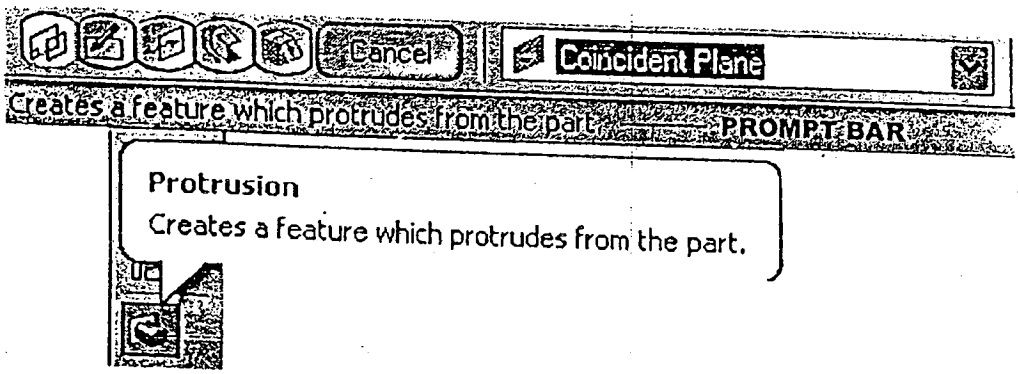


Fig. 1.18b) Tool bars (Continued)

1.6.4 Basic Sketching Commands

The commands used are of windows based. Just by selecting the icon of the command, the operation can be executed. The commands can be grouped into three modules, namely, Drawing (draft) environment, Part environment and Assembly environment.

1.6.4.1 Drawing (draft) environment commands

The commands used to create geometric figures and machine parts are shown in Table 1.2.

Table 1.2 Commands for geometric figure creation

Sl. No.	Command	Icon
1.	Select tool	
2.	Point	
3.	Line	
4.	Curve	
5.	Arc by 3 points	
6.	Arc by center point	
7.	Circle by center point	

8. Rectangle 
9. Fillet 
10. Chamfer 
11. Trim 
12. Trim corner 
13. Extend to next 
14. Split 
15. Offset 
16. Fill 
17. Move 
18. Rotate 
19. Mirror 
20. Scale 
21. Stretch 
22. Smart dimension 
23. Distance between 
24. Angle between 
25. Leader 
26. Text 
27. Character map 
28. Connect 

29.	Parallel	
30.	Perpendicular	
31.	Concentric	
32.	Collinear	
33.	Rigid	
34.	Tangent	
35.	Equal	
36.	Lock	
37.	Symmetria	
38.	Zoom	
39.	Pan	
40.	Fit	

1.6.4.2 Part environment commands

The commands used to create parts are shown in Table 1.3.

Table 1.3 Commands for part drawing

1.	Sketch	
2.	Protrusion	
3.	Revolved Protrusion	
4.	Swept Protrusion	
5.	Lofted Protrusion	
6.	Helical Protrusion	

7. Cutout 

8. Revolved Cutout 

9. Swept Cutout 

10. Lofted Cutout 

11. Helical Cutout 

12. Hole 

13. Thread 

14. Add draft 

15. Round 

16. Chamfer 

17. Pattern 

18. Pattern along curve 

19. Mirror 

20. Rib 

21. Thin wall 

22. Thin region 

23. Parallel plane 

24. Angled plane 

25. Perpendicular plane 

26. Rotate 

27. Spin about 

28. Common views 

29. Shaded 

30. Shaded Visible edges 

31. Zoom 

32. Zoom area 

33. Pan 

34. Fit 

35. Axis of revolution 

1.6.4.3 Assembly environment commands

The commands used to assemble machine parts are shown in Table 1.4.

Table 1.4 Commands for assembling machine parts

1. Assemble 

2. Move part 

3. Mate 

4. Planar align 

5. Axial align 

6. Insert 

7. Parallel 

8. Connect 

9. Angle 

1.7 STARTING A NEW DRAWING SHEET

The new 3D drawing sheet is opened by clicking in initial window under create menu Solid Part.

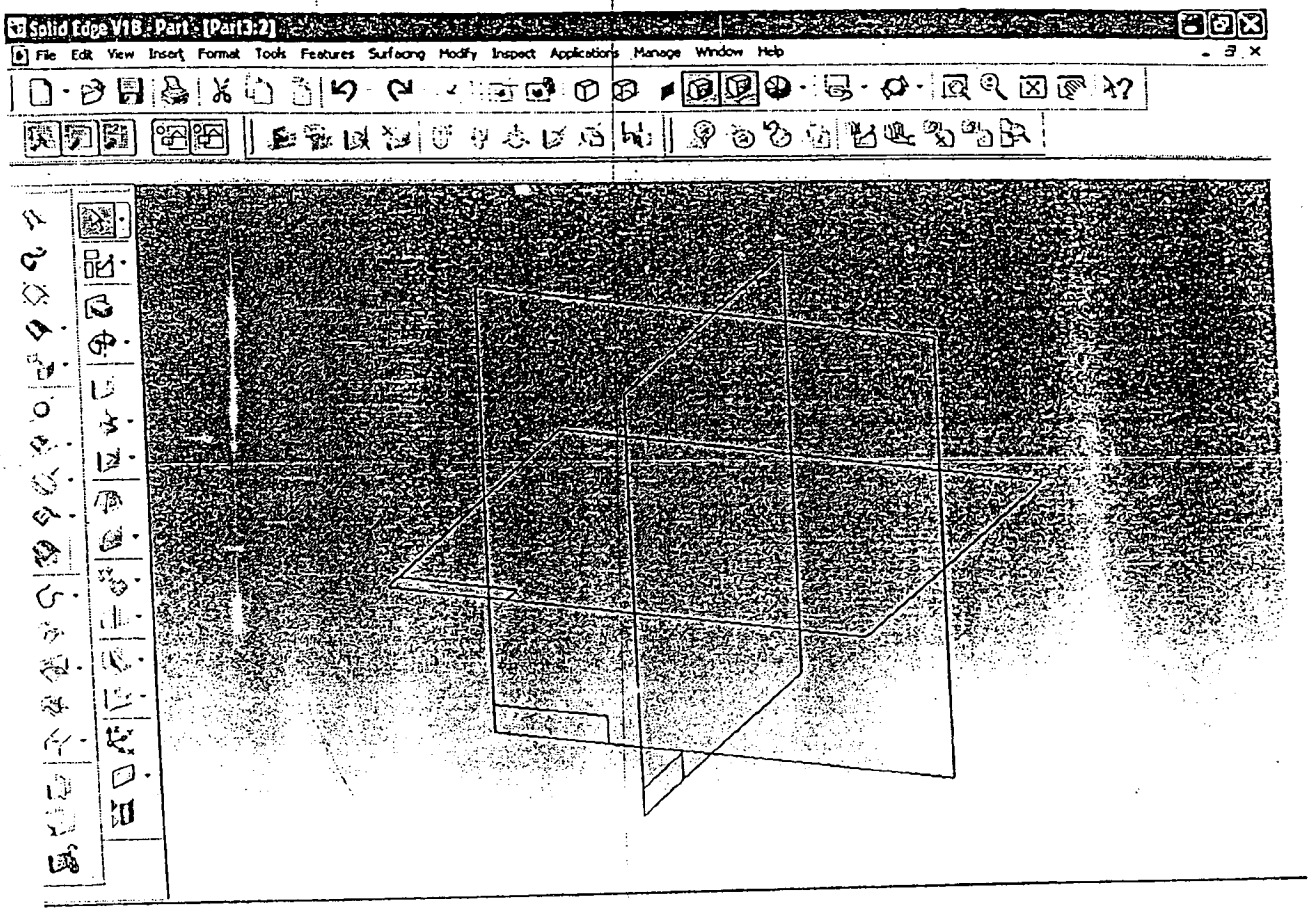


Fig. 1.19 Layout of sheet on computer screen.

CHAPTER – 2
SECTIONS OF SOLIDS

2.1. INTRODUCTION

Section of a solid means, cut away the solid to observe its internal features, which are essential to note the cross sectional shape and dimensions at the region of interest in that solid for various manufacturing purposes.

As an example, when a right circular cone is cut with a section plane at different angles to its axis, different sections viz. circle, ellipse, parabola and hyperbola, result at its cut surface when the section plane is parallel to base and inclined to base. The practical applications of such conic sections viz. antennae bridges etc. are well known.

In case of hollow solids and machine elements with webs or unsymmetrically drilled holes etc. all the details may not be visible in any one of the four views. In such case the hidden or invisible edges, holes etc. will be shown by continuous dotted lines. But if such features are too many, reading of drawing may be more complicated and hence difficult to interpret. In such cases it is customary to imagine that such solids being cut through by an imaginary cutting plane. Later the part of the cut solid between the cutting plane and the observer is assumed to be removed so as to enable the observer to see the details at the region of interest, where the solid cut portions are shown by cross hatched lines. Then, such a views with cross hatched lines is called a section view.

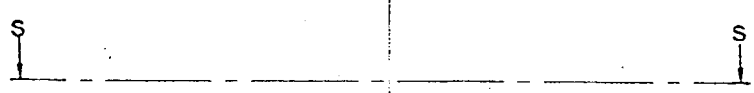
Even the cross sections of solid crane hooks, connecting rods, beams, arms or pulleys or gears etc. may be shown. In order to understand the concept of sectioning more clearly and enable to prepare or to read a sectioned drawing, the preliminary study of analyzing the sectional details of basic solids viz. pyramids, cones, prisms, cylinders etc. will help significantly.

2.2. DEFINITIONS

2.2.1. Section View : It is an orthographic view showing the interior features of the remaining sectioned object as visual lines.

2.2.2. Section Lines : These are the cross hatched lines drawn on the solid cut surfaces of an interior portion of the object. These are the uniformly spaced thin continuous lines drawn inclined at 45° to the axis or to the main outline of the section. Section lines in two different solids are due to two different section planes and should be drawn in opposite directions.

2.2.3. Section Plane: It is an imaginary flat surface used to cut through a solid to reveal its interior. They are represented by their respective traces, i.e. VT on VP, HT on HP and PT on PP. It is generally denoted conventionally with names SS or AA or XX as follows :



The arrows indicate the direction of viewing the cut solid after removing the cut portion in between the section plane and the observer.

2.2.4. True Shape of Section : It is the cut surface of a solid which appears to the observer with its actual dimensions and shape. When the cut surface is parallel to the observer, only then one can see the true shape of section. In other words, if the section plane is parallel to VP or HP or PP, the projection on that respective reference plane will be the true shape of section.

2.2.5. Apparent Section : It is the cut surface of a solid which appears to the observer with apparent dimensions. When the cut surface is not parallel to the observer, i.e. if the section plane is inclined to a reference plane, the projection of the cut surface obtained on that plane will be an apparent section.

2.2.6. Auxiliary Section : It is the true shape of section projected on an auxiliary reference plane which is parallel to the section plane. Hence, an auxiliary/ additional plane helps to obtain the true shape of section in case of inclined section planes.

2.3 ILLUSTRATIVE EXAMPLES

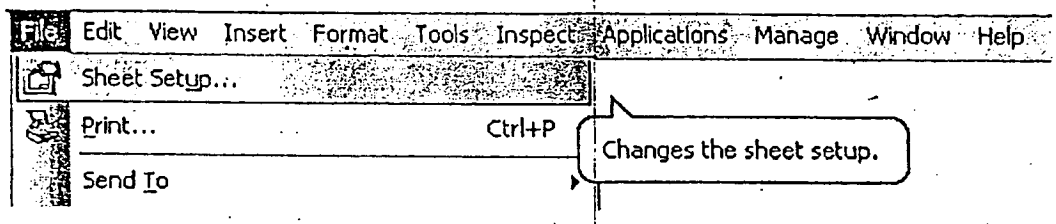
The sectional views of pyramids, tetrahedrons, cones, cubes, prisms, cylinders are illustrated.

2.3.1 Sections of Pyramids

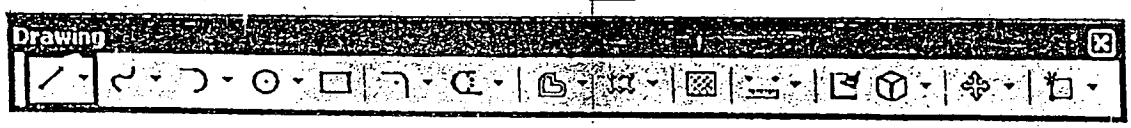
Problem 2.1. An equilateral triangular pyramid of base side, 40mm and height 70mm rests with its base on the HP such that one of its slant edges parallel to VP. A section plane perpendicular to VP and inclined at 63° to HP cuts the pyramid by passing through one of its lateral faces at a height of 9mm above the HP. Draw the front view, sectional top view and sectional side view along with the cut solid.

Computer Aided Drafting Procedure

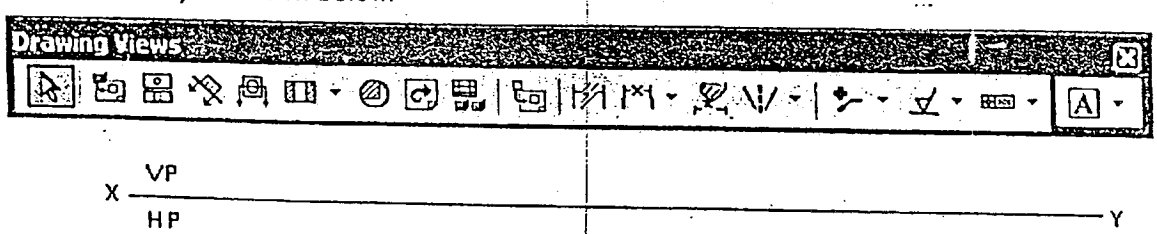
1. Open the SOFTWARE. Click on the DRAWING in the CREATE dialog box.
2. Set up the sheet of required size by clicking the SHEET SET UP in the FILE. Select A4 wide size sheet for this problem.



3. Draw the line by using the LINE COMMAND (DRAWING TOOL BAR).



4. Make annotations XY, HP, and VP to the line by using TEXT COMMAND (DRAWING VIEWS TOOL BAR) as shown below.



5. Create the TRIANGLE in the top view with base side of 40mm by using LINE COMMAND (FROM DRAWING TOOL BAR), ANGLE BETWEEN COMMAND (FROM DRAWING VIEW TOOL BAR) and DISTANCE BETWEEN COMMAND (FROM DRAWING VIEW TOOL BAR). With one edge perpendicular to the XY line using PERPENDICULAR COMMAND . Mark the corner points of base of triangle as a, b, c and center as 'o'. Join a, b, c to o, and mark apex as 'o' as shown in the solution.

6. Create the projectors from corners of the top view, perpendicular to the "XY" line in the upward direction using **LINE COMMAND**  . Change the properties, (width) of the line, using **LINE RIBBON BAR**. Make all the projector lines 0.05mm thick. Then draw the line (front view) then Mark the intersection points as (a)', b', c' using the **TEXT COMMAND**  , as shown in the Figure.

7. Draw axis of length 70mm from the XY line, using **LINE COMMAND**  . Join all the corners to apex to get front view. Mark annotations as shown.

8. Create the X_1Y_1 line perpendicular to the XY line at any distance from projection line representing the intersection between VP and left PP using the **LINE COMMAND**  . Mark the intersection point of the lines as 'o'.

9. Draw horizontal projectors using **LINE COMMAND**  towards left side to get side view and represent it as a", b", c" and o" as shown.

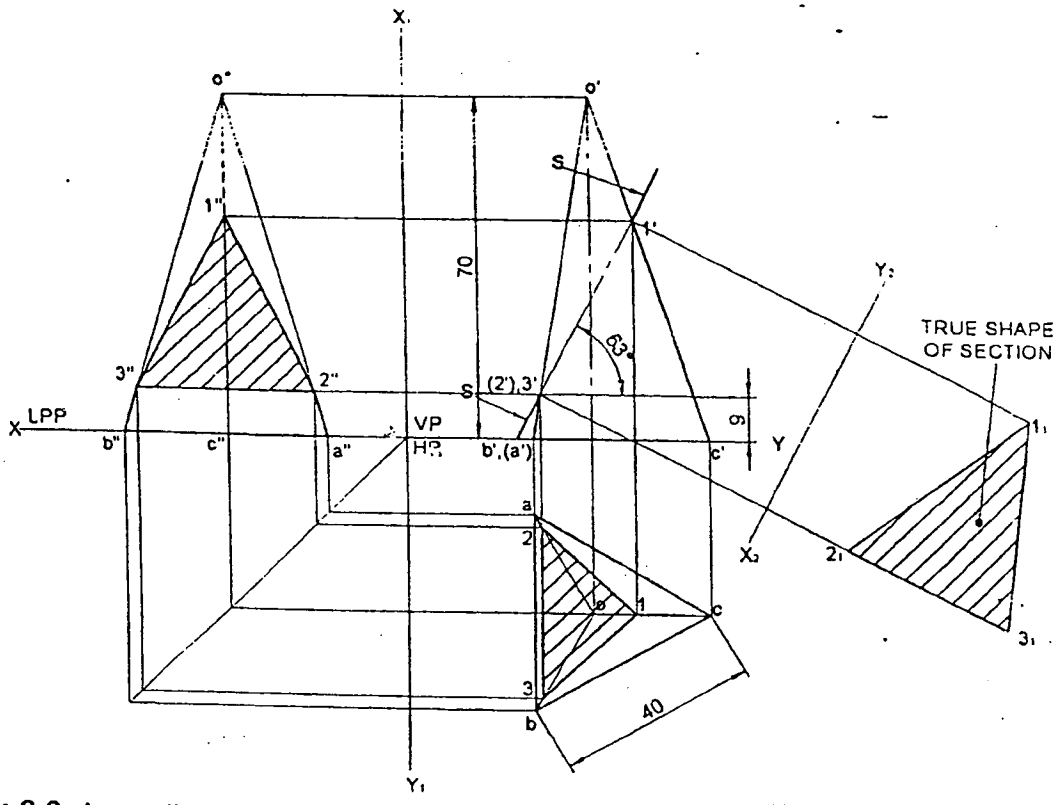
10. Using **LINE COMMAND**  draw a line inclined at 63° to XY line passing through front view at a height of 9mm from the base of triangular pyramid and represent it as SS using text command and show the arrow mark using leader command as shown in the Fig. Mark the points 1', (2') and 3' where, the sectional plane cuts the slan' edges of the pyramid.

11. Using **LINE COMMAND**  drop the projectors to cut the slant edge of pyramid in the top view mark the respective slant edges as 1, 2 and 3. Join these points. Using **FILL COMMAND**  select the area bounded by 1, 2 and 3 in top view to get hatching for the sectioned pyramid.

12. Using **LINE COMMAND**  draw the lines towards left PP from points 1, 2 and 3 and 1', 2' and 3' to get 1", 2" and 3" in the side view. Using **FILL COMMAND**  select the area bounded by 1", 2" and 3" in side view to get hatch ing for the sectioned pyramid.

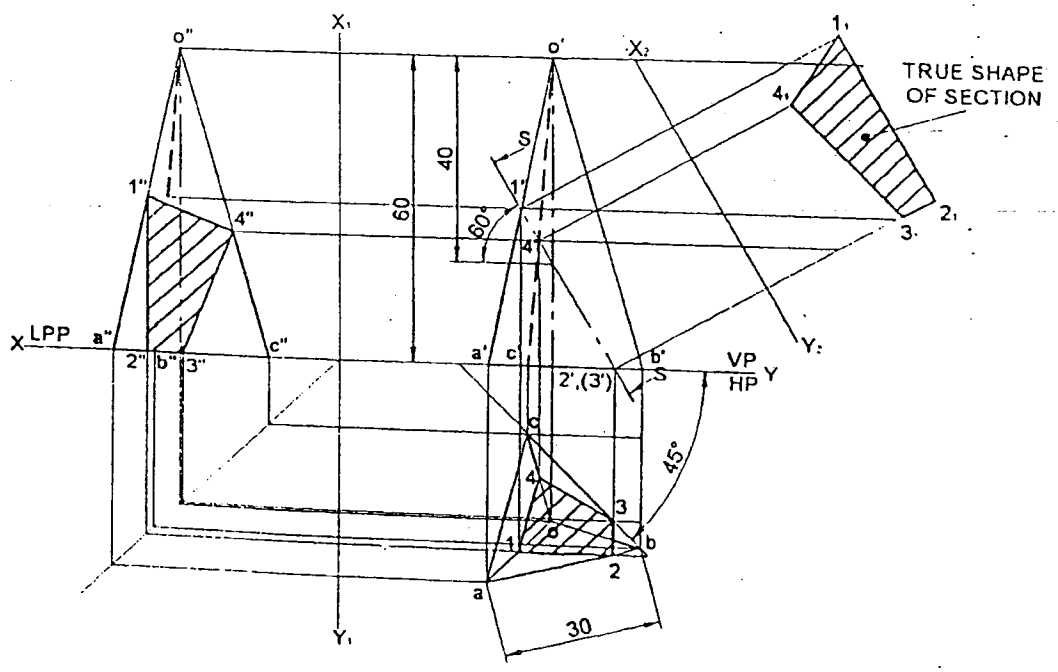
13. Draw a line parallel to sectional plane SS at any distance and represent it as X_2Y_2. Using **LINE COMMAND**  draw lines from points 1', 2' and 3' such that, lines should be perpendicular to X_2Y_2. Measure the distance between XY line and points 1, 2 and 3 from the top view and represent the same distance on the respective lines from X_2Y_2 to get 1_1, 2_1 and 3_1 join these points using **LINE COMMAND**  and hatch using **FILL COMMAND**  to get the true shape of section as shown in the fig.

14. Using **DIMENSION COMMANDS**  and  dimension the triangular pyramid and finally save the file.



Problem 2.2. An equilateral triangular pyramid of 30mm side of base and axis 60mm long rests with its base on HP such that one of the base edges is inclined at 45° to the VP and nearer to it. It is cut by a section plane inclined at 60° to the HP and perpendicular to the VP, intersecting the axis at 40 mm from the vertex. Draw the front view, sectional views looking from the top and right side along with the cut solid. Also project the true shape of section.

Solution



Problem 2.3. Fig. P2.3 shows the sectional side view of an equilateral triangular truncated pyramid. Determine the true shape of section. Also find the inclination of the section plane with the reference plane and size of the pyramid.

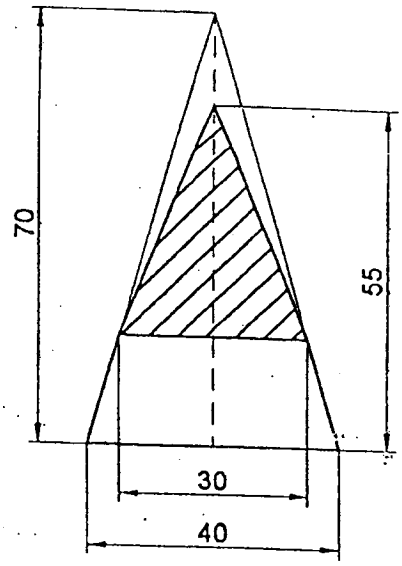
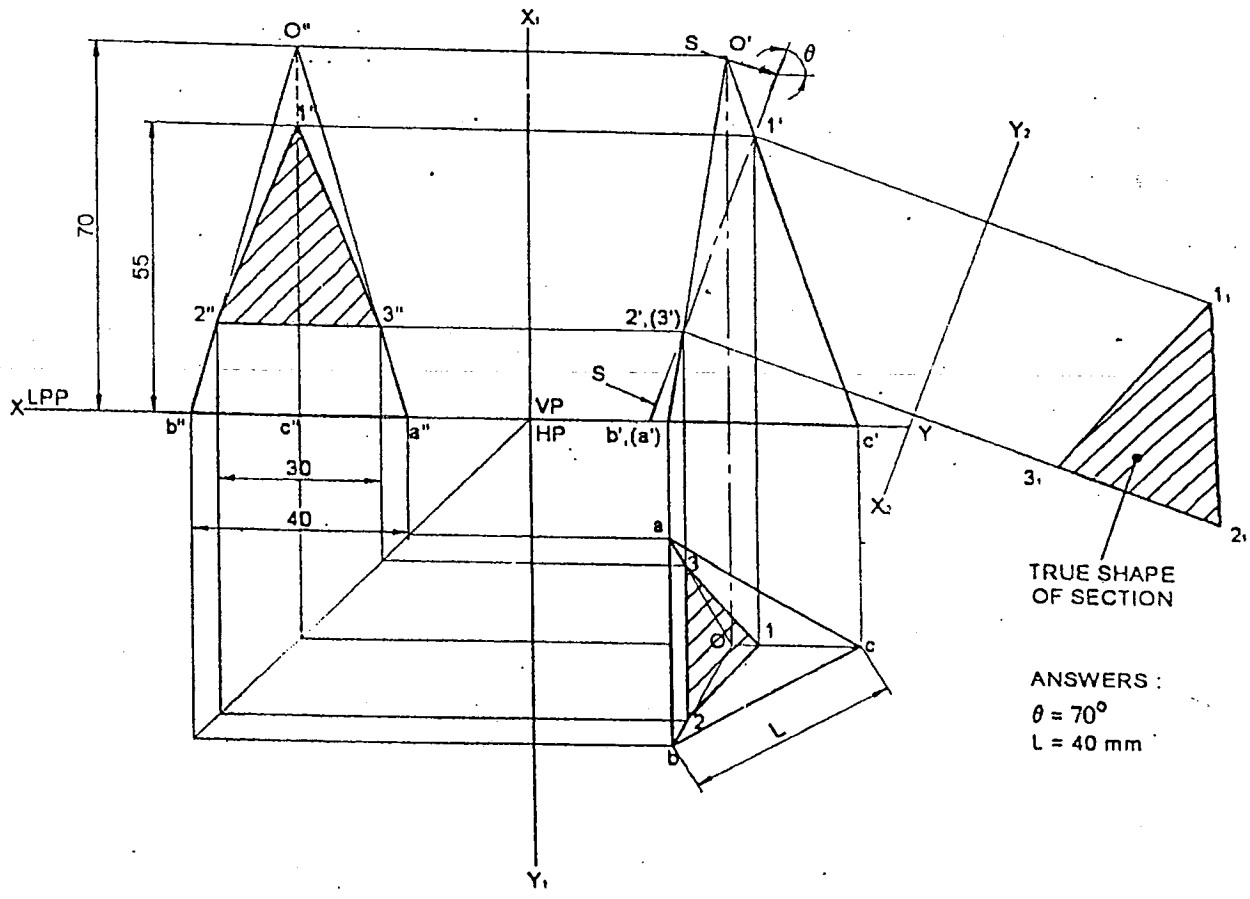


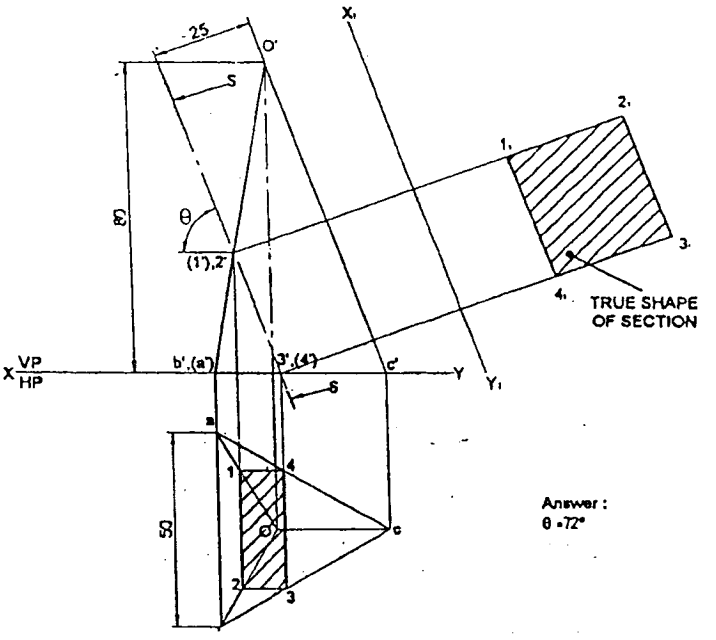
Fig. P2.3

Solution



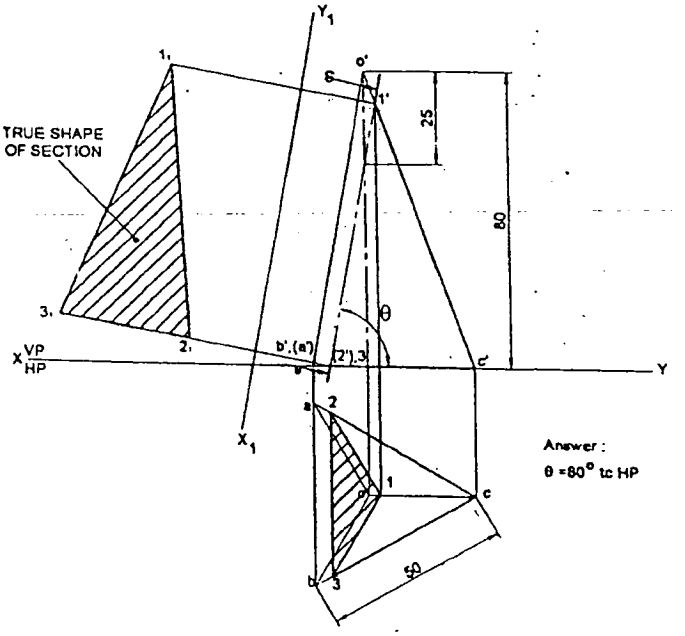
Problem 2.4. A triangular pyramid of base sides 50mm and axis 80mm long stands vertically with its base on the HP, such that one of the base edges is perpendicular to VP. A sectional plane perpendicular to VP and parallel to one of the slant edges of the pyramid passes at a distance of 25mm from it. Draw the sectional top view and true shape of section. Also determine the inclination of the section plane with the reference plane.

Solution



Problem 2.5. A triangular pyramid of 50mm side of base and axis length 80mm rests on its base on the HP with one of its base edges perpendicular to the VP. A section plane perpendicular to the VP and parallel to one of the lateral faces of the pyramid passes through at a distance of 25 mm from the apex. Draw the front view, sectional top view and true shape of section. Determine the inclination of the section plane with the reference plane.

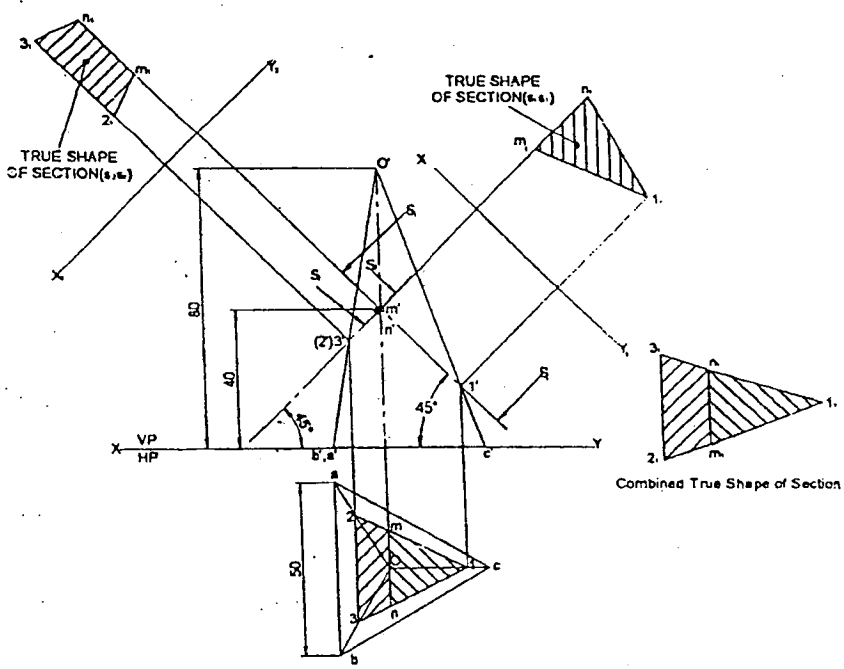
Solution



Problem 2.6. A triangular pyramid base 50mm sides and axis 80mm long, resting on its base on the ground

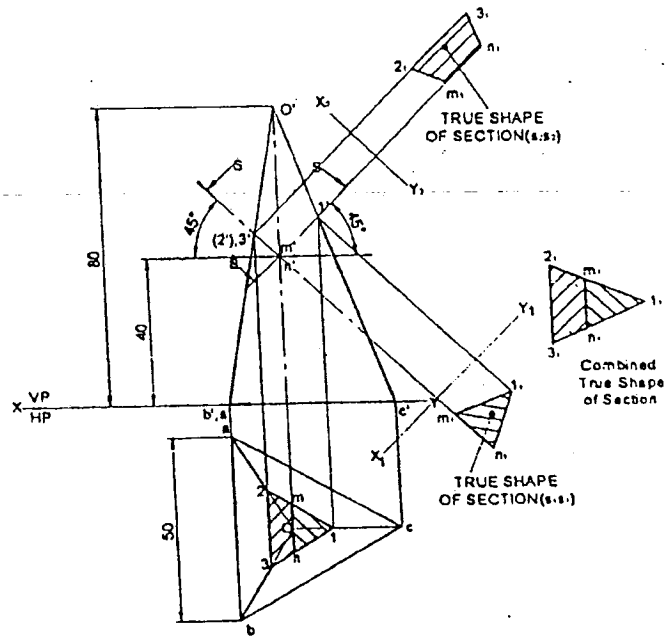
with one of its base edges perpendicular to VP, is cut by two section planes, both perpendicular to the VP and are inclined at 45° to the HP, meet the axis at its midheight. Both the section planes lie on either side of the axis and lean towards the base of the pyramid. Draw the front view, sectional top view and the combined true shape of section.

Solution



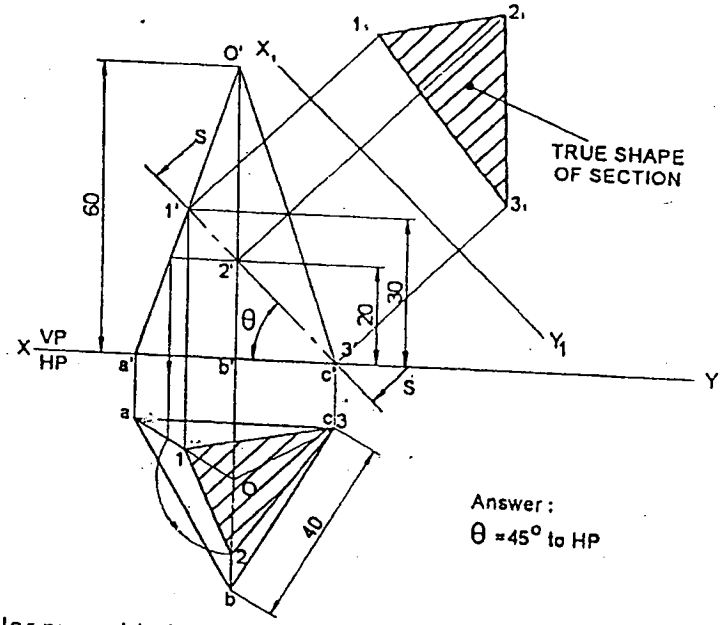
Problem 2.7. A triangular pyramid of base sides 50mm and 80mm long, resting on its base on the ground with one of its base edges perpendicular to the VP, is cut by two section planes, both perpendicular to the VP and are inclined at 45° to the HP, meet the axis at its midheight. Both the section planes lie on either side of the axis and lean upwards. Draw the front view, sectional top view and the combined true shape of section.

Solution



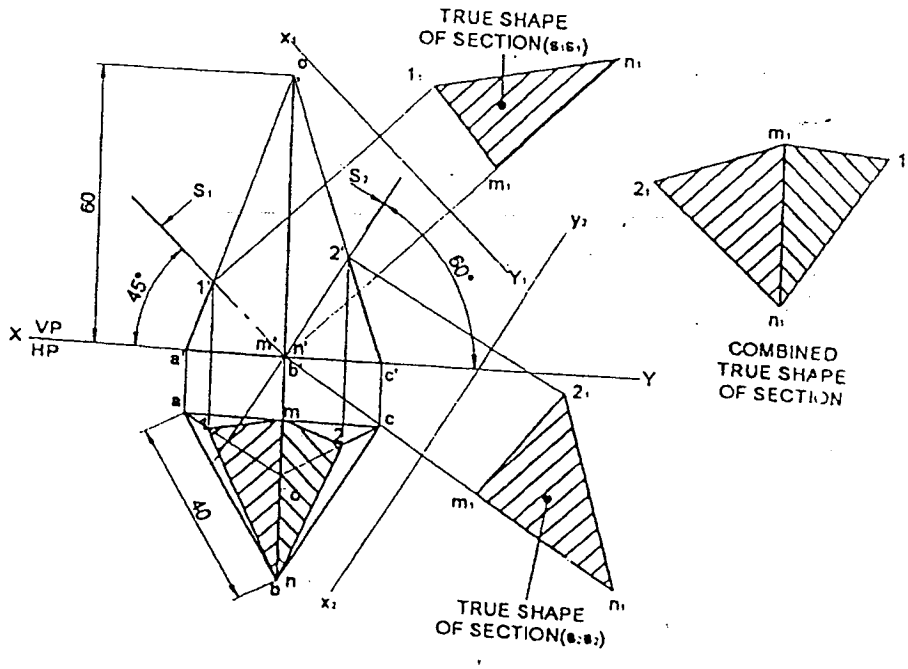
Problem 2.8. A triangular pyramid, base 40mm sides and axis 60mm long, resting on its base on the HP with one of its base edges parallel to the VP. A section plane passing through one of the base corners of the pyramid and the two slant edges at 20mm and 30mm above the HP cuts the pyramid. Draw the front view, sectional top view and true shape of section. Determine the inclination of the section plane with the reference plane.

Solution



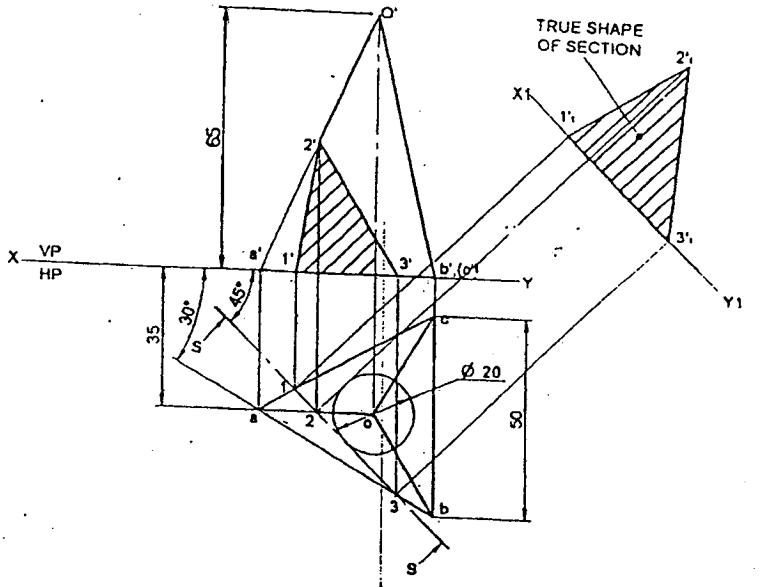
Problem 2.9. A triangular pyramid of base sides 40mm and axis length 60mm is resting on its base on the ground with one of its base edges parallel to the VP and nearer to it. It is cut by two section planes both perpendicular to the VP and inclined to HP and meet at one of the base corners of the pyramid which is at equidistant from the other two base corners. One of the section planes is inclined at 45° to the HP and cuts the left slant edge while the other section plane is inclined at 60° to the HP and cuts the right end slant edge. Draw the front view, sectional top view and the combined true shape of section.

Solution



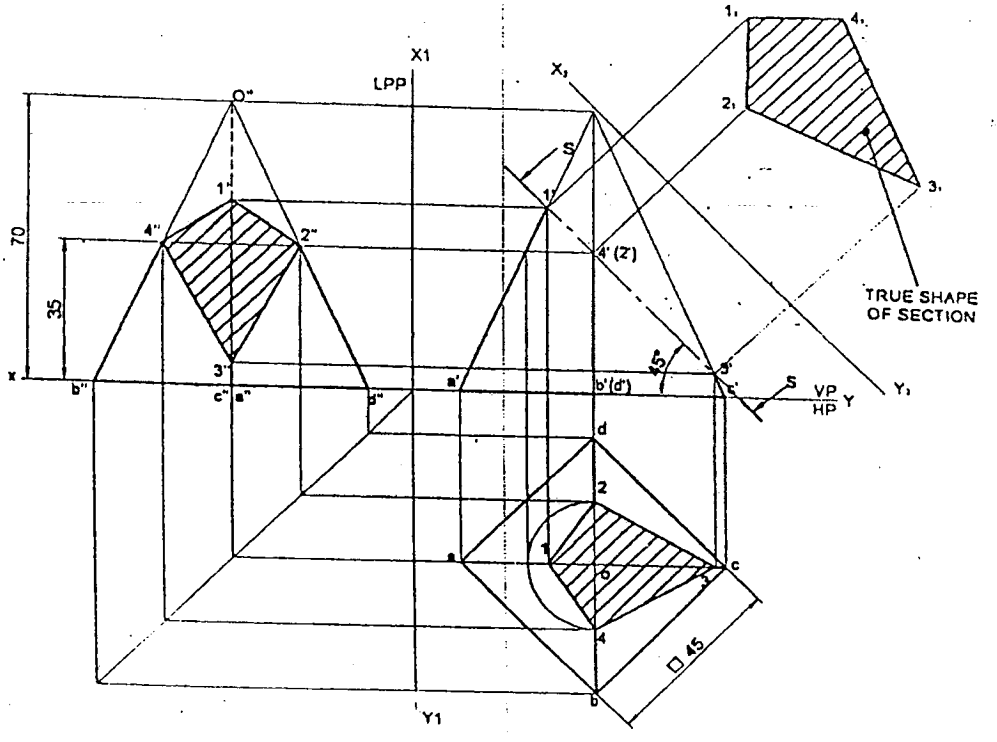
Problem 2.10. A triangular pyramid of base sides 50mm and axis 65mm long rests vertically on its base with one of the base edges inclined at 30° to the VP and away from it in such a way that the apex will be at 35mm in front of the VP. A HT inclined at 45° to XY line cuts the pyramid at 10mm infront of the axis. Both the section plane and the reference base edge of the pyramid lean towards right side. Draw the resulting sectional view and the true shape section.

Solution



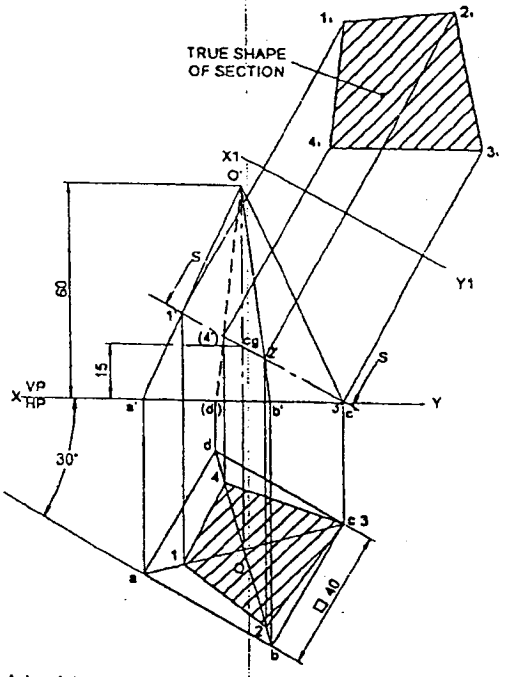
Problem 2.11. A square pyramid of base side 45mm and axis length 70mm rests on its base on the HP in such way that all of its base edges are equally inclined to the VP. It is cut by a section plane perpendicular to the VP, inclined at 45° to the HP and bisecting the axis. Draw its sectional top view, sectional side view and true shape of section.

Solution



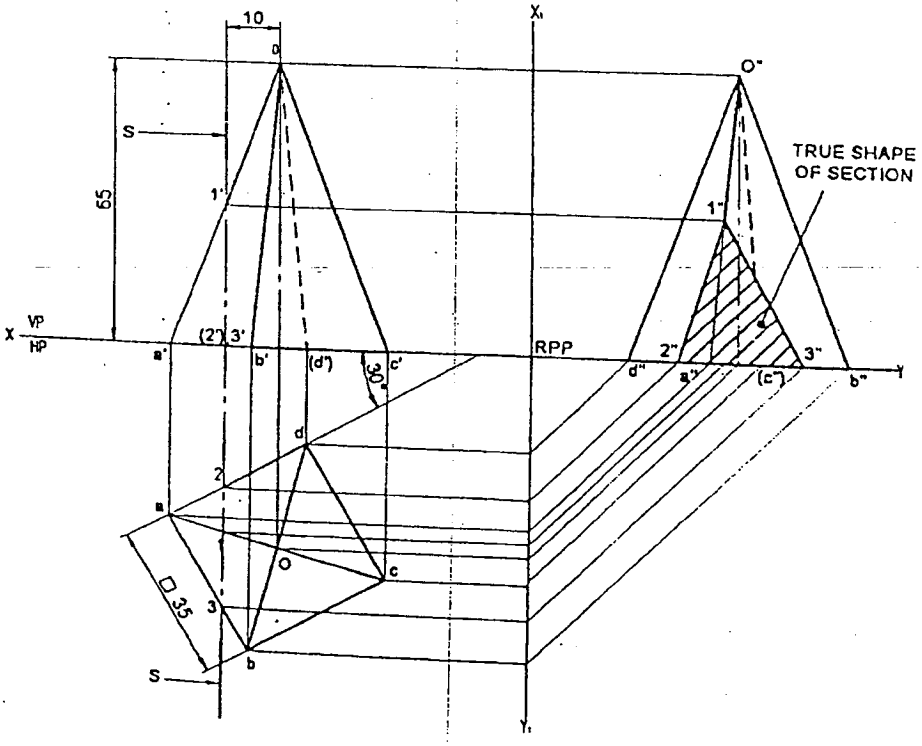
Problem 2.12. A square pyramid side of base 40mm and altitude 60mm has its base on the HP with an edge of base inclined at 30° to the VP. It is cut by a VT, passing through one of the extreme base corner and the center of gravity of the pyramid. Draw the sectional top view and true shape of section.

Solution



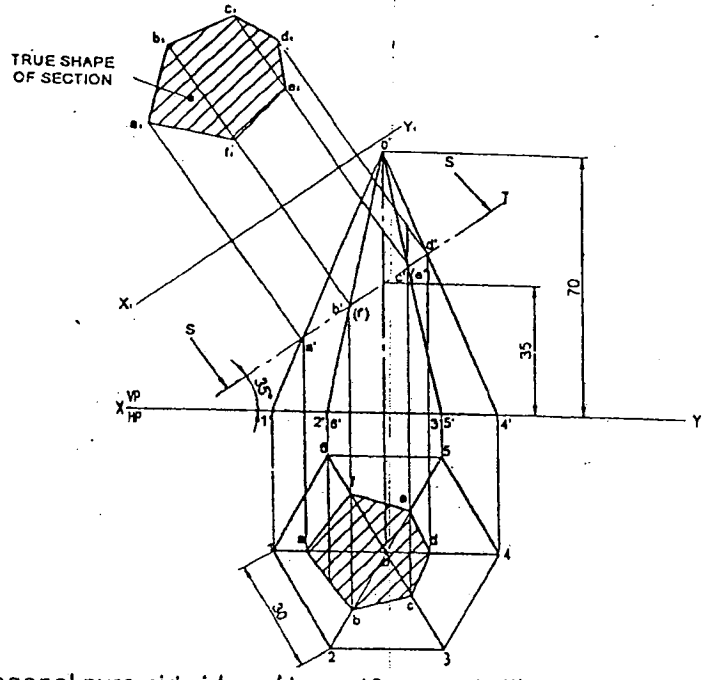
Problem 2.13. A square pyramid of base side 35mm and axis length 65mm is resting on the HP on its base with a side of base inclined at 30° to the VP. It is cut by a plane perpendicular to both the HP and VP and is 10mm away from the axis. Draw its top view, front view and true shape of section.

Solution



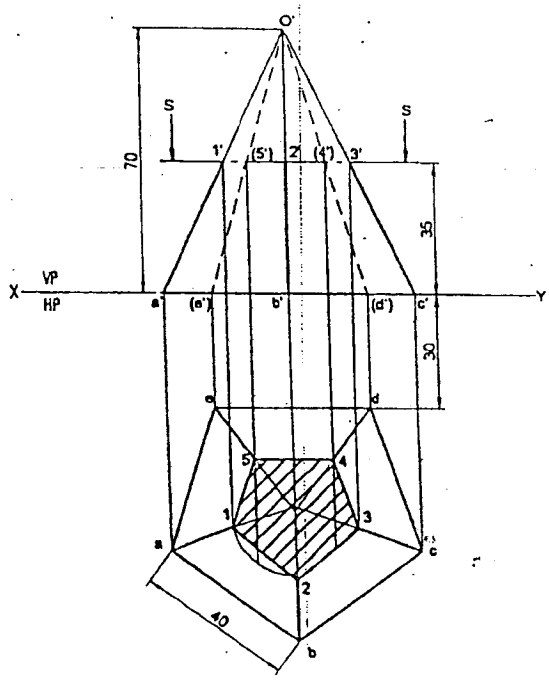
Problem 2.14. A hexagonal pyramid sides of base 30mm and altitude 70mm is rests with its with its base on the HP and with a side of base parallel to the VP. It is cut by a cutting plane inclined at 35° to the HP and perpendicular to the VP and is bisecting the axis. Draw the front view, the sectional view looking from the top and true shape of section.

Solution



Problem 2.15. A pentagonal pyramid sides of base 40mm and altitude 70mm is rests with its with its base on the HP and with a side of base parallel to the VP and 25 mm from it. It is cut by a horizontal cutting plane and is bisecting the axis. Draw the front view and the sectional view looking from the top.

Solution

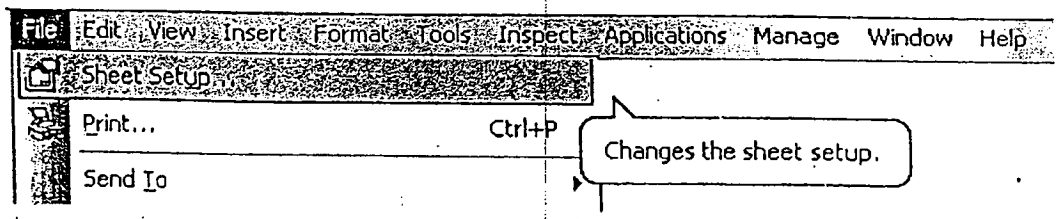


2.3.2 Sections of Tetrahedrons

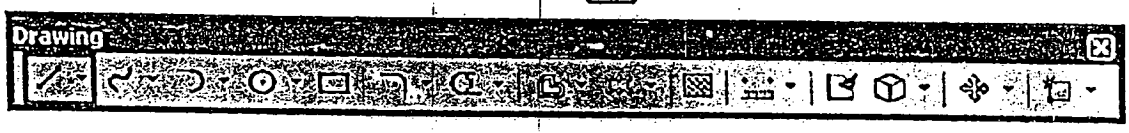
Problem 2.16. A tetrahedron of sides 60mm is resting on the HP on one of its faces, with an edge perpendicular to the VP and the nearest base corner is 25mm infront of it. A VT, whose angle of inclination 55° with the reference line XY cuts the solid by passing through the axis at a height of 40mm above the base. Draw the resulting sectional view and true shape of section.

Computer Aided Drafting Procedure

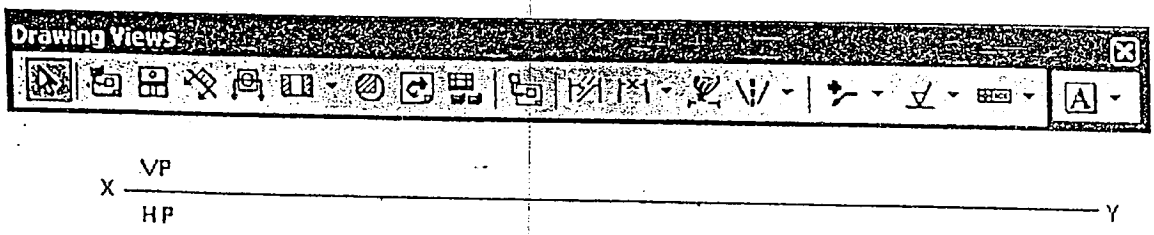
1. Open the SOFTWARE. Click on the DRAWING in the CREATE dialog box.
2. Set up the sheet of required size by clicking the SHEET SET UP in the FILE. Select A4 wide size for this problem.



3. Draw the line by using the LINE COMMAND (DRAWING TOOL BAR).



4. Make annotation XY, HP, and VP to the line by using TEXT COMMAND (DRAWING VIEWS TOOL BAR) as shown below.



5. Create the TRIANGLE in the top view with base side of 40mm by using LINE COMMAND (FROM DRAWING TOOL BAR), ANGLE BETWEEN COMMAND (FROM DRAWING VIEW TOOL BAR) and DISTANCE BETWEEN COMMAND (FROM DRAWING VIEW TOOL BAR). With one edge perpendicular to the XY line using PERPENDICULAR COMMAND. Mark the corner points of base of triangular as a **b, c** and center as **'o'** . Join **a, b, c** to **o** and mark apex as **'o'** as shown in the Fig.
6. Create the projectors the lines from top view, perpendicular to the XY line in the upward direction using LINE COMMAND Change the properties, (width) of the line, using LINE RIBBON BAR. Make all the projector lines 0.05mm thick. Then draw the line (front view) then Mark the intersection points as **(a)', b', c'** using the TEXT COMMAND, as shown in the Fig.

7. Draw axis line of tetrahedron and draw a line of length 70mm from one corner in front view to meet the axis line using **LINE COMMAND** join all the corners to top corner to get front view mark annotations as shown.

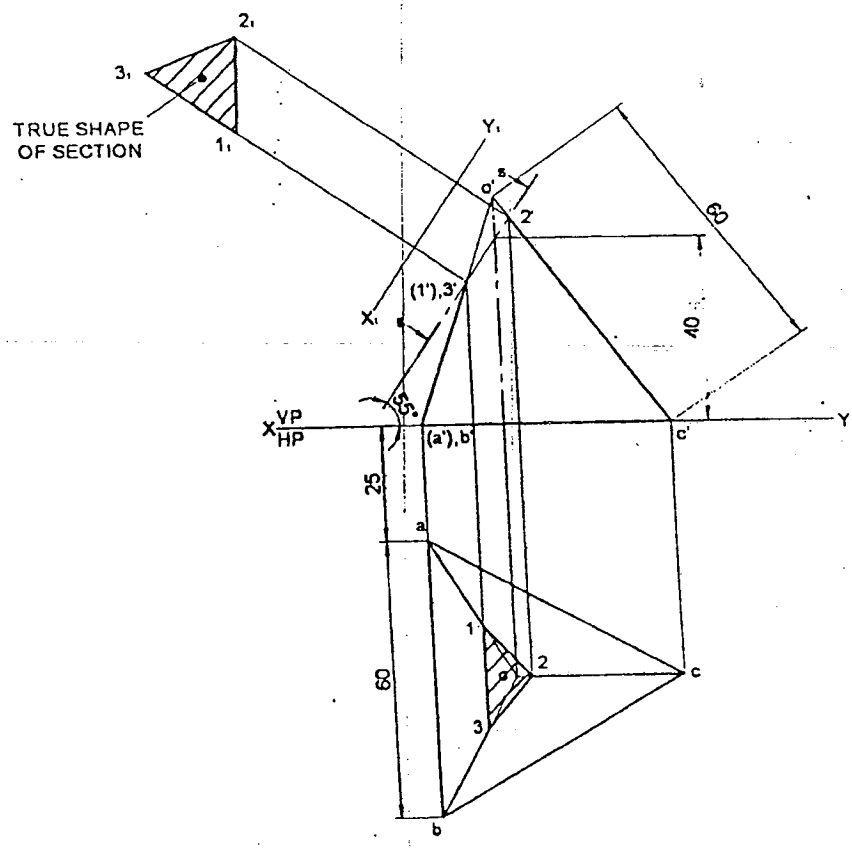
8. Using **LINE COMMAND** draw a line inclined at 55° to XY line passing through front view at a height of 40mm from the base of tetrahedron and represent it as SS using text command and show the arrow mark using leader command as shown in the Fig. Mark the points 1', (2') and 3' where the sectional plane cuts the slant edges of the tetrahedron.

9. Using **LINE COMMAND** drop the projectors to cut the slant edge of tetrahedron in the top view mark the respective slant edges as 1, 2 and 3. Join these points. Using fill command select the area bounded by 1, 2 and 3 in top view to get hatching for the sectioned pyramid.

10. Draw a line parallel to sectional plane SS at any distance and represent it as X_2Y_2. Using line command draw lines from points 1', 2' and 3' such that, lines should be perpendicular to X_2Y_2. Measure the distance between XY line and points 1, 2 and 3 from the top view and represent the same distance on the respective lines from X_2Y_2 to get 1_1, 2_1 and 3_1 join these points using **LINE COMMAND** and hatch using **FILL COMMAND** to get the true shape of the section as shown in the fig.

11. Trim all the unwanted construction lines by using **TRIM COMMAND**. Note, for the edges which are not visible, choose line type as dotted and annotate as shown.

12. Using **DIMENSION COMMANDS** and dimension the solid and save the file.



Problem 2.17. Fig. P.16 shows two concentric equilateral triangles. It is the resulting sectional view of a tetrahedron resting on its base on the HP which is cut by a VT. Complete the projections of the cut solids. Determine the height of the full solid and the position of the section plane.

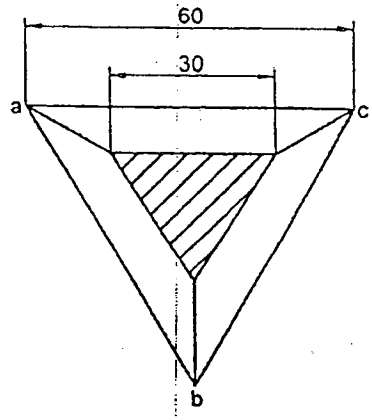
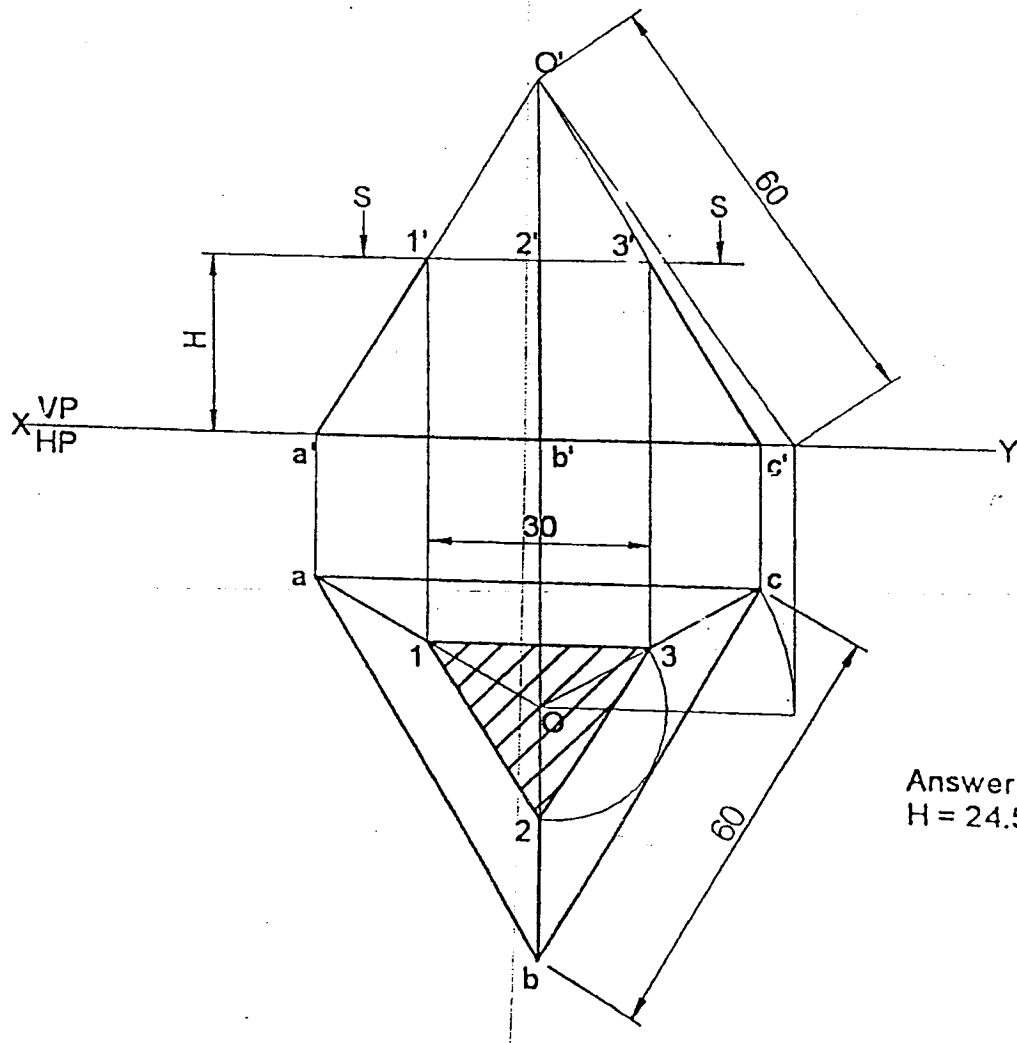


Fig. P.16

Solution



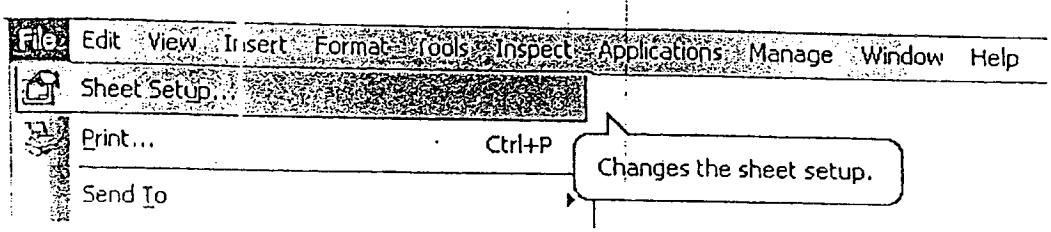
Answer :
H = 24.53 mm

2.3.3 Sections of Cones

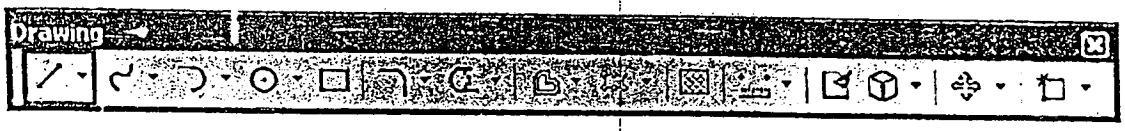
Problem 2.18. A cone of base diameter 50mm and axis length 65mm rests with its base on the HP. Draw the true shape of section made by a section plane perpendicular to the VP and inclined to the HP at 50° and passing through an end point on the circumference of the base circle of the cone.

Computer Aided Drafting Procedure

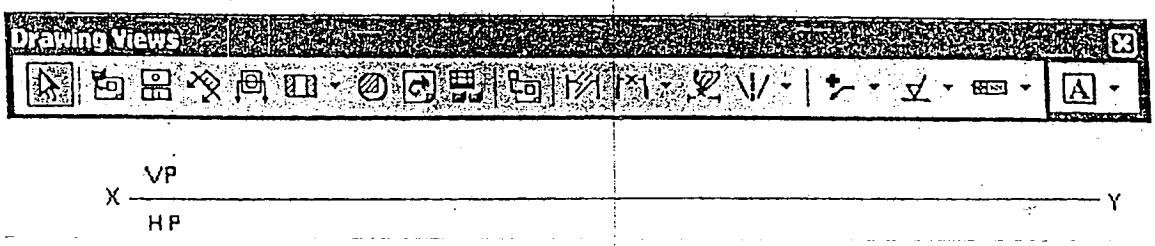
1. Open the **SOFTWARE.** Click on the **DRAWING** in the **CREATE** dialog box.
2. Set up the sheet of required size by clicking the **SHEET SET UP** in the **FILE.** Select **A4 wide size** for this problem.



3. Draw the line by using the **LINE COMMAND** (**DRAWING TOOL BAR**).



4. Make annotation XY, HP, and VP to the line by using **TEXT COMMAND** (**DRAWING VIEWS TOOL BAR**) as shown below.



5. Using **CENTER AND RADIUS COMMAND** draw a circle of dia 50mm below XY line divide the circle into any number of parts say eight as shown. Represent them as a, b, etc.
6. Create the projectors the lines from top view, perpendicular to the XY line in the upward direction using **LINE COMMAND** Change the properties, (width) of the line, using **LINE RIBBON BAR.** Make all the projector lines 0.05mm thick. Then draw the line (front view) then Mark the intersection points as **a', b', c'** etc., using the **TEXT COMMAND** as shown in the Fig.
7. Using **LINE COMMAND** draw a line to XY line passing through front view from one end of the corner of cube at base such that it should be perpendicular to the solid diagonal of the cube and represent it as SS using **TEXT COMMAND** and show the arrow mark using **LEADER COMMAND** as shown in the Fig. Mark the points 1', 2', 3', 4', where the sectional plane cuts the sides of the cube.

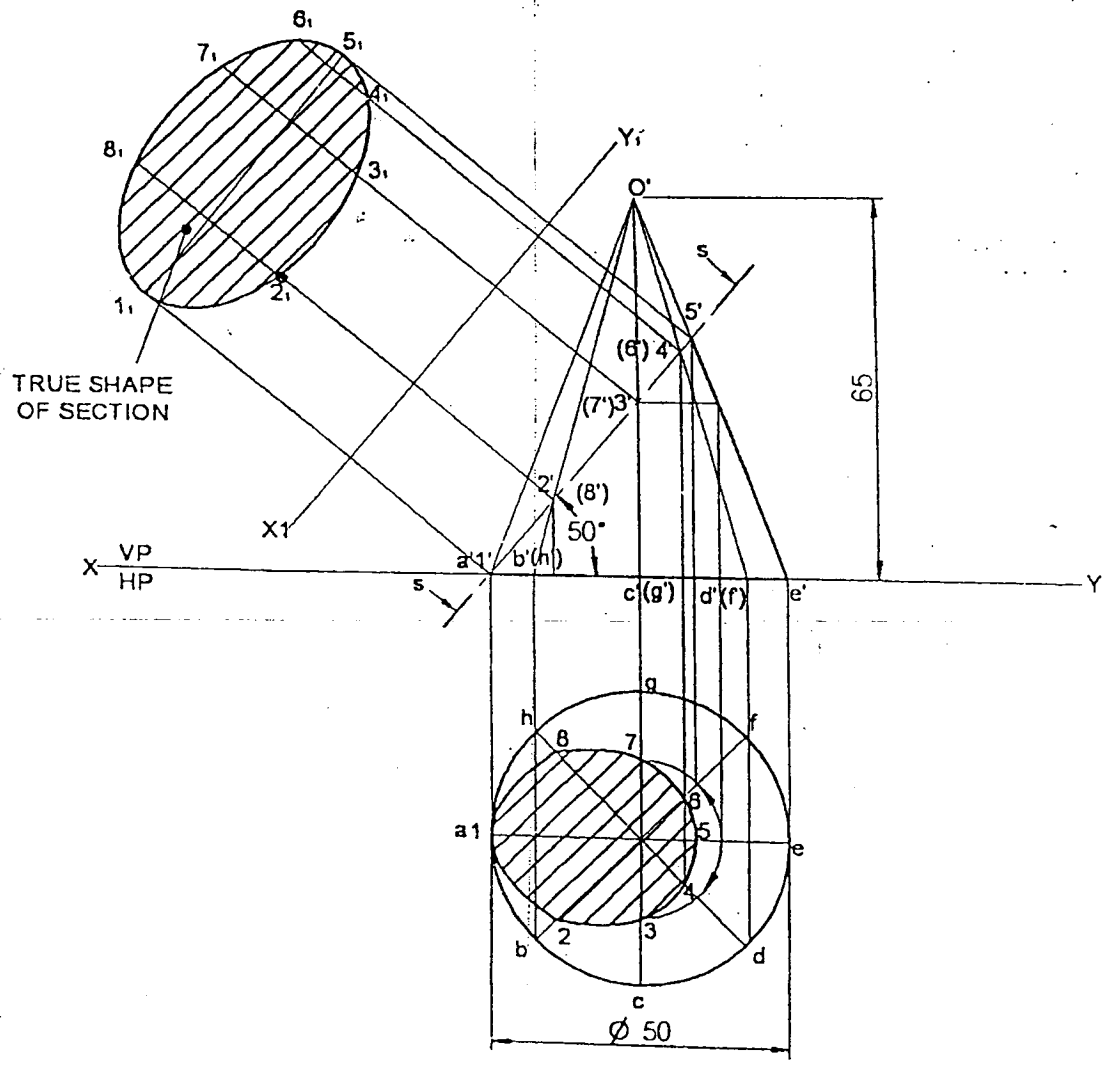
8. Using **LINE COMMAND** drop the projectors to the top view and mark as 1, 2, 3 and 4. Join these points.

   Using **FILL COMMAND** selects the area bounded by 1, 2, 3 and 4. in top view to get hatching for the sectioned cube. In this case it Is total top view as shown in the fig.

9. Draw a line parallel to sectional plane SS at any distance and represent it as X_1Y_1. Using **LINE COMMAND** draw lines from front view points 1', 2', 3' and 4' such that, lines should be perpendicular to X_1Y_1. Measure the distance between XY line and points 1, 2, 3 and 4 from the top view and represent the same distance on the respective lines from X_1Y_1 to get 1_1, 2_1, 3_1 and 4_1, join these points using **LINE COMMAND** and hatch using **FILL COMMAND** to get the true shape of the section as shown in the fig.

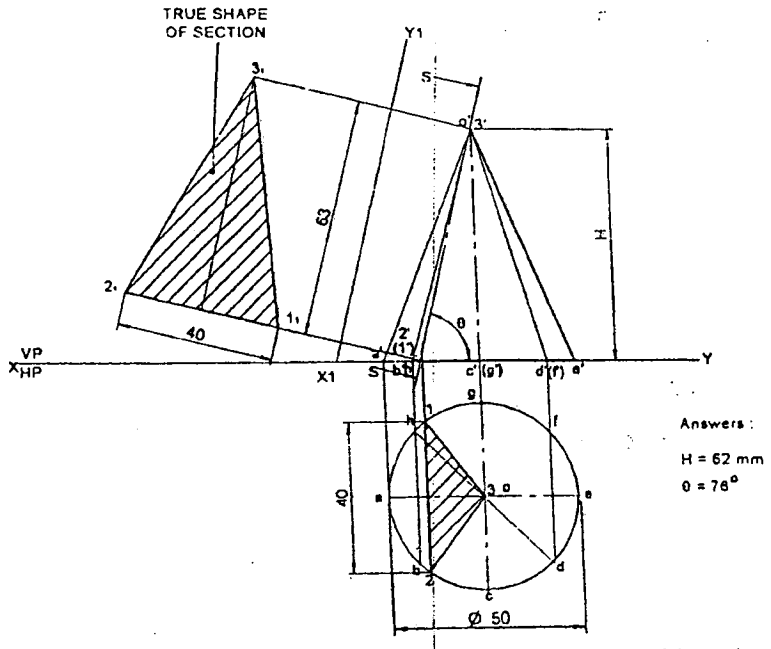
10. Trim all the unwanted construction lines by using **TRIM COMMAND**. Note, the edges which are not visible choose line type as dotted and annotate as shown.

11. Using **DIMENSION COMMANDS** and dimension the solid and save the file.



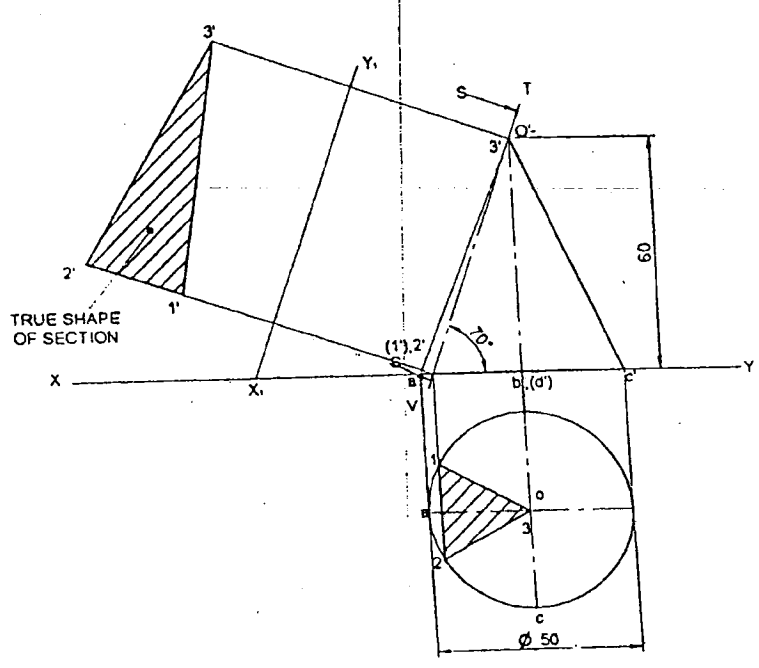
Problem 2.19. A cone of base diameter 50mm is resting on its base on the HP. It is cut by section plane perpendicular to the VP, so that the true shape of cut section is a triangle of base 40 mm and altitude 63mm. Locate the section plane and determine the angle of inclination of the VT with the reference line XY. Draw the front view. Determine the height of the cone. Also draw the apparent section and true shape of section.

Solution



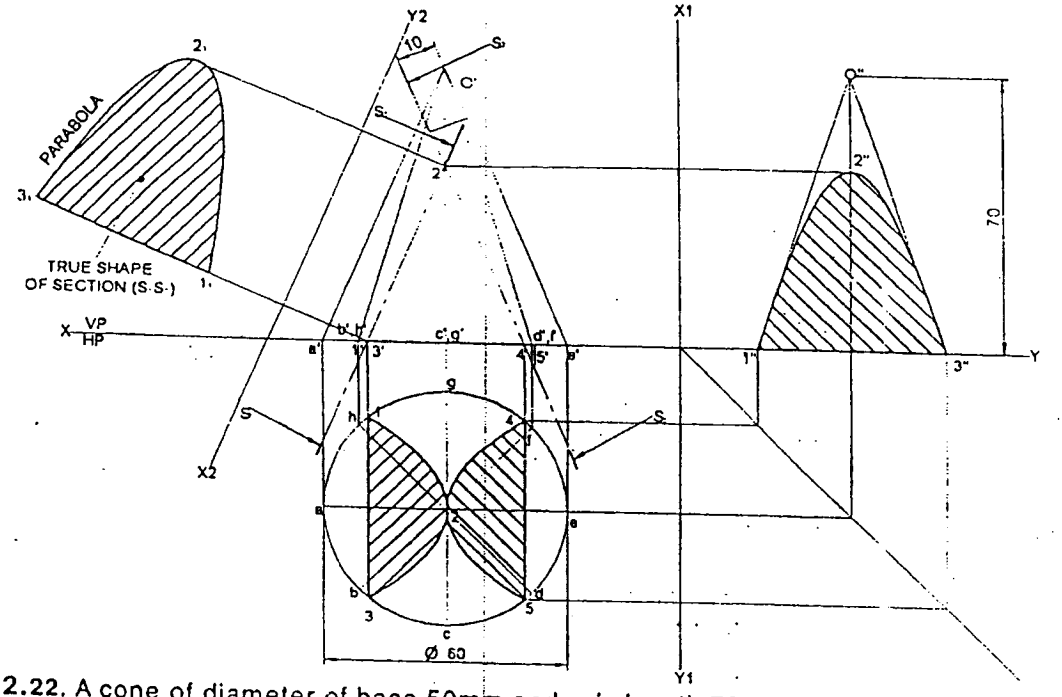
Problem 2.20. A cone of base diameter 50mm and height 60mm stands with its base on the HP. It is cut by a VT inclined at 70° to the reference line XY and is passing through the apex of the cone. Draw its front view, sectional top view and true shape of section.

Solution



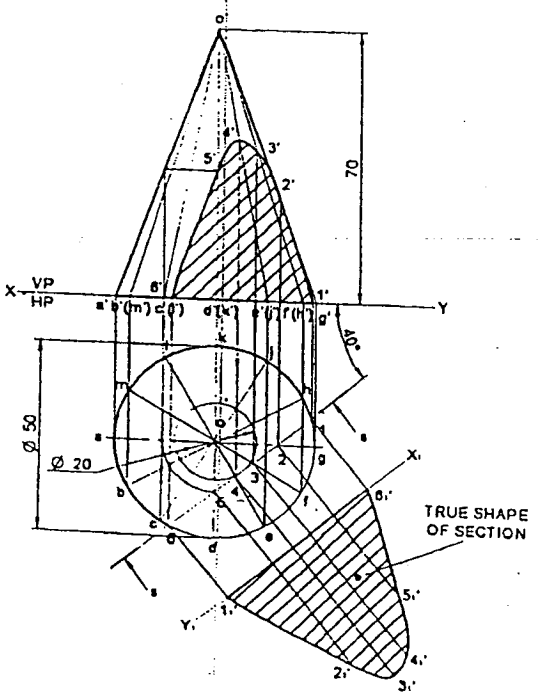
Problem 2.21. A cone of diameter of base 60mm and axis length 70mm is resting on its base on the ground. It is cut by two section planes. One is parallel to contour generator and 10mm away from it, while the other is parallel to the opposite contour generator. Both the cutting planes lean towards the base, intersecting each other on the axis of the cone. Draw the sectional plan, elevation and the left side view. Also draw the true shape of section with respect to any one of the section planes. Name the curve thus obtained.

Solution



Problem 2.22. A cone of diameter of base 50mm and axis length 70mm is standing with its base on the HP. It is cut by a section plane inclined at 40° to the VP and perpendicular to the HP cuts the cone at a distance 10mm infront of its axis. Draw the top view, sectional front view and true shape of section.

Solution

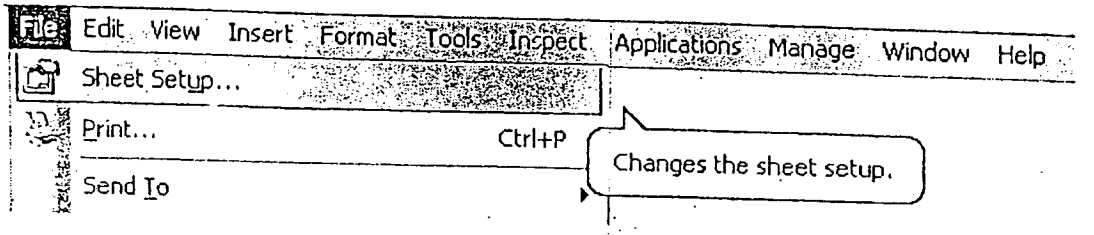


2.3.4 Sections of Cubes

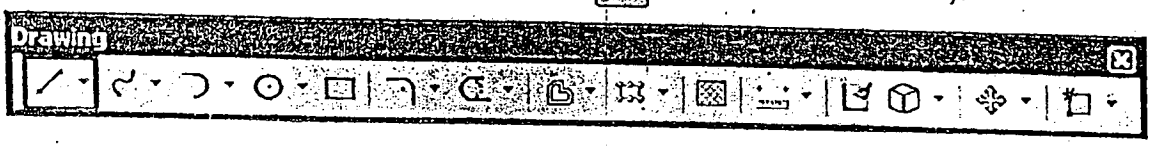
Problem 2.23. A cube of 45mm edge rests on one of its faces on the ground with its base edges equally inclined to the VP. A VT perpendicular to one of the solid diagonals cuts the solid through one of its base corners. Draw the sectional top view, true shape of section and determine the inclination of the section plane with the reference plane.

Computer Aided Drafting Procedure

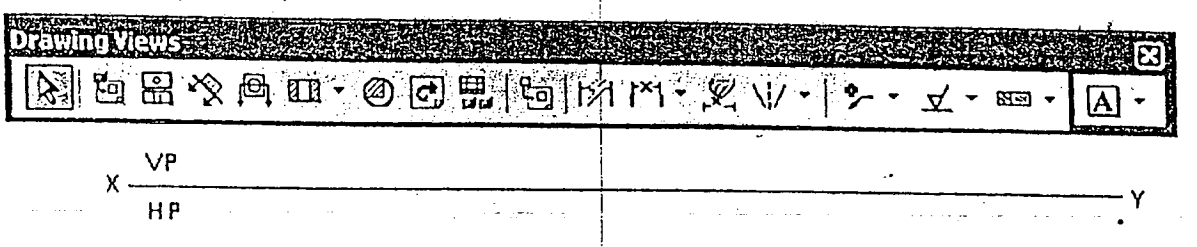
1. Open the SOFTWARE. Click on the **DRAWING** in the **CREATE** dialog box.
2. Set up the sheet of required size by clicking the **SHEET SET UP** in the **FILE**. Select **A4 wide size** for this problem.



3. Draw the line by using the **LINE COMMAND** (**DRAWING TOOL BAR**).



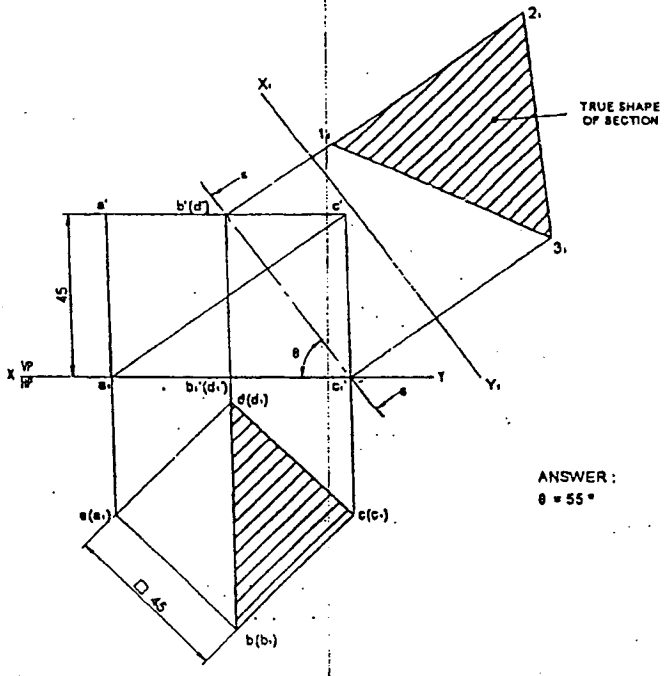
4. Make annotation XY, HP, and VP to the line by using **TEXT COMMAND** (**DRAWING VIEWS TOOL BAR**) as shown below.



5. Using **RECTANGULAR COMMAND** by giving values 40 and 40, square is obtained of 40 X 40. Represent the corners as a,b,c and d which represents top face of the cube and a_1, b_1, c_1 and d_1 as bottom face of the cube as shown in the fig.
6. Create the projectors from the top view, perpendicular to the XY line in the upward direction using **LINE COMMAND** Change the properties, (width) of the line, using **LINE RIBBON BAR**. Make all the projector lines 0.05mm thick. Then draw the line (front view) then Mark the intersection points as a_1', b_1', c_1' etc., using the **TEXT COMMAND**, as shown in the Fig.
7. Using line command draw a line at a distance equal to height of the cube above the XY line, Mark the intersection points (between the horizontal and vertical projected lines) as **a',b',c', etc.**, for the top face and **a_1', b_1', c_1', etc.**, for bottom face of the cube using **TEXT COMMAND**. Join all the respective points by using **LINE COMMAND**.

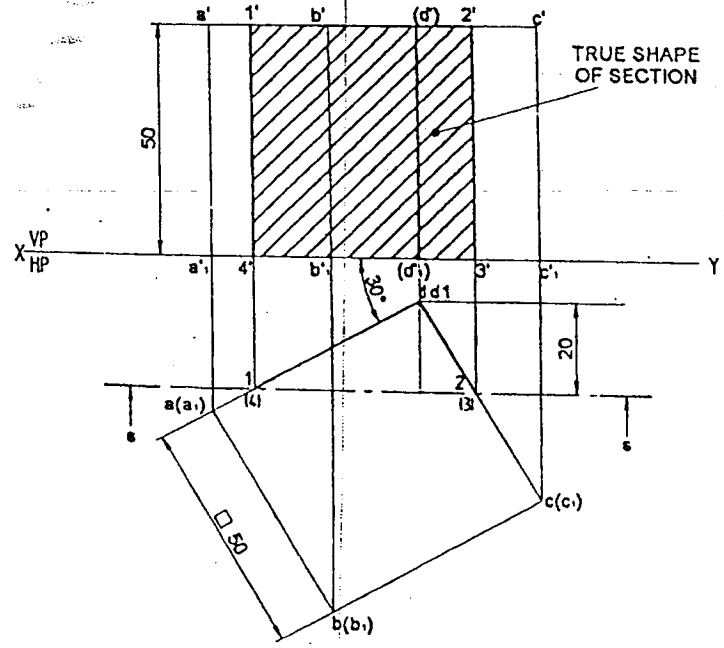
8. Trim all the unwanted construction lines by using **TRIM COMMAND**  . Mark the height of the prism at 40mm as shown Draw axis line of cube length 40mm from the XY line , using **LINE COMMAND**  join all the points to apex to get front view mark annotations as shown.

9. Using **DIMENSION COMMAND**  dimension the solid and save the file.



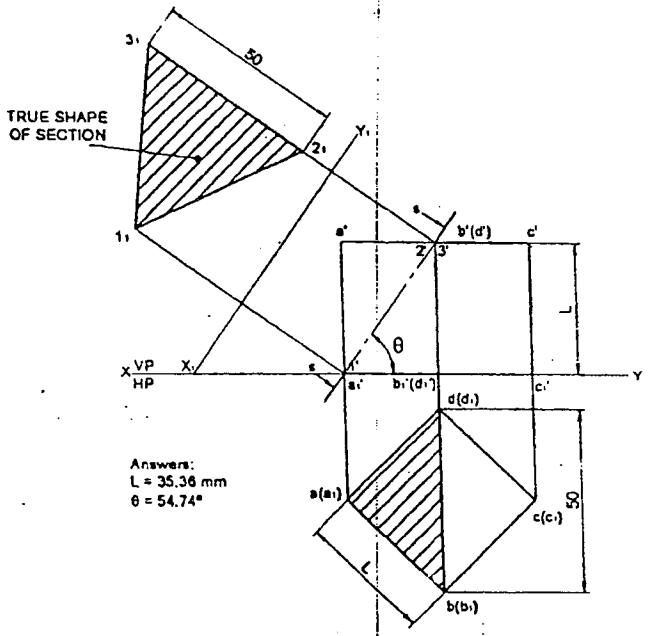
Problem 2.24. A hexahedron of 50mm side rests with a face on the HP such that one of its vertical faces is inclined at 30° to the VP. A section plane parallel to the VP and perpendicular to the HP cuts the cube at a distance of 20mm from the farthest vertical edge from the observer. Draw its top view, sectional front view and true shape of section.

Solution



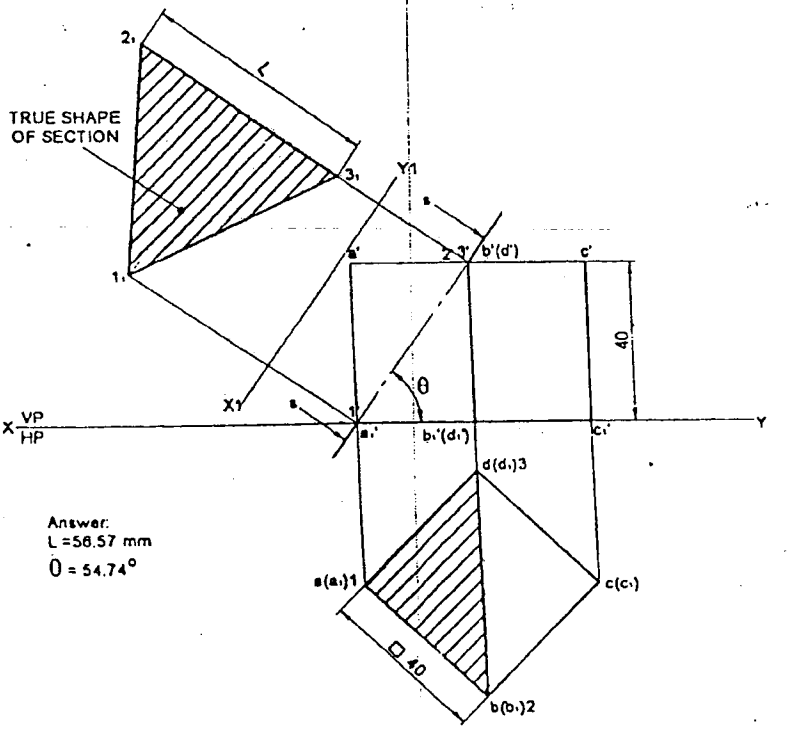
Problem 2.25. The true shape of section of a hexahedron is an equilateral triangle of sides 50mm. Position the cube of suitable size on the HP and locate the VT. Determine the inclination of section plane with HP and size of the cube. Also draw the sectional top view and true shape of section.

Solution



Problem 2.26. A cube of 40mm side is cut by a VT, so that the true shape of section is an equilateral triangle of sides of maximum length. Draw the sectional top view and true shape of section. Determine the inclination plane to HP and measure the length of the sides of the equilateral triangle.

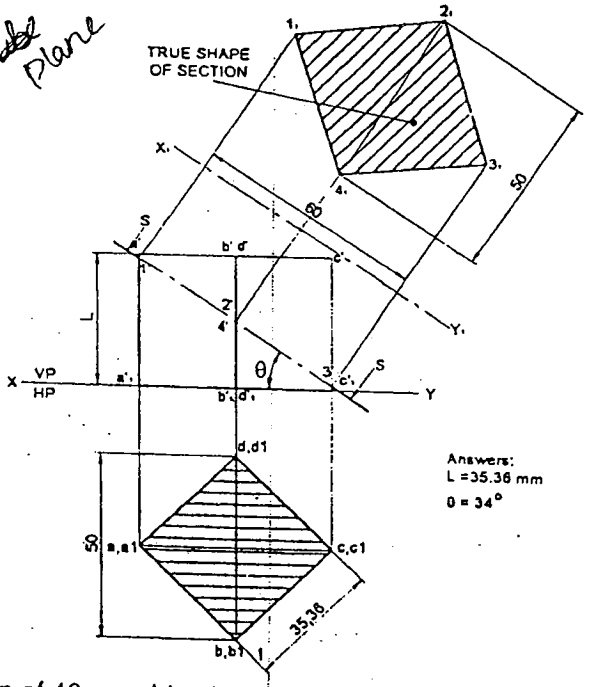
Solution



Problem 2.27. The true shape of the section of a cube is a rhombus having diagonals of 60mm and 50mm. Draw the projections of the cube keeping it on base using a suitable position. Determine the size of the cube and the inclination of AIP with the HP. Also check the true shape of section.

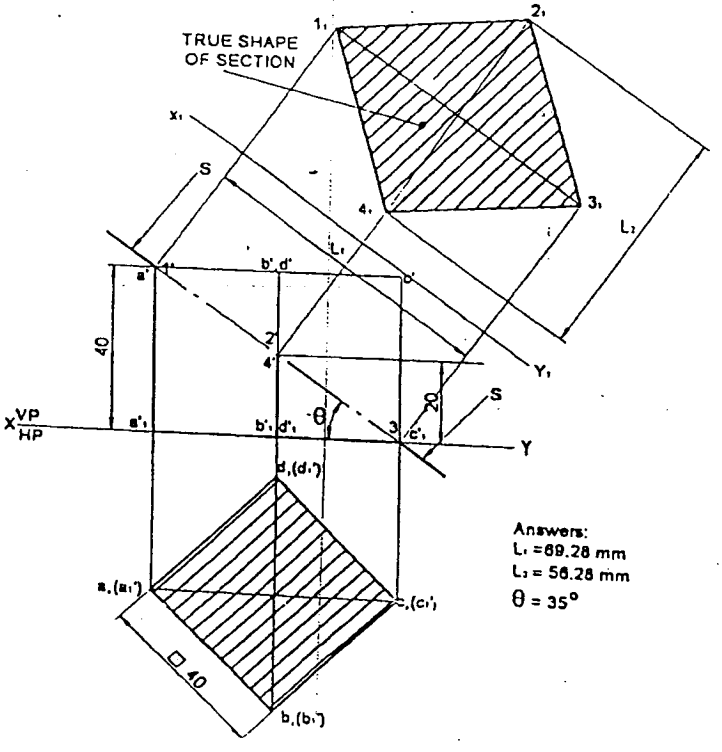
Solution

Axially inclined cube plane



Problem 2.28. A hexahedron of 40mm sides is cut by a section plane, so that the true shape of section is a rhombus of sides of maximum length. Draw the sectional top view and the true shape of section. Also find the inclination of the section plane with the reference plane and the size of the rhombus.

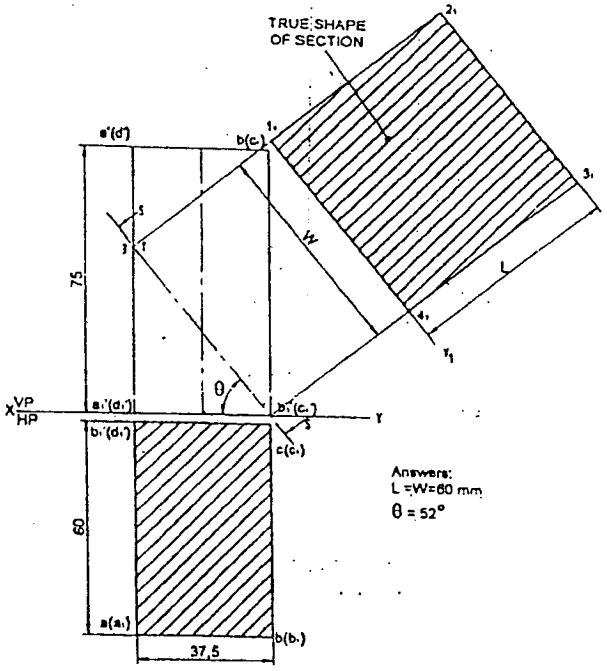
Solution



2.3.5 Sections of Prisms

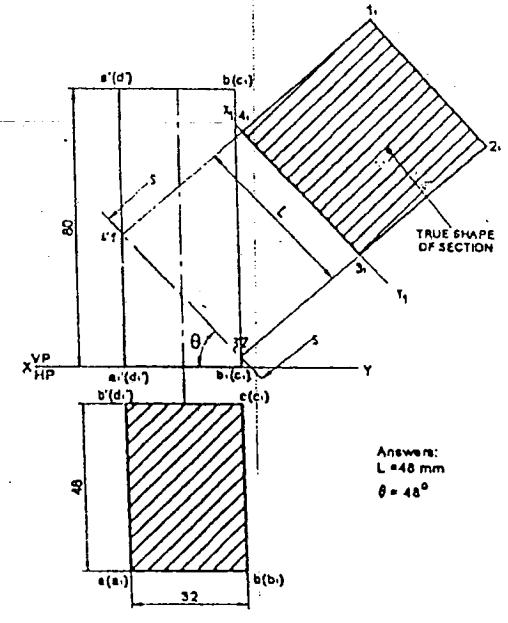
Problem 2.29. A rectangular prism of height 75mm and cross section 60 X 37.5 mm is resting on its base on the HP with one of its shorter base edges parallel to VP. A VT whose width between its ends is equal to the longer base edge cuts the prism through one of the extreme base edges and pass through the lateral face opposite to that base edge. Draw the front view, sectional top view and true shape of the section. Measure the inclination of the section plane and sides of the true shape.

Solution



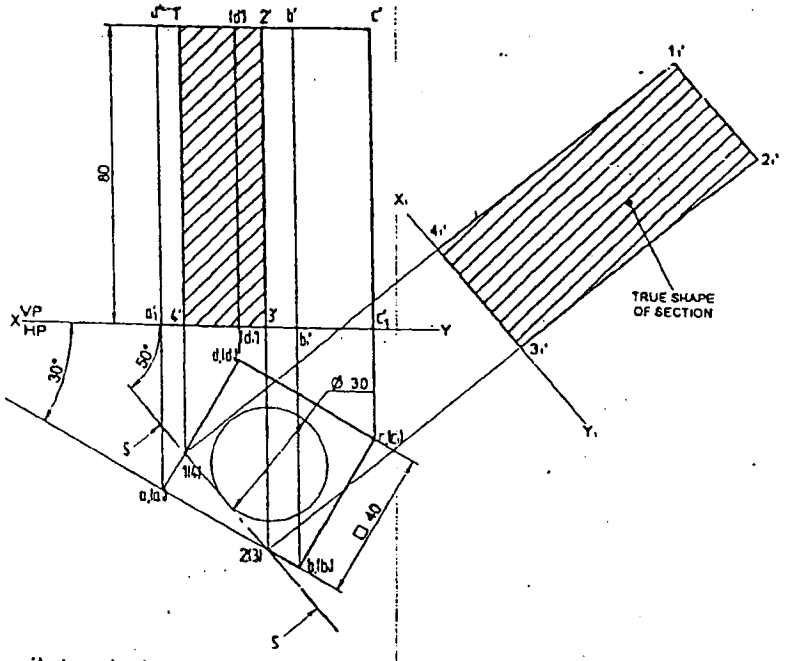
Problem 2.30. A rectangular prism of height 80mm and cross section 48X32 mm is resting on the HP with its base. It is cut by a section plane in such a way that the true shape of section is a square of sides of maximum dimension. Draw the front view and determine the inclination of section plane to the reference plane. Also draw the sectional top view and true shape of section.

Solution



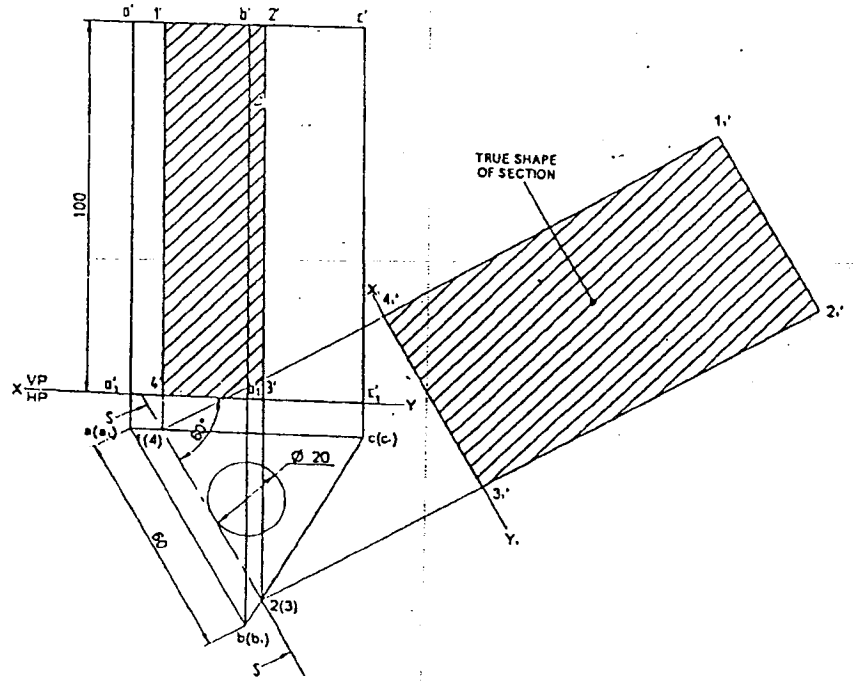
Problem 2.31. A square prism, sides of square-faces 40mm and height 80mm rets with its base on the HP with a vertical face inclined at 30° to the VP. It is cut by a plane inclined at 50° to the VP and perpendicular to the HP and is 15mm from axis nearer to the observer. Both that inclined face and the section plane lean towards the same direction. Draw its top view, sectional front view and true shape of section.

Solution



Problem 2.32. An equilateral triangular prism of 60mm base side and axis length 100mm is resting on the HP with its axis vertical and one of its base edges parallel to the VP and nearer to it. It is cut by an inclined section plane perpendicular to the HP and 60° to the VP and 10mm infront of the axis. Draw the sectional front view and true shape of section.

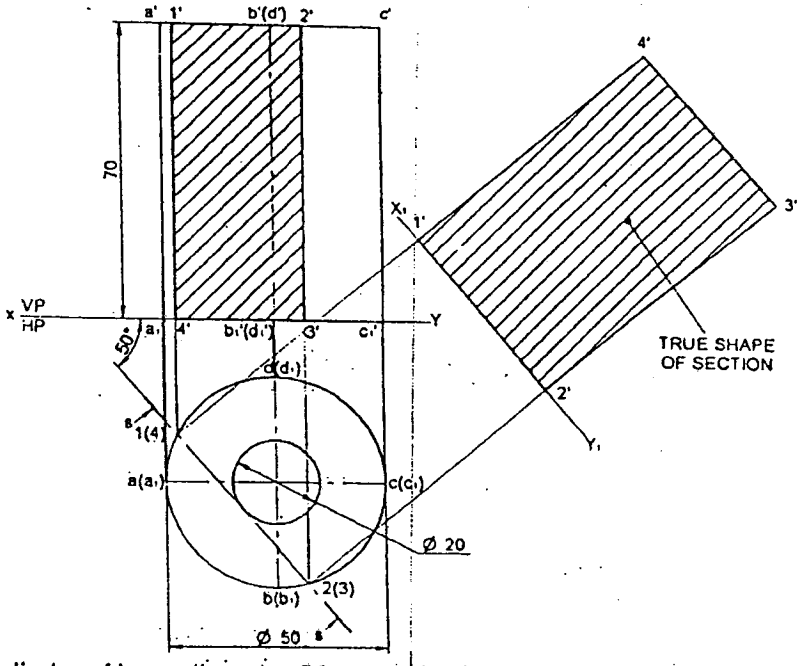
Solution



2.3.6 Sections of Cylinders

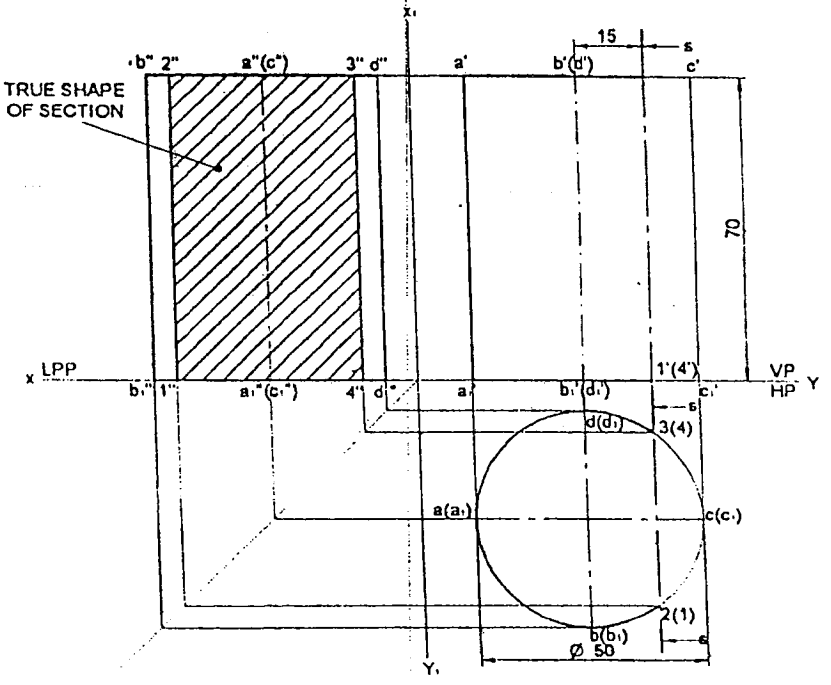
Problem 2.33. A cylinder of base diameter 50mm and height 70mm is resting with its base on the HP. A section plane inclined at 50° to the VP and perpendicular to the HP cuts the solid at 10mm in front of it. Draw its top view, sectional front view and true shape of section.

Solution



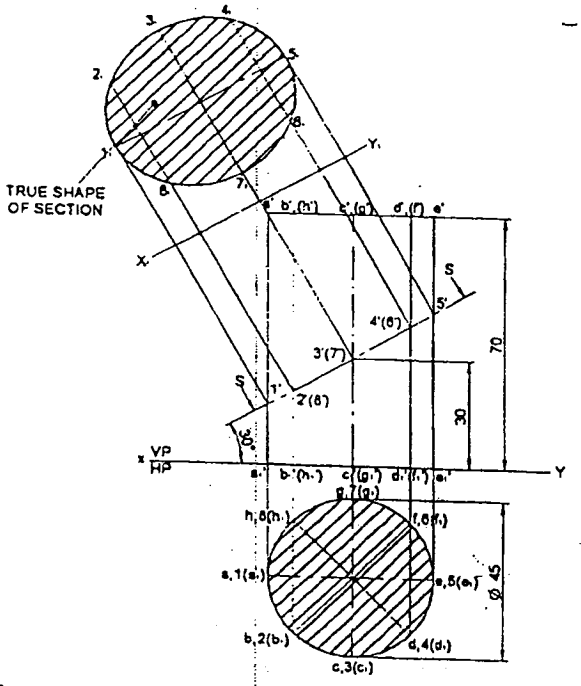
Problem 2.34. A cylinder of base diameter 50mm and axis 70mm is resting on the HP with its axis vertical. A section plane perpendicular to both the HP and the VP cuts the cylinder at 15mm right of the axis. Draw the projections of the cylinder showing the true shape of section.

Solution



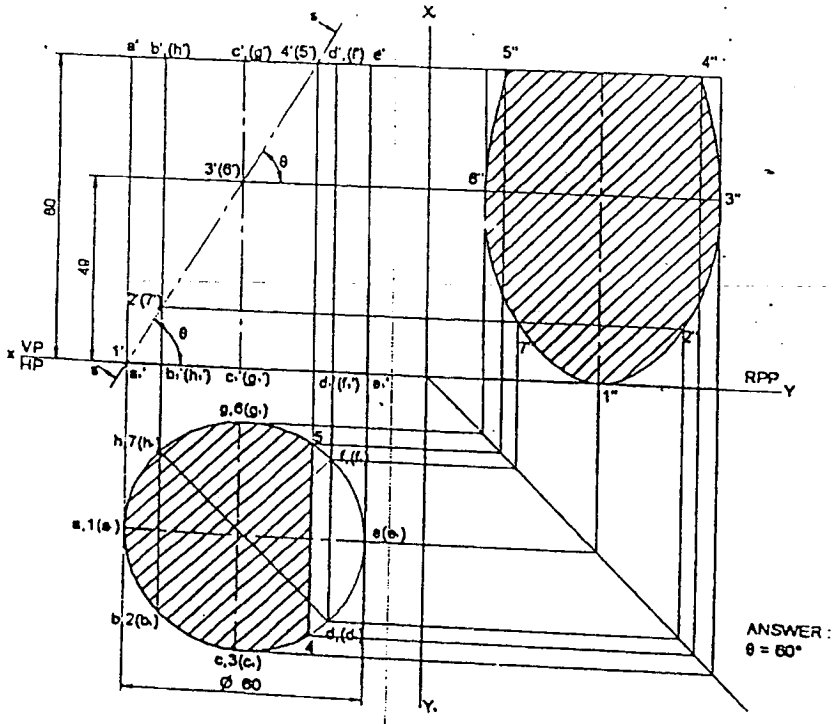
Problem 2.35. A cylinder of diameter of base 45mm and height 70mm long rests on its base on the HP. It is cut by a plane perpendicular to the VP and inclined at 30° to the HP and meets the axis at a height of 30mm above the base. Draw the front view, sectional top view and true shape of section.

Solution



Problem 2.36. A cylinder, 60mm diameter of base and axis 80mm long rests with its base on the HP. A section plane passing through one of its extreme end points on the circumference of its base circle and a point on the axis at 49mm from the base cuts the cylinder. Determine the inclination of the section plane with the reference plane. Also draw the sectional top view and the sectional side view.

Solution



vi) All types of holes are to be shown by broken section.

3.4 ILLUSTRATIVE EXAMPLES

Problem 3.1. Fig. P3.1 shows a machine component. Draw the following views:

(a) Front view
(b) Top view and
(c) Left side view

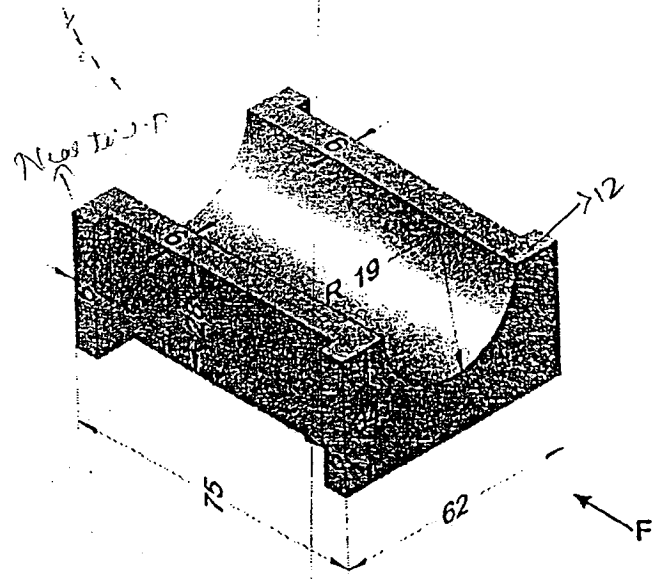
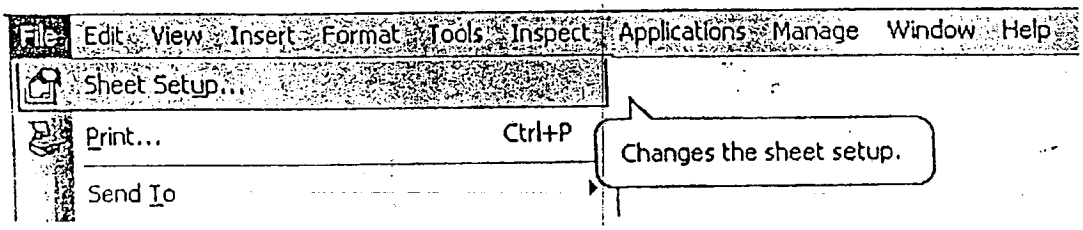


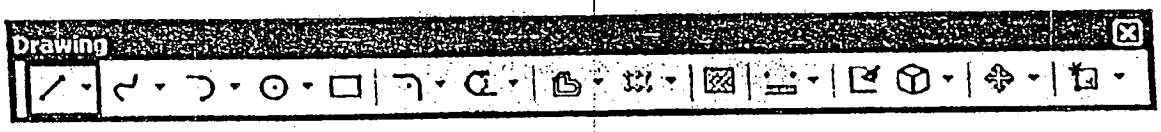
Fig. P3.1

Computer Aided Drafting Procedure

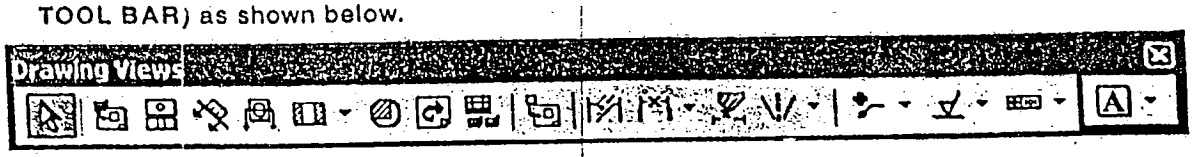
1. Open the **SOFTWARE**. Click on the **DRAWING** in the **CREATE** dialog box.
2. Set up the sheet of required size by clicking the **SHEET SET UP** in the **FILE**. Select **A4 wide size** for this problem.

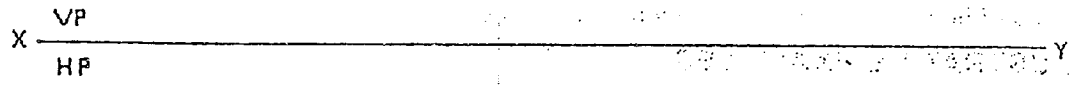


3. Draw the line by using the **LINE COMMAND** (DRAWING TOOL BAR).



4. Make annotation XY, HP, and VP to the line by using **TEXT COMMAND** (DRAWING VIEWS **TOOL BAR**) as shown below.





5. Create the projectors the lines from top view, perpendicular to the "X,Y"-line in the upward direction using **LINE COMMAND**. Change the properties, (width) of the line, using **LINE RIBBON BAR**. Make all the projector lines 0.05mm thick. Then draw the line (front view) then Mark the Intersection points as (a)', b', c' using the **TEXT COMMAND** A, as shown in the Fig.

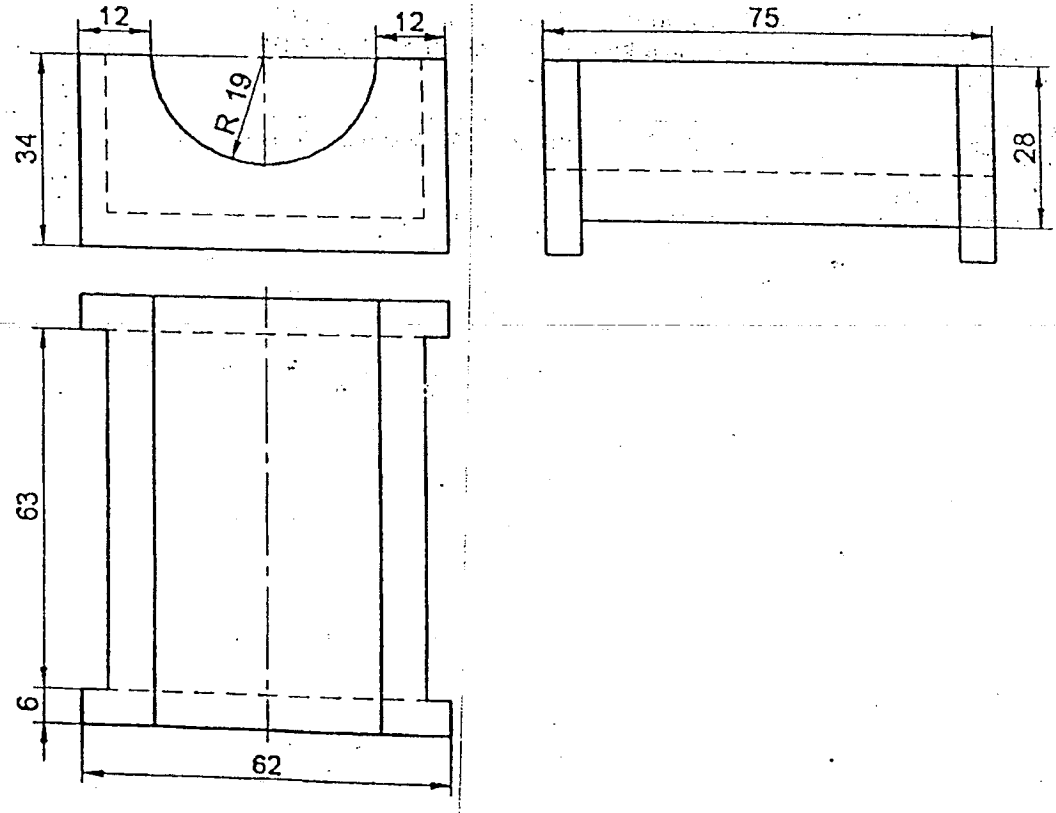
6. Using **LINE COMMAND**, **CURVE COMMAND**, **DISTANCE BETWEEN COMMAND** and **ANGLE BETWEEN COMMAND**. Draw the front view of the machine part as shown.

7. Create the X_1Y_1 line perpendicular to the XY line at any distance from projection line representing the intersection between VP and PP using the **LINE COMMAND**. Mark the intersection point of the lines as 'o'.

8. Draw horizontal projectors using **LINE COMMAND** towards PP to get side view and represent it as shown.

9. Trim all the unwanted construction lines by using **TRIM COMMAND**. Note, for the edges which are not visible, choose line type as dotted and annotate as shown.

10. Using **DIMENSION COMMANDS** and dimension the solid and save the file.



Problem 3.2. Fig. P3.2 shows a machine component. Draw the following views:

(a) Front view
(b) Top view and
(c) Right side view

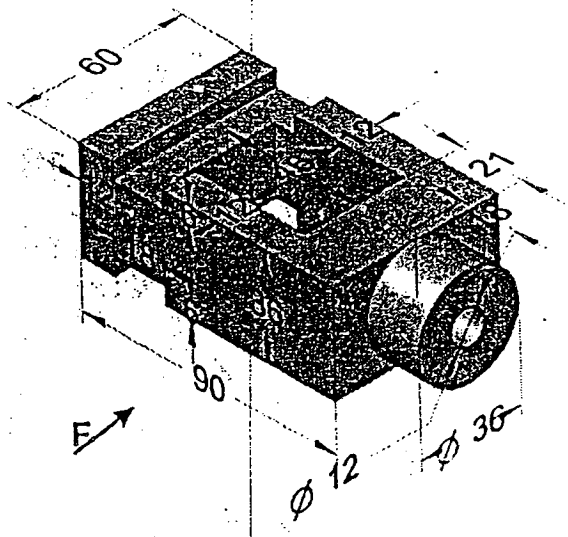
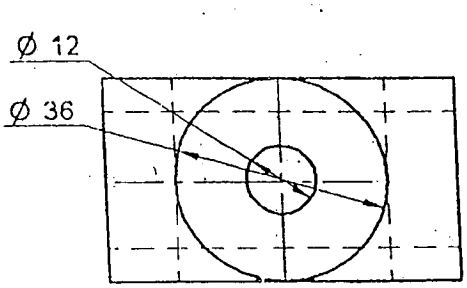
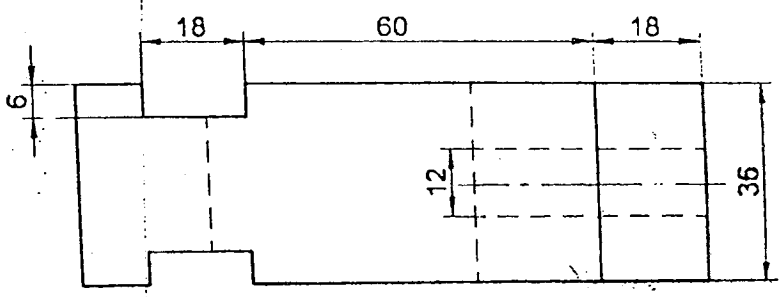
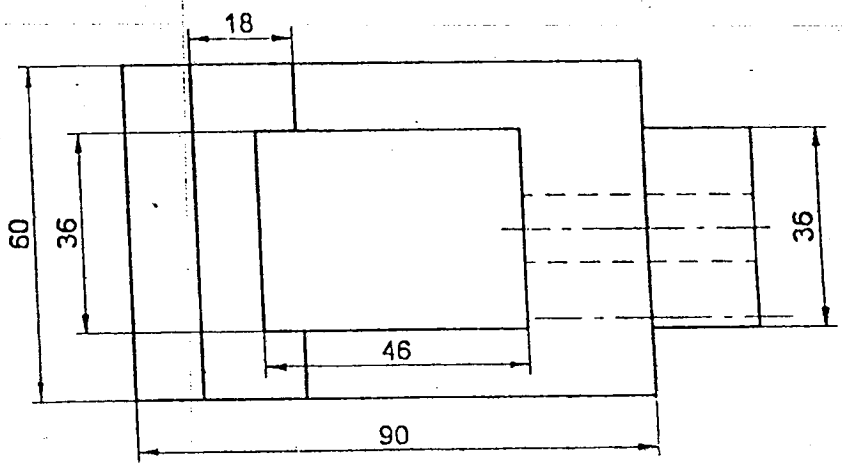


Fig. P3.2

Solution :







Problem 3.3. Fig. P3.3 shows a machine component. Draw the following views:

(a) Front view
(b) Top view and
(c) Right side view

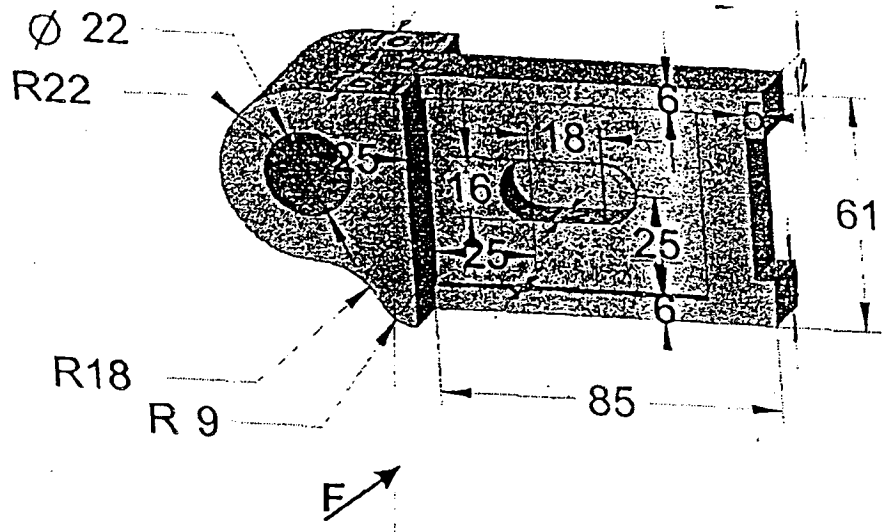
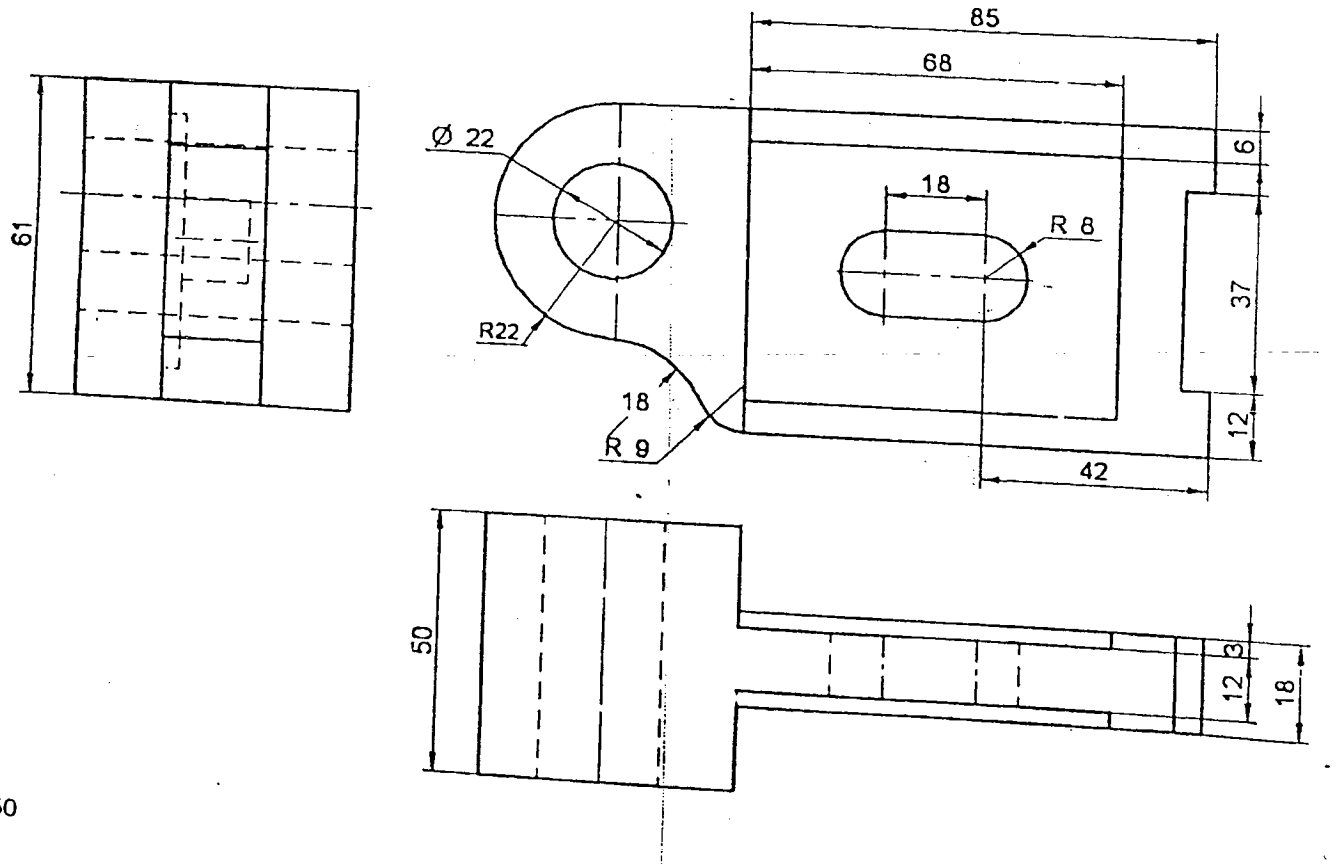


Fig. P3.3

Solution :



Problem 3.4. Fig. P3.4 shows a machine component. Draw the following views:

(a) Front view
(b) Top view and
(c) Left side view

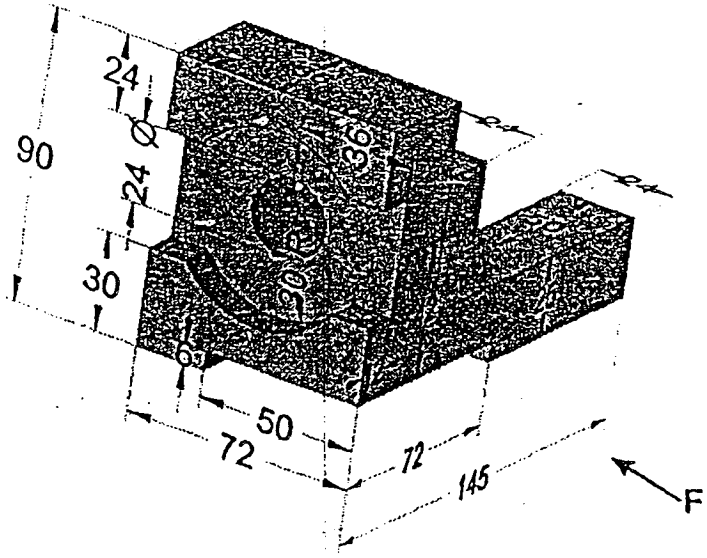
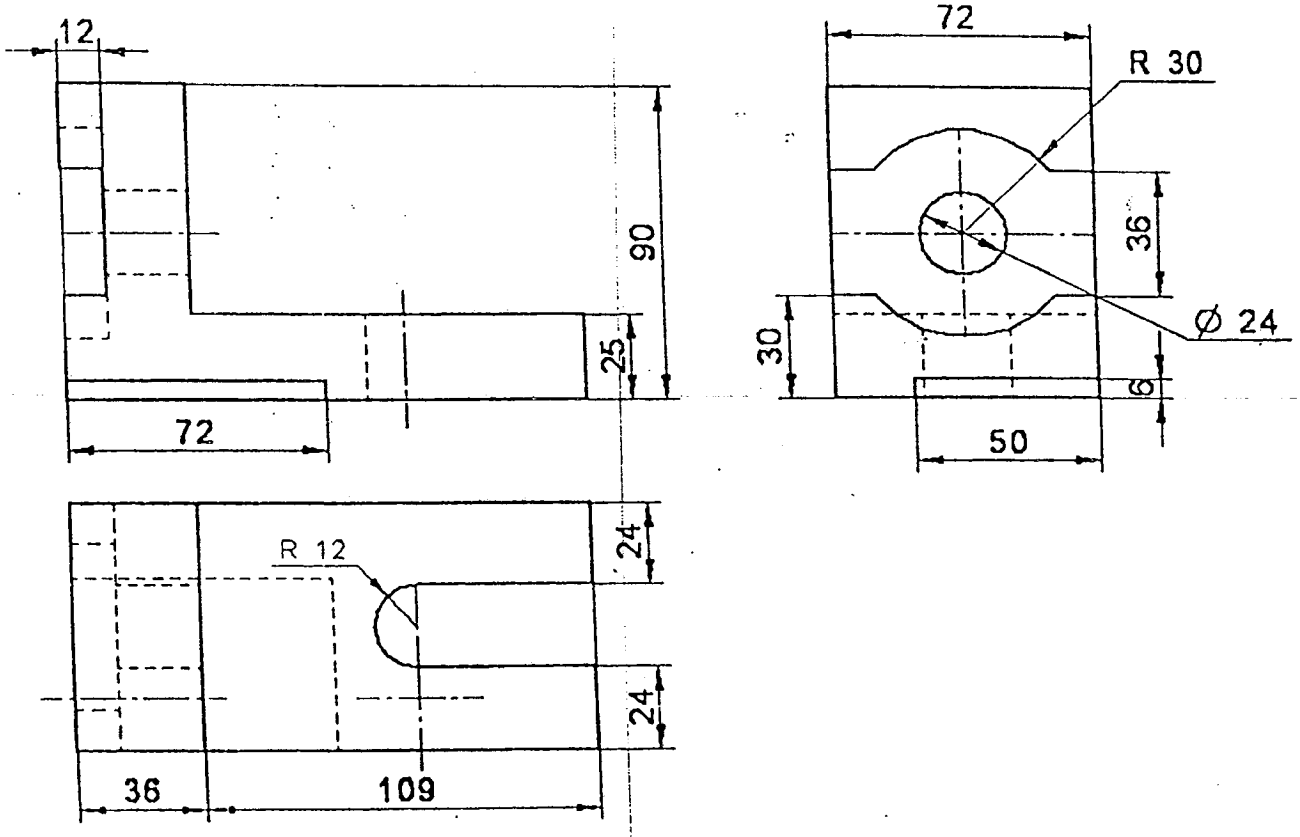


Fig. P3.4

Solution :



Problem 3.5. Fig. P3.5 shows a machine component. Draw the following views:

(a) Front view
(b) Top view and
(c) Left side view

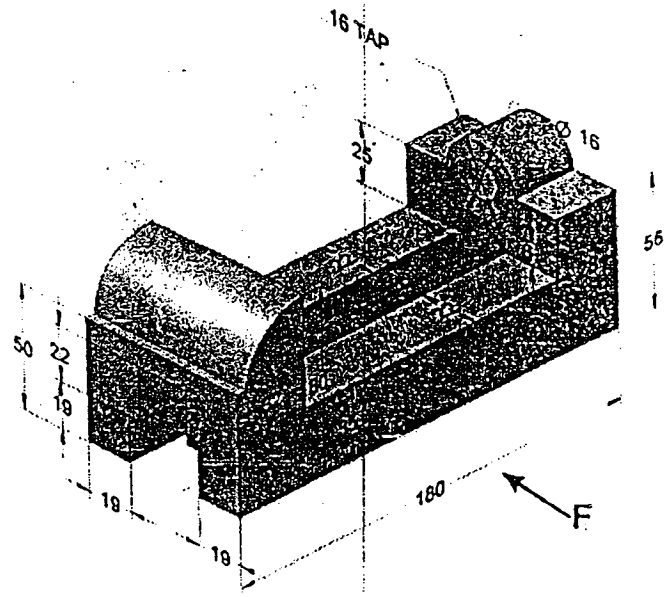
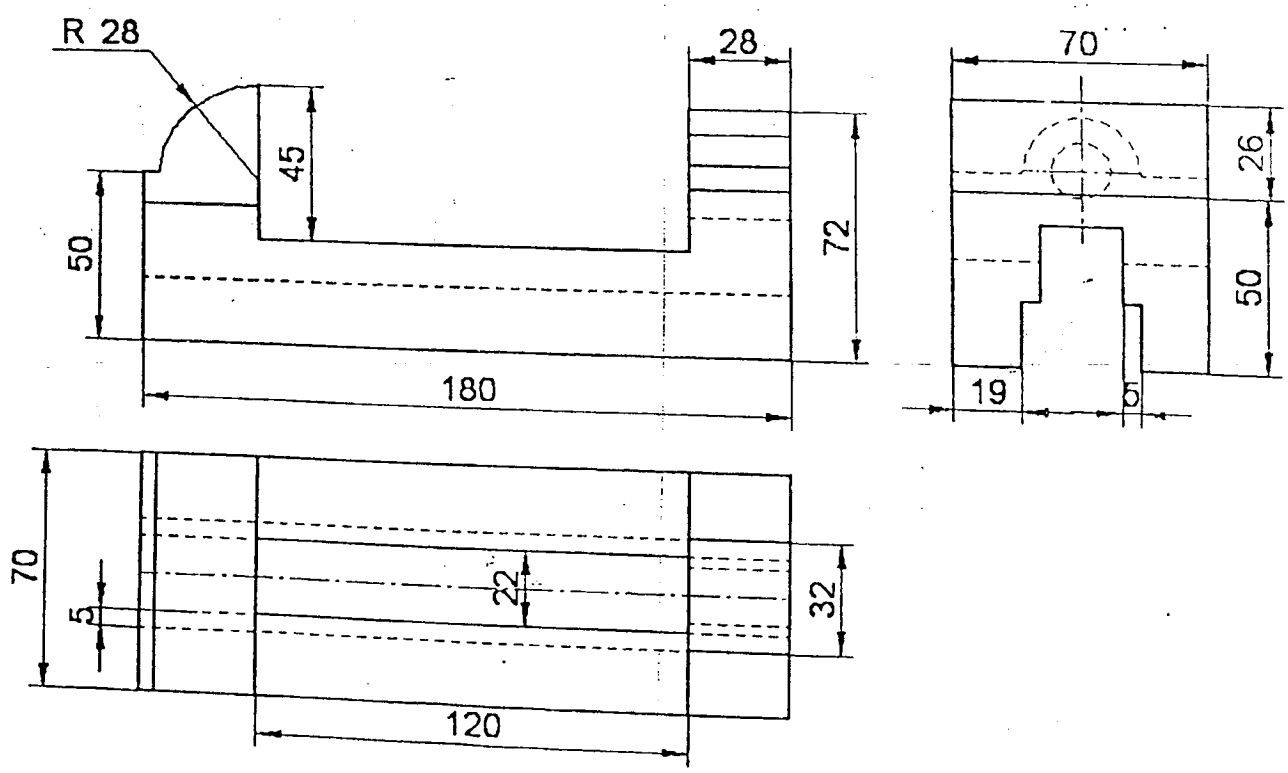


Fig. P3.5

Solution :



Problem 3.6. Fig. P3.6 shows a machine component. Draw the following views:

(a) Front view
(b) Side view from left and
(c) Top view

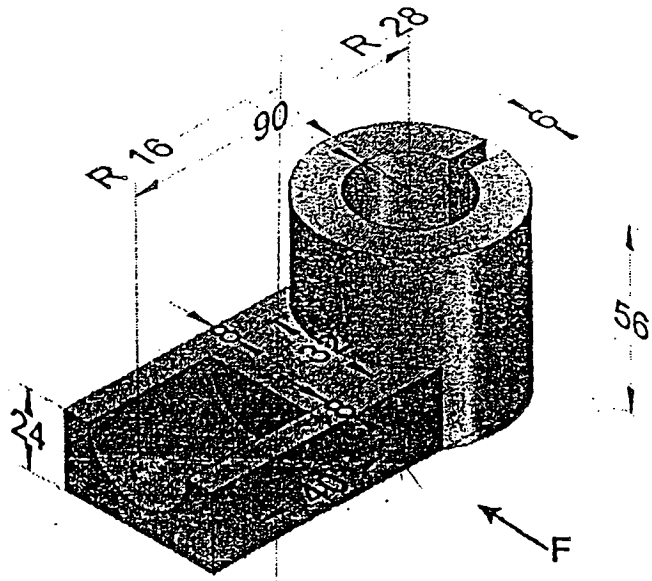
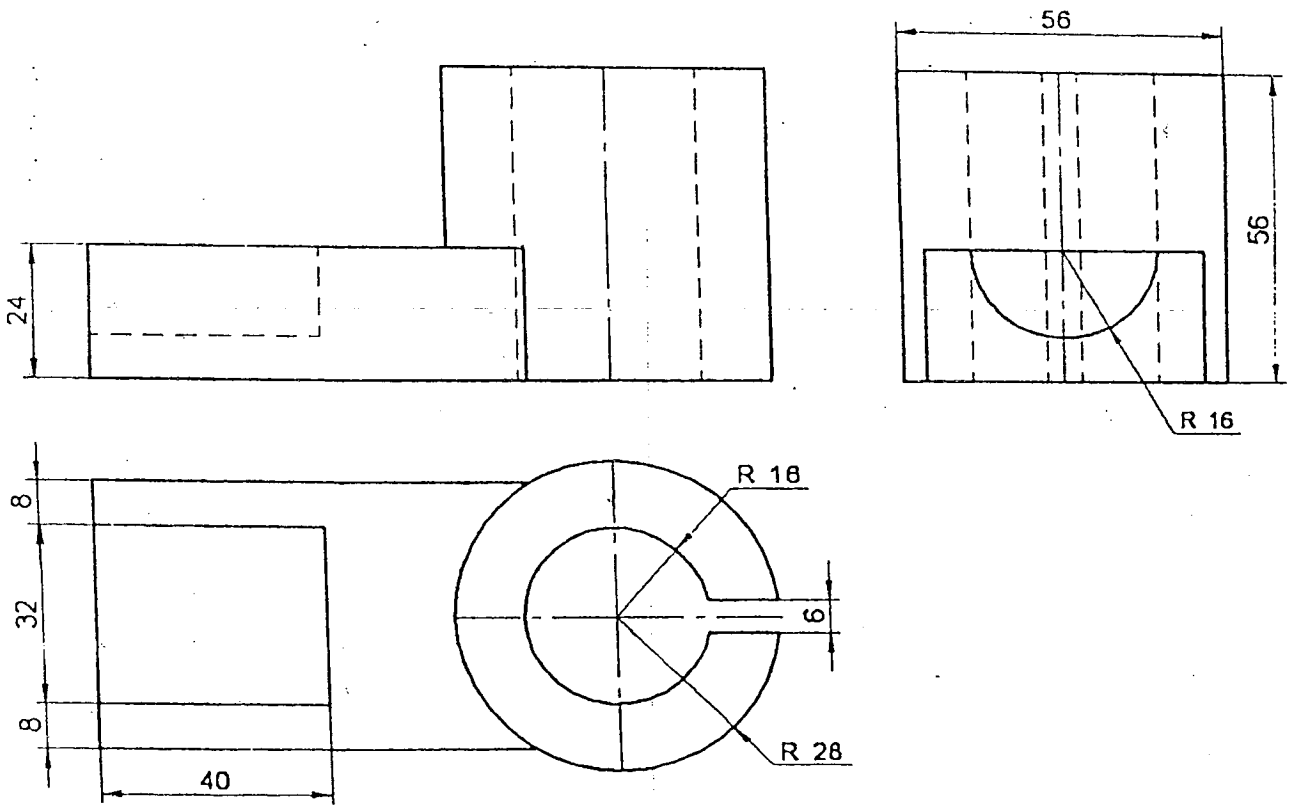


Fig. P3.6

Solution :



Problem 3.7. Fig. P3.7 shows a machine component. Draw the following views:

(a) Sectional front view (dou Section)
(b) Top view and
(c) Left side view

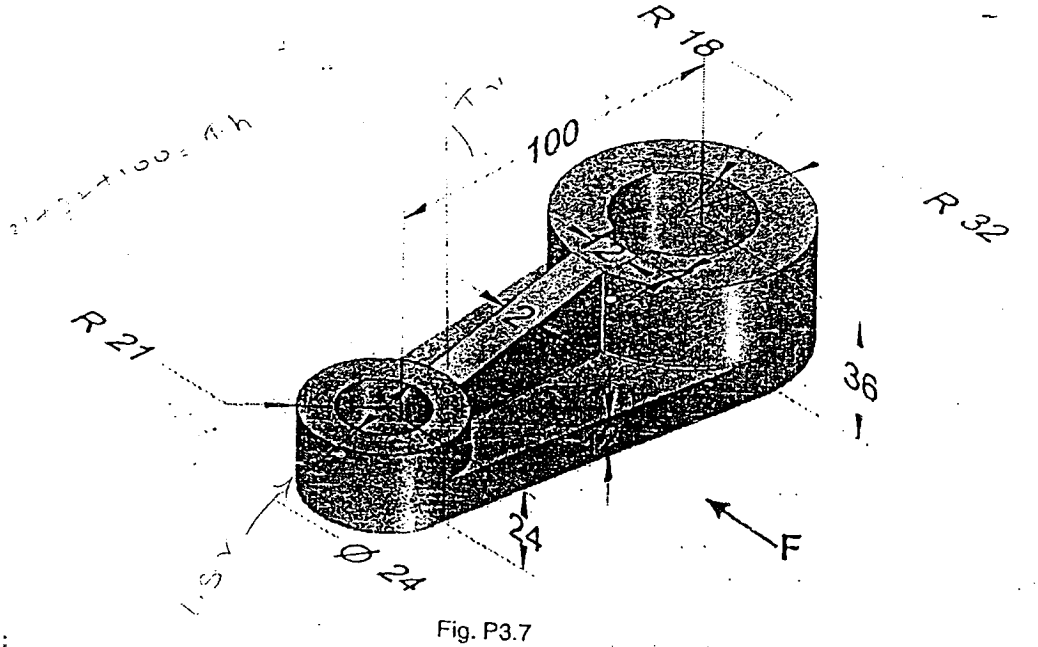
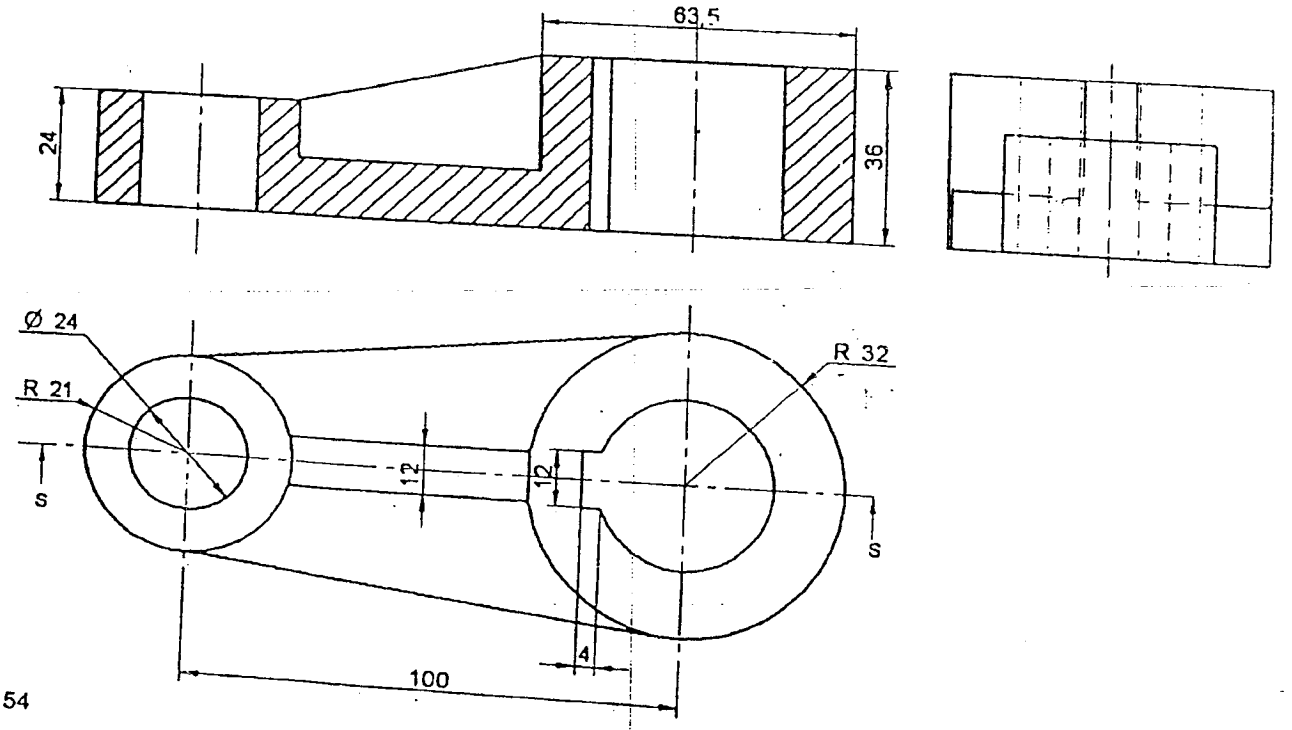


Fig. P3.7

Solution :



Problem 3.8. Fig. P3.8 shows a machine component. Draw the following views:

(a) Front view
(b) Top view and
(c) Side view from left

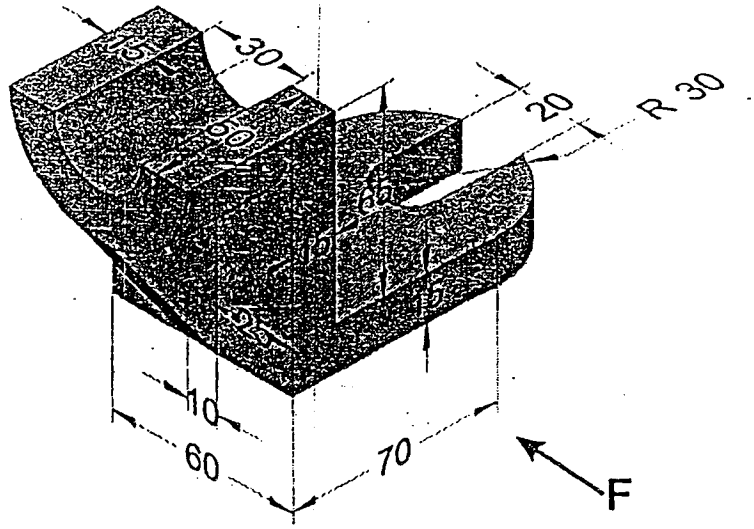
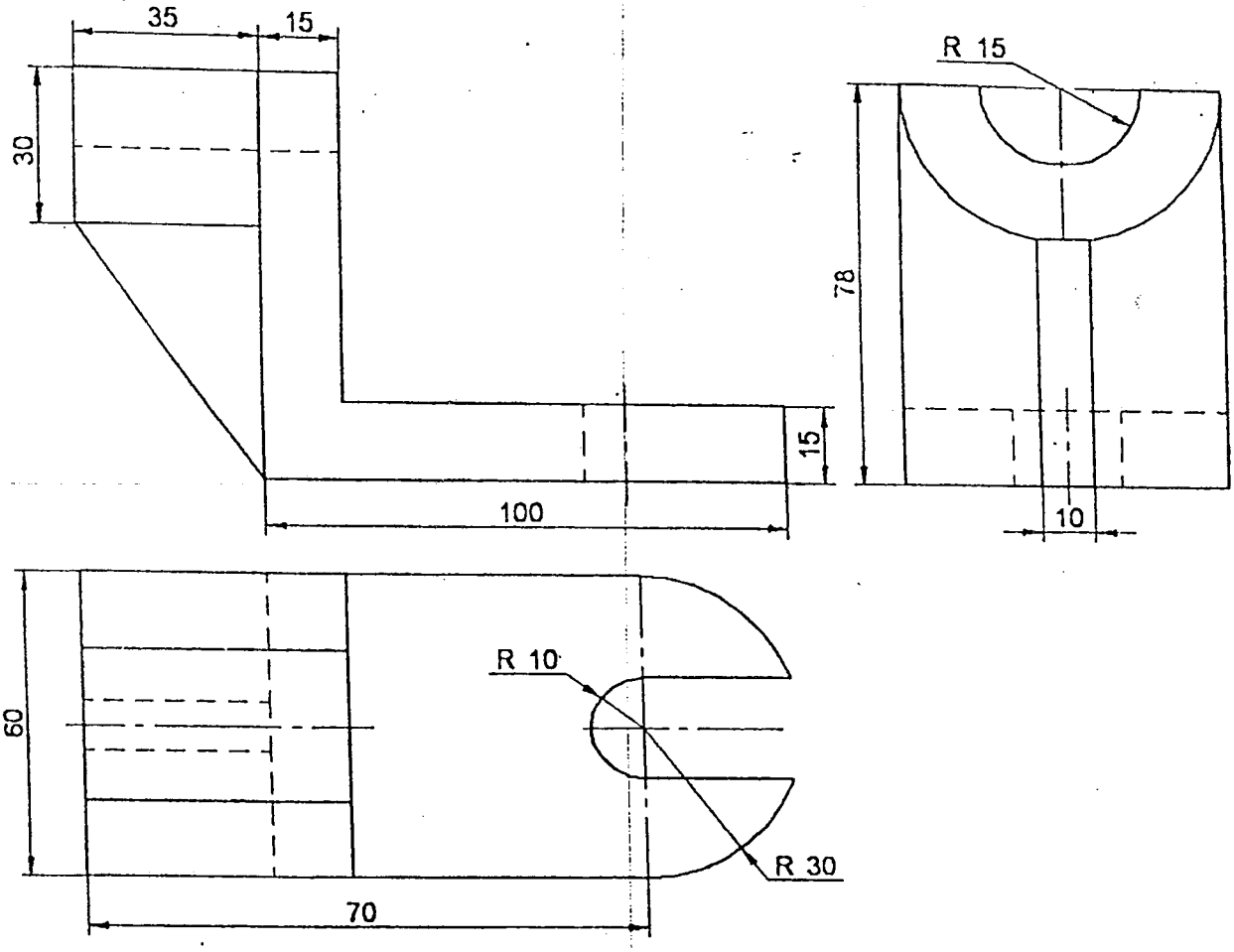


Fig. P3.8

Solution :



Problem 3.9. Fig. P3.9 shows a machine component. Draw the following views:

(a) Sectional front view
(b) Top view and
(c) Side view from left

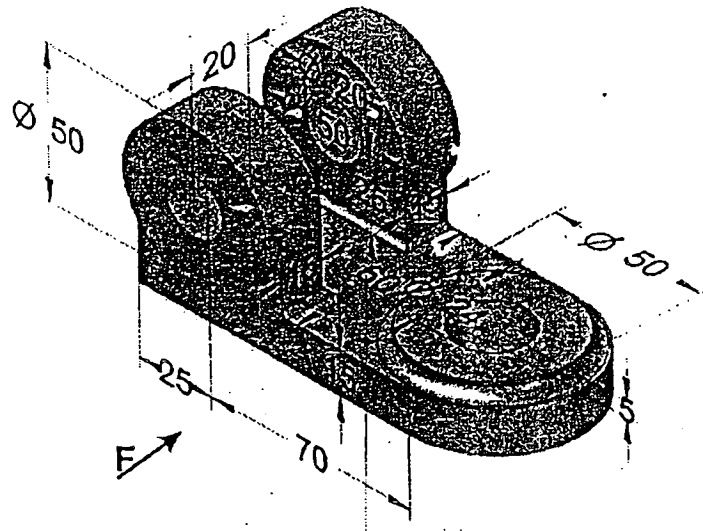
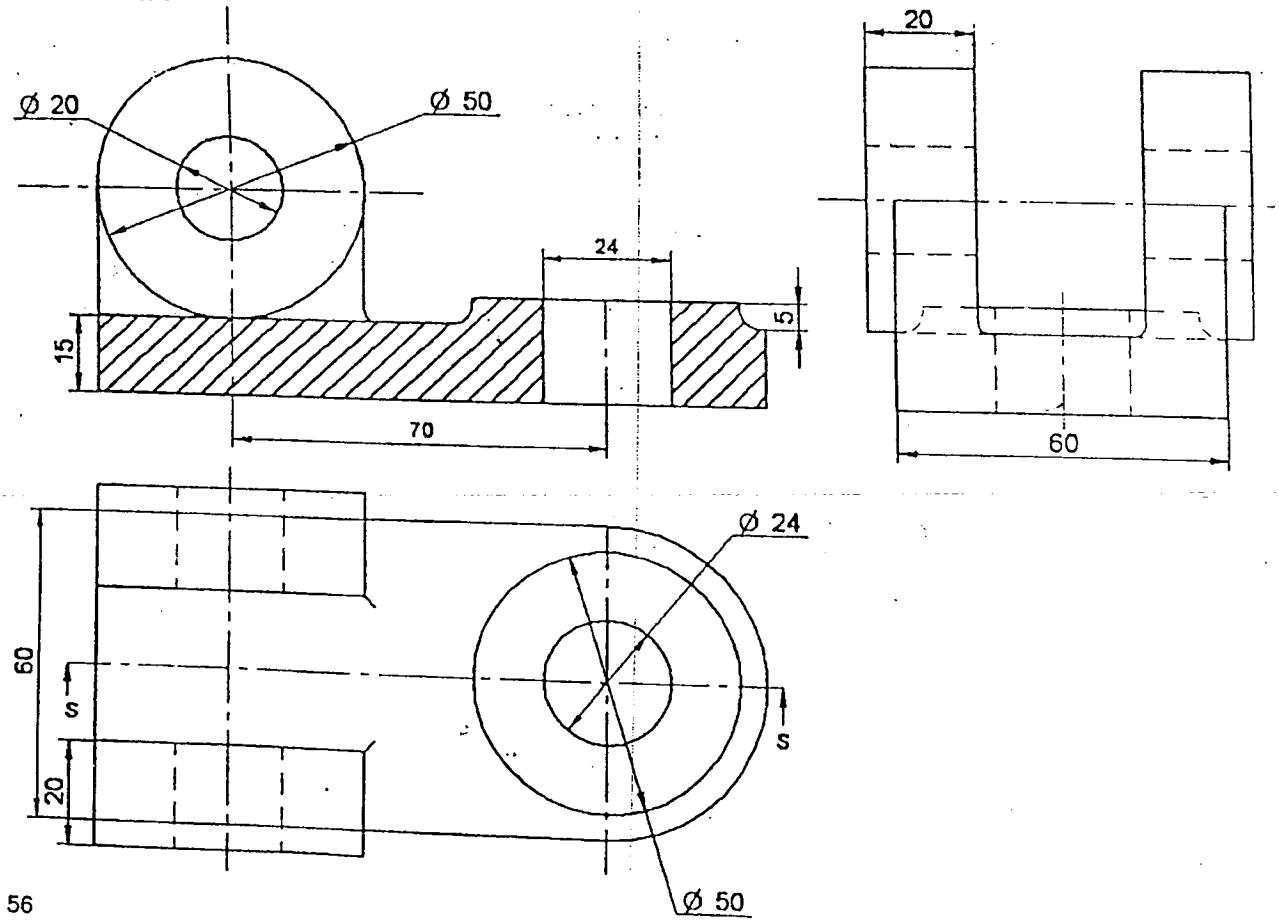


Fig. P3.9

Solution :



Problem 3.10 Fig. P3.10 shows a machine component. Draw the following views:

(a) Sectional front view
(b) Top view and
(c) Left side view

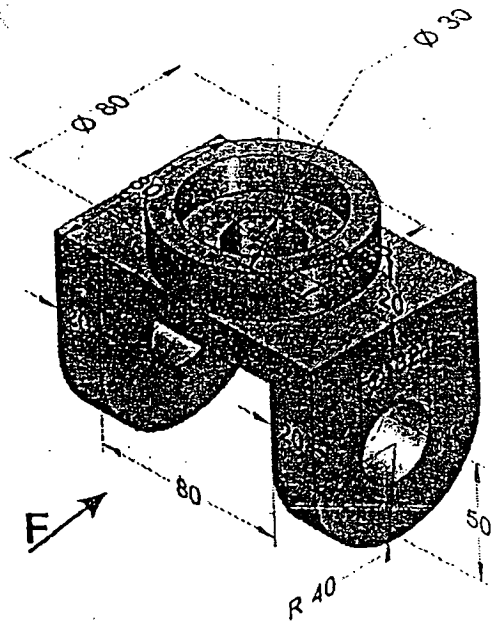
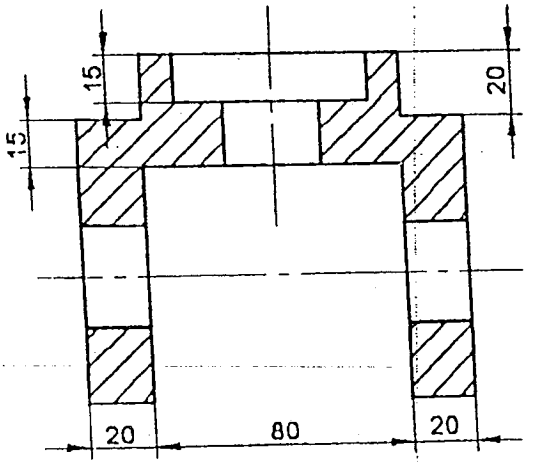
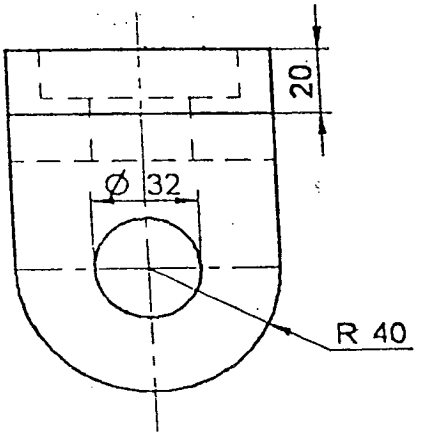
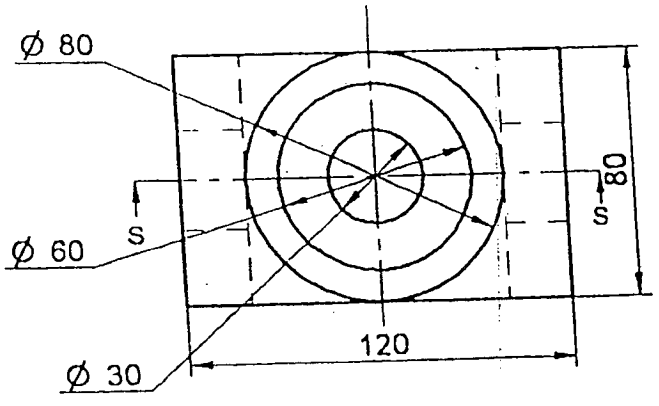


Fig. P3.10

Solution :







Problem 3.11 Fig. P3.11 shows a machine component. Draw the following views:

(a) Front view
(b) Top view and
(c) Sectional Left Side view

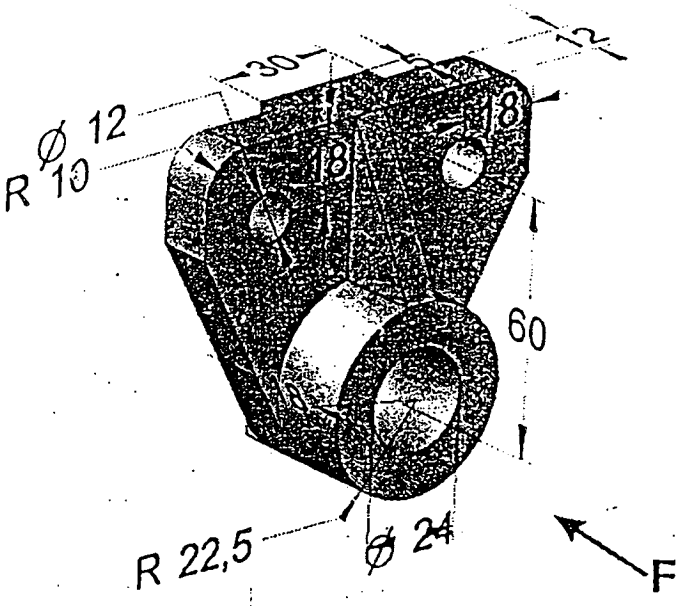
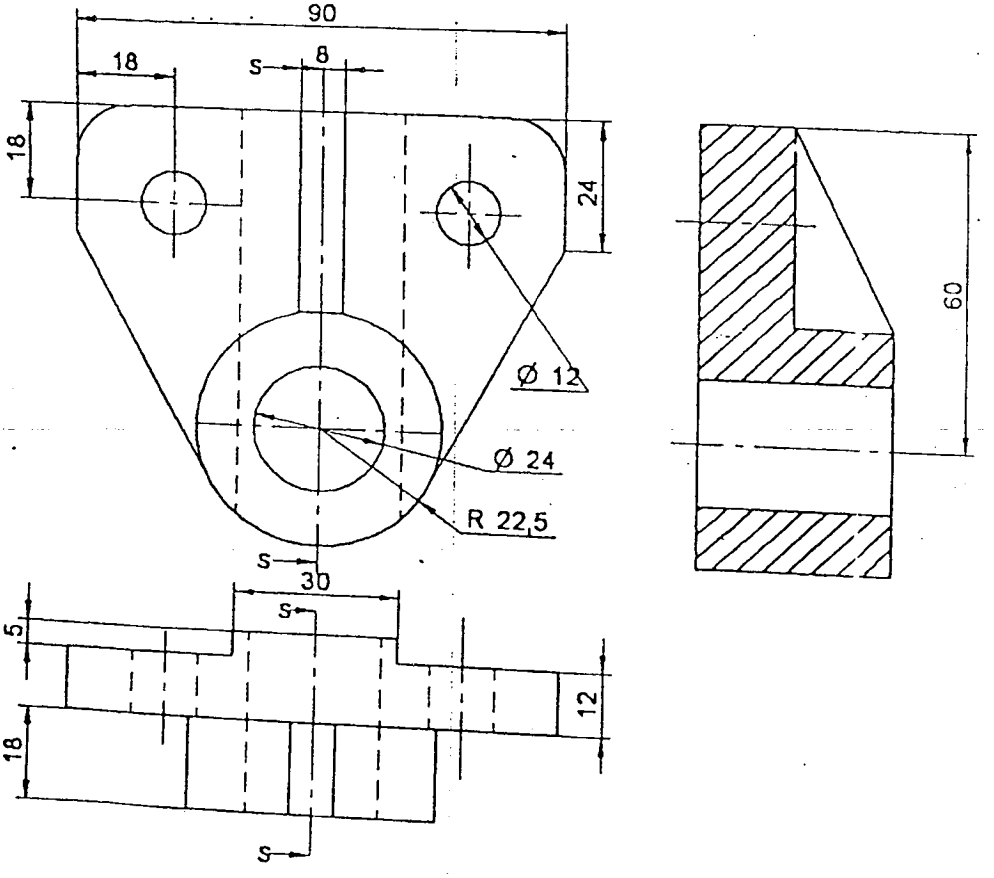


Fig. P3.11

Solution :



Problem 3.12. Fig. P3.12 shows a machine component. Draw the following views:

(a) Front view
(b) Top view and
(c) Sectional Left Side view

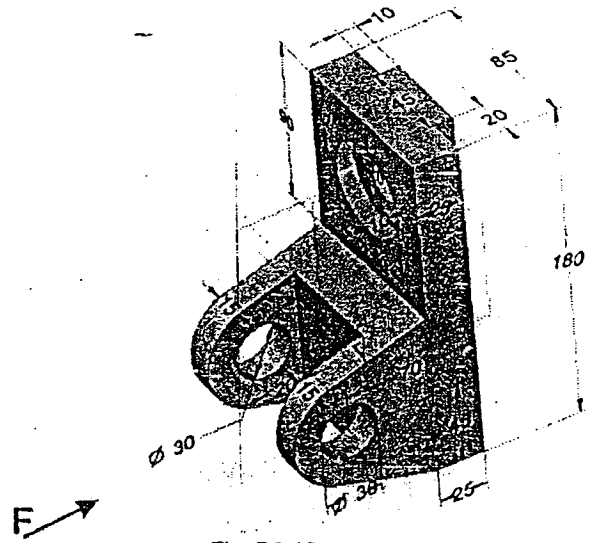
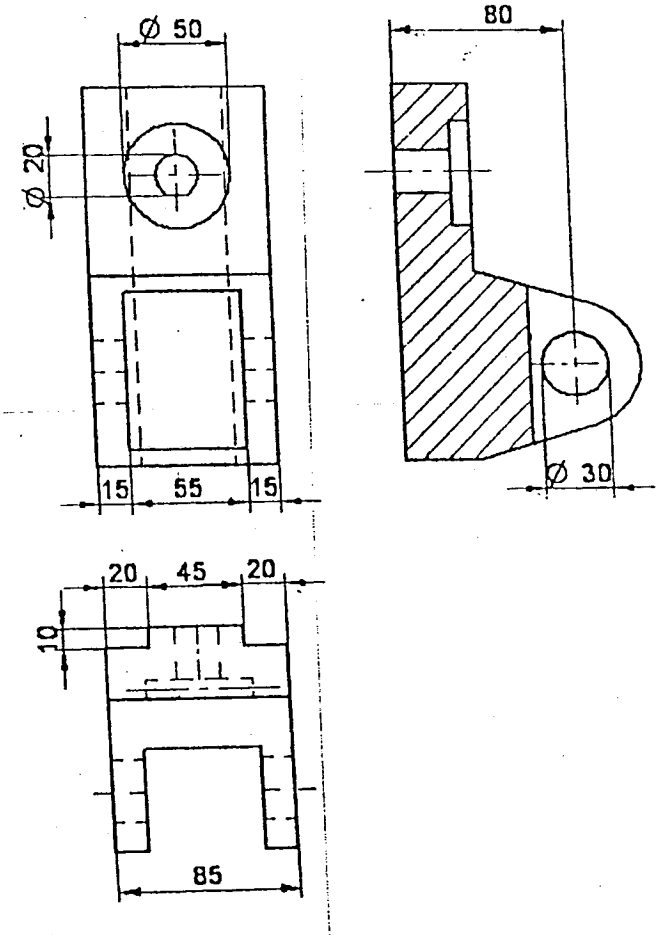


Fig. P3.12

Solution :



Problem 3.13. Fig. P3.13 shows a machine component. Draw the following views:

(a) Sectional front view
(b) Top view
(c) Side view from left

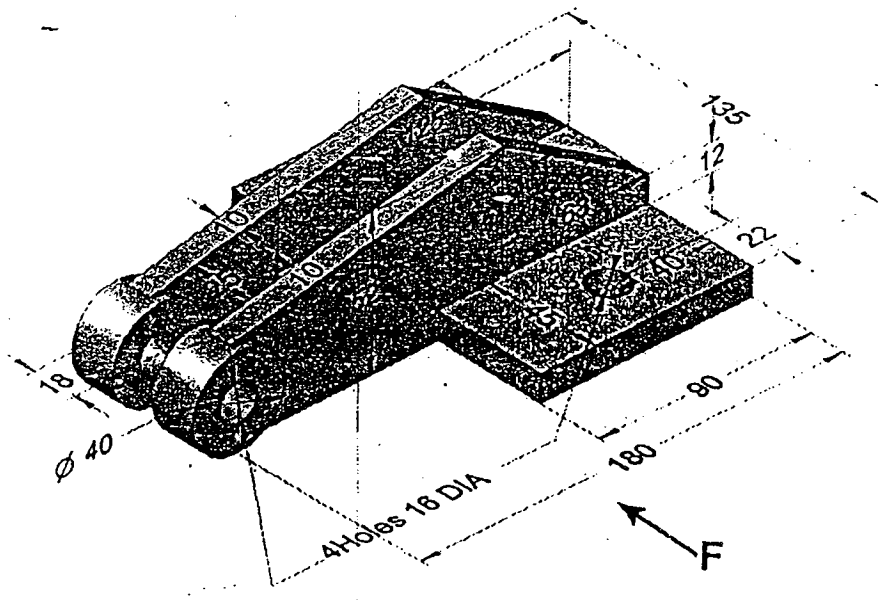
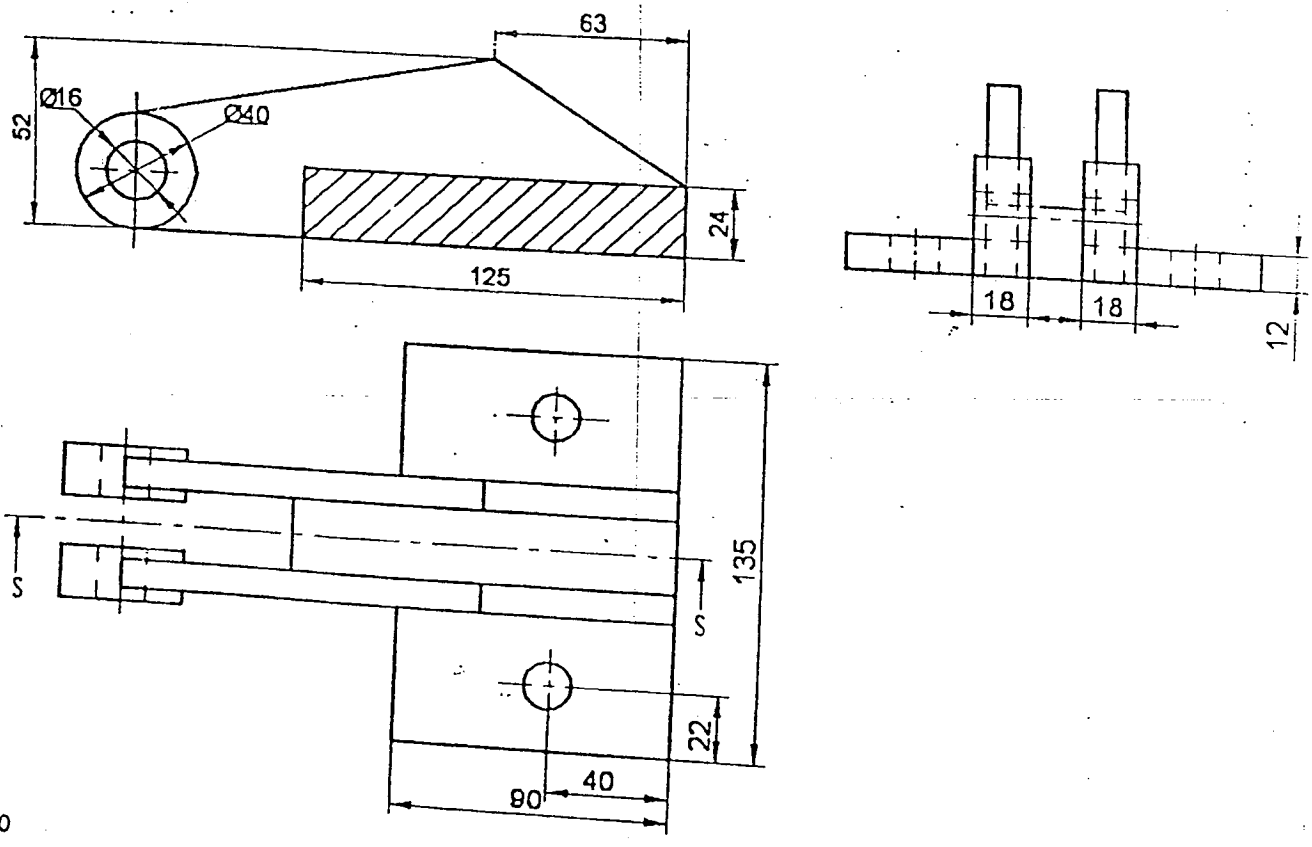


Fig. P3.13

Solution :



Problem 3.14. Fig. P3.14 shows a machine component. Draw the following views:

(a) Sectional front view
(b) Top view
(c) Side view from left

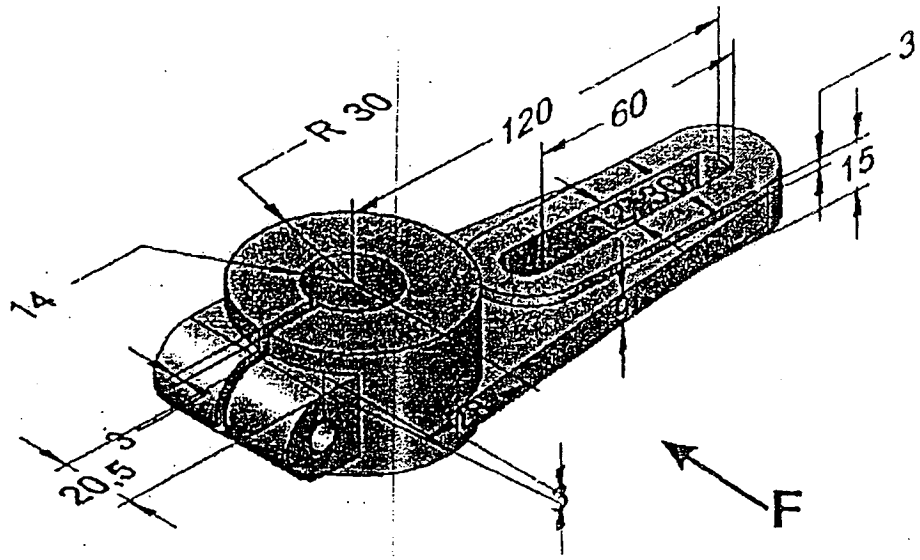
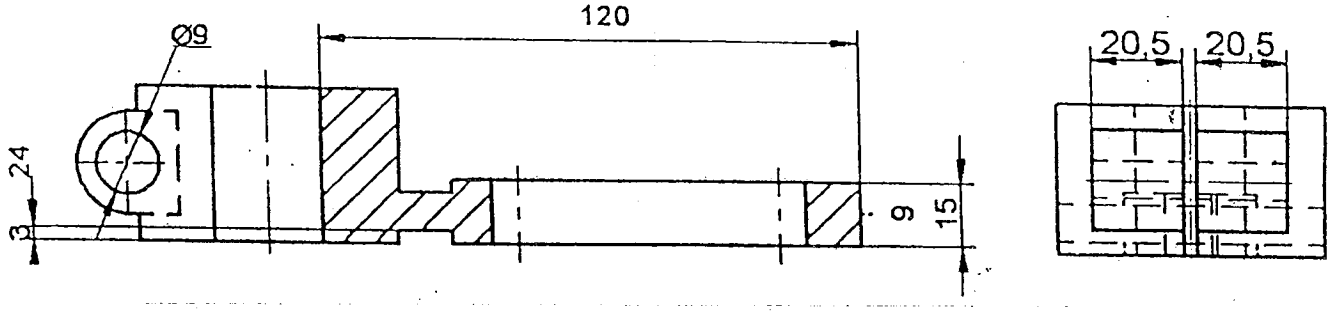
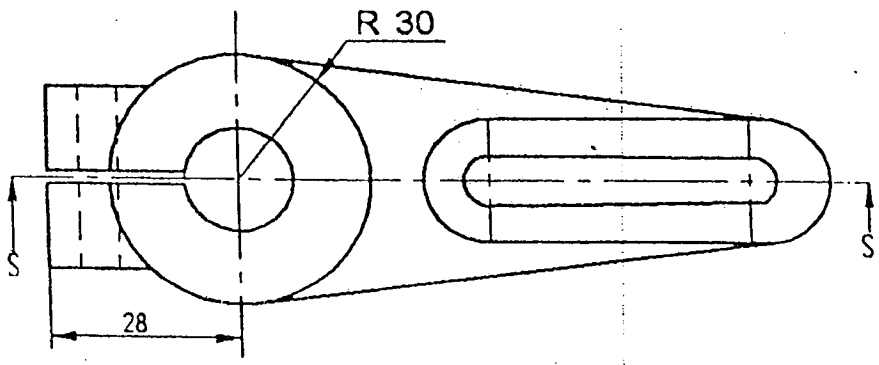


Fig. P3.14

Solution :





Problem 3.15. Fig. P3.15 shows a machine component. Draw the following views:

(a) Half Sectional front view right half in section
(b) Top view and
(c) Left side view

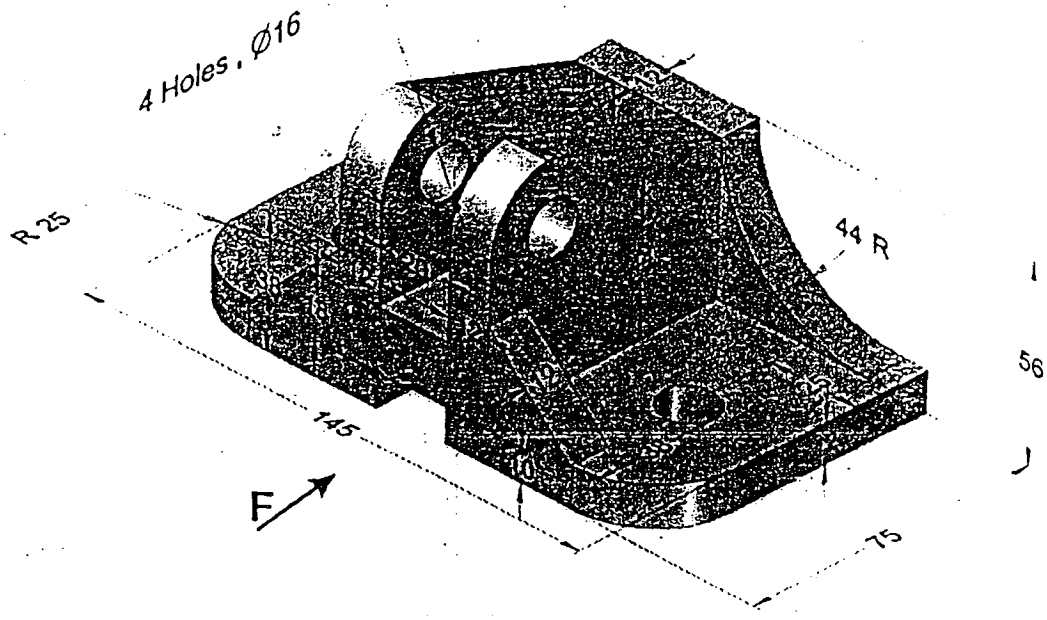
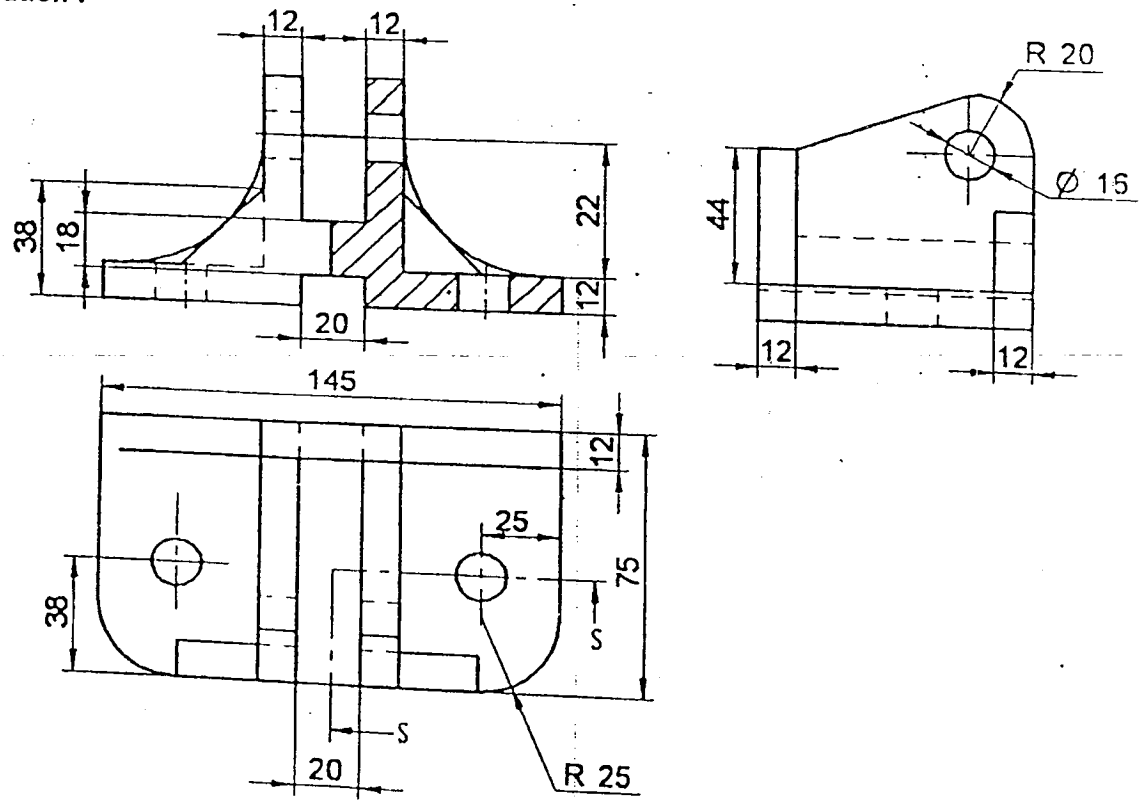


Fig. P3.15

Solution :



Problem 3.16. Fig. P3.16 shows a machine component. Draw the following views:

(a) Front view
(b) Sectional left side view and
(c) Top view

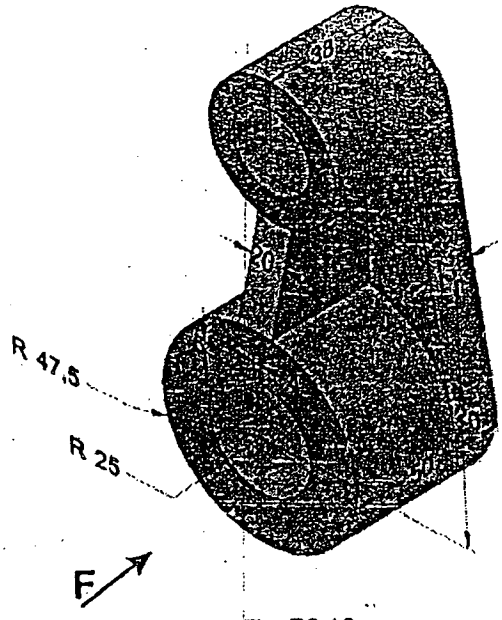
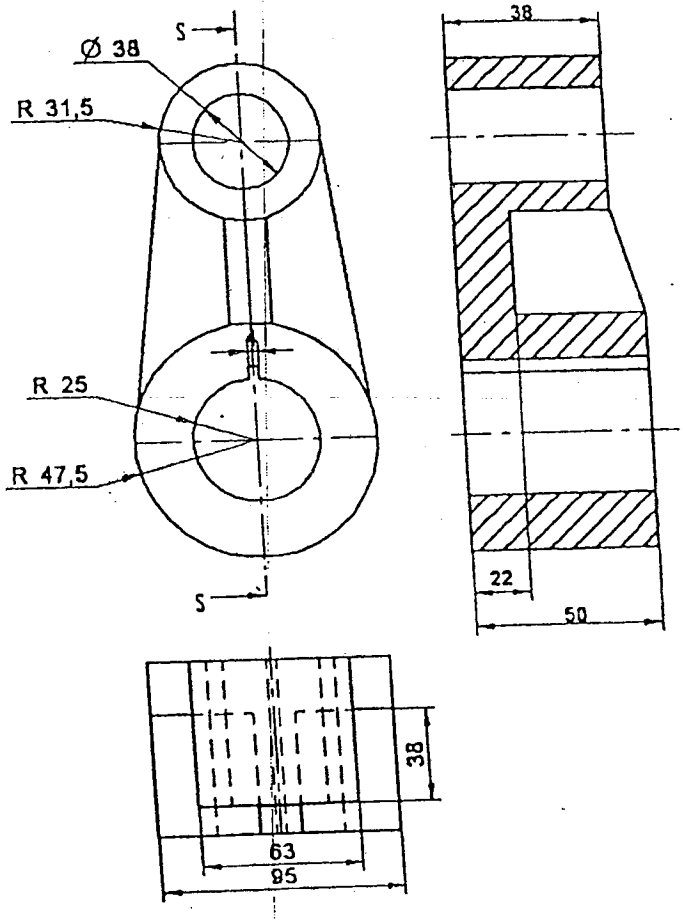


Fig. P3.16

Solution :



Problem 3.17. Fig. P3.17 shows a machine component. Draw the following views:

(a) Sectional front view
(b) full sectional left side view
(c) Sectional top view along section SS

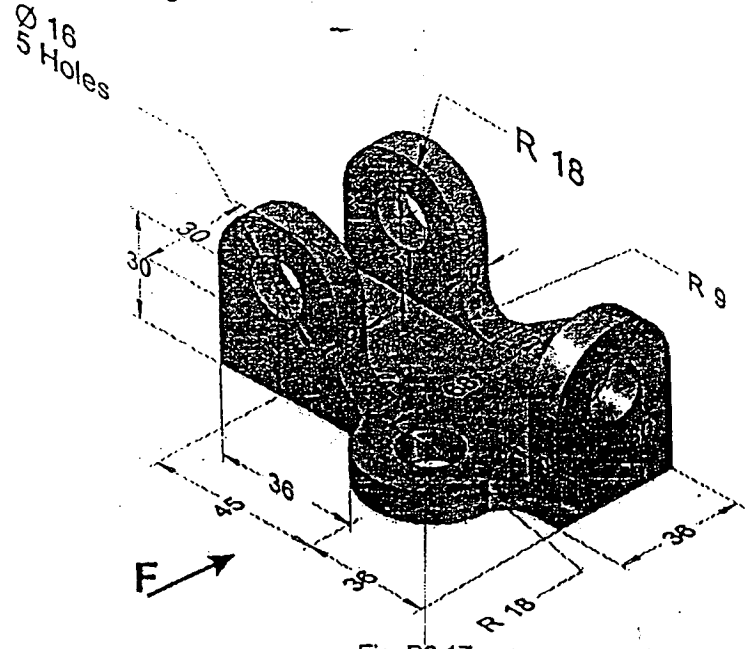
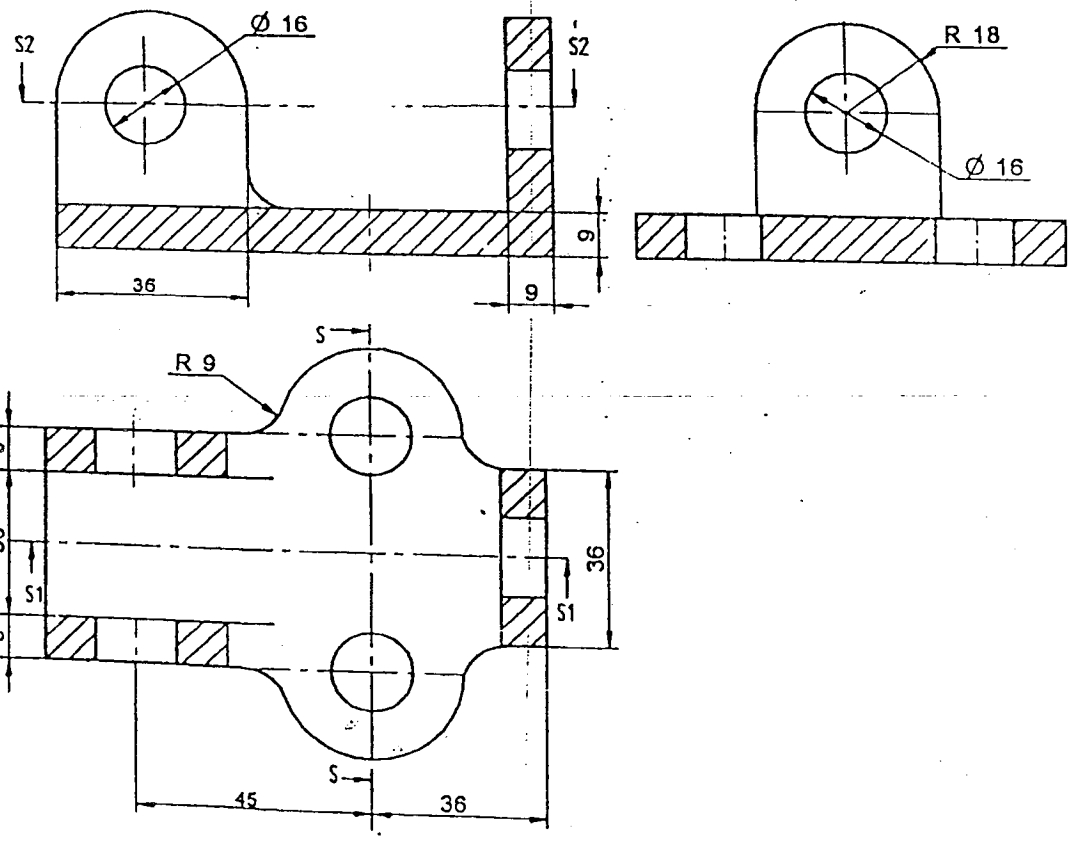


Fig. P3.17

Solution :



Problem 3.18. Fig. P3.18 shows a machine component. Draw the following views:

(a) Front view
(b) Top view and
(c) Left Side view

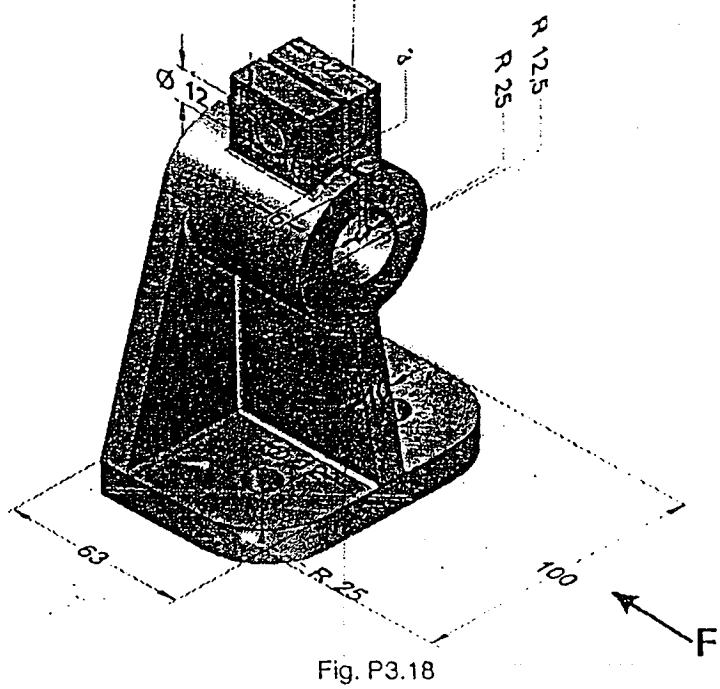
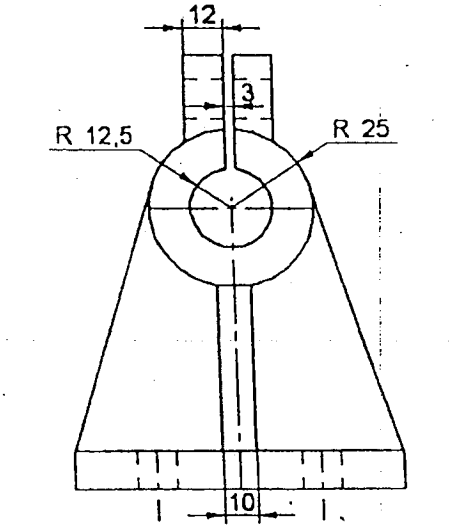
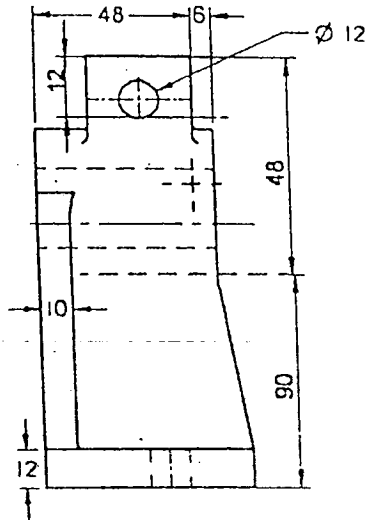
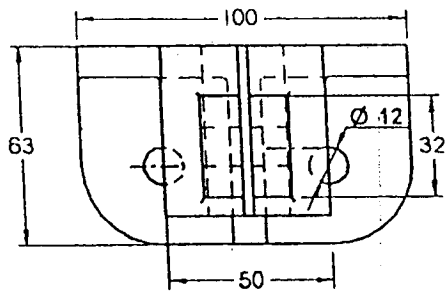


Fig. P3.18

Solution :







Problem 3.19. Fig. P3.19 shows a machine component. Draw the following views:

(a) Front view
(b) Top view and
(c) Sectional left Side view

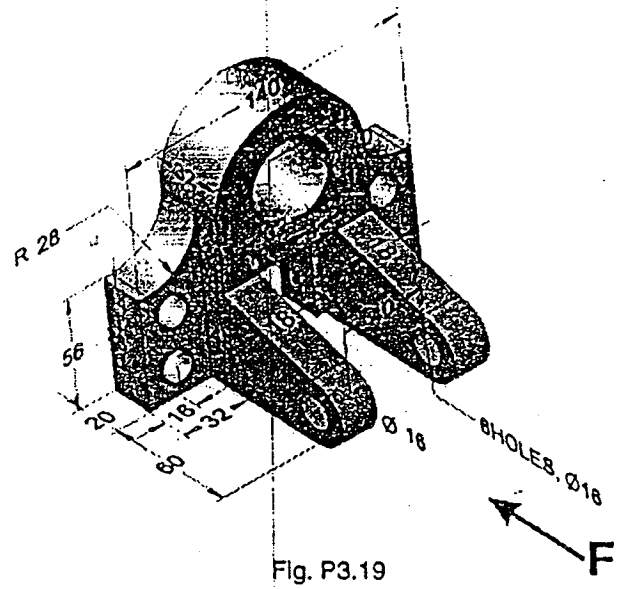
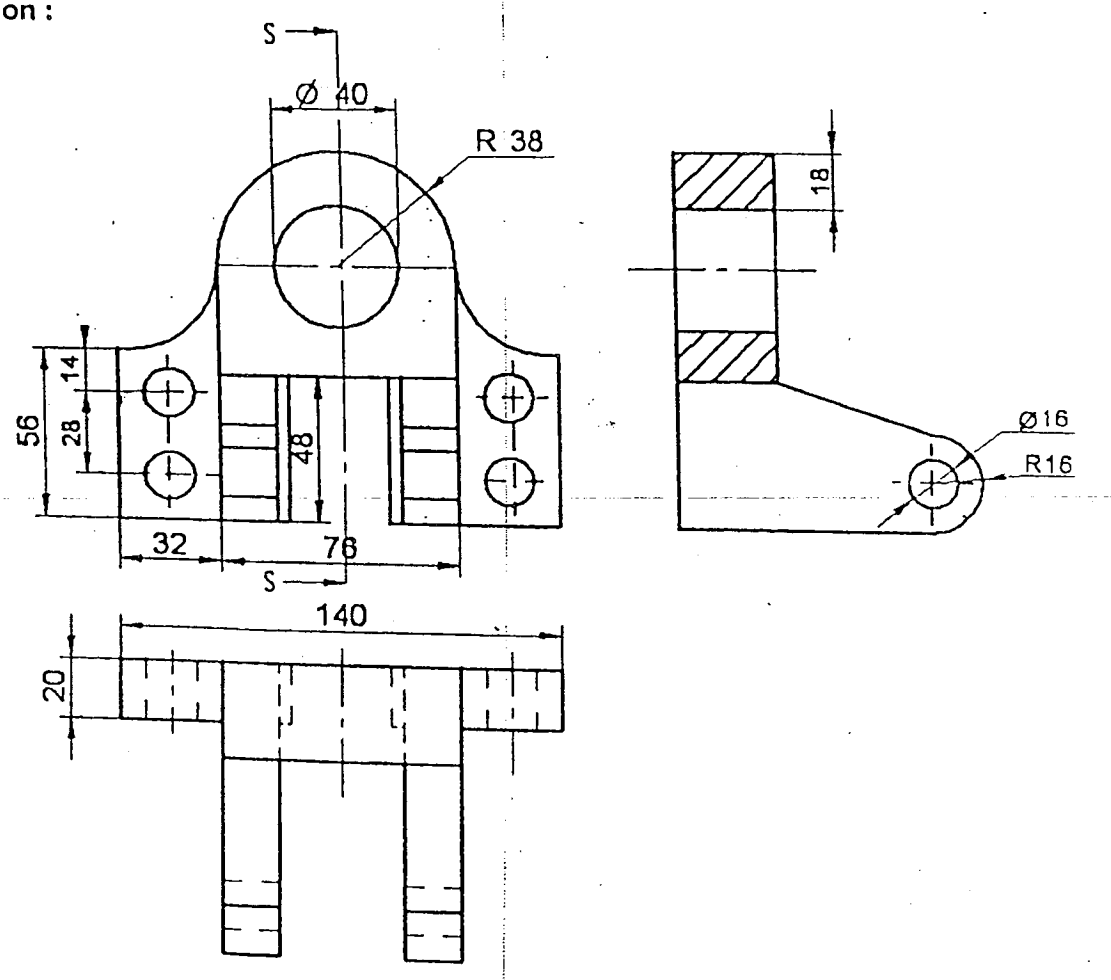


Fig. P3.19

Solution :



Problem 3.20. Fig.P3.20 shows a machine component. Draw the following views:

(a) Front view
(b) Top view and
(c) Sectional left Side view

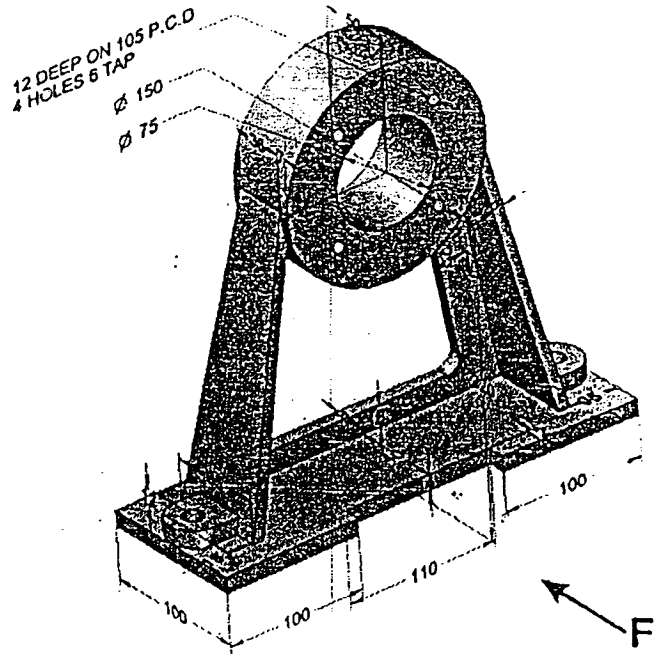
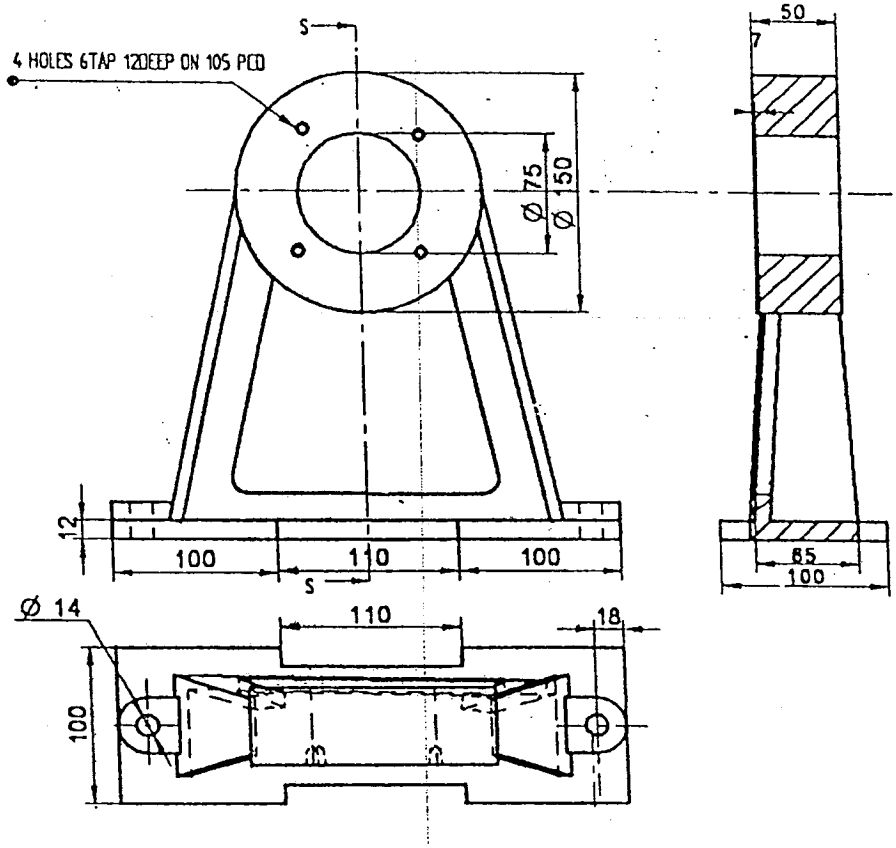


Fig. P3.20

Solution :



Problem 3.21. Fig.P3.21 shows a machine element. Draw the following views:

(a) Front elevation
(b) Top view and
(c) Side view looking from the left

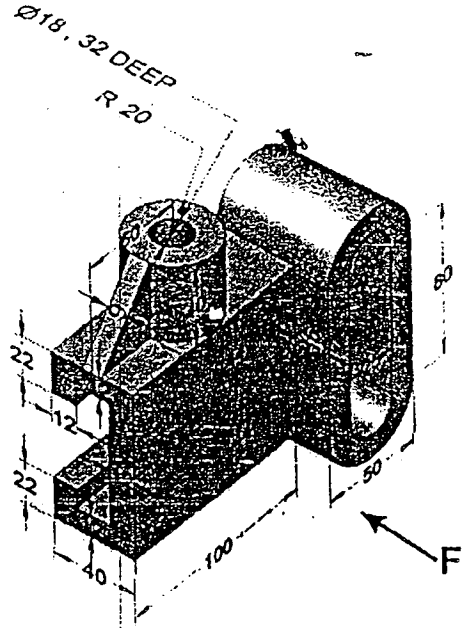
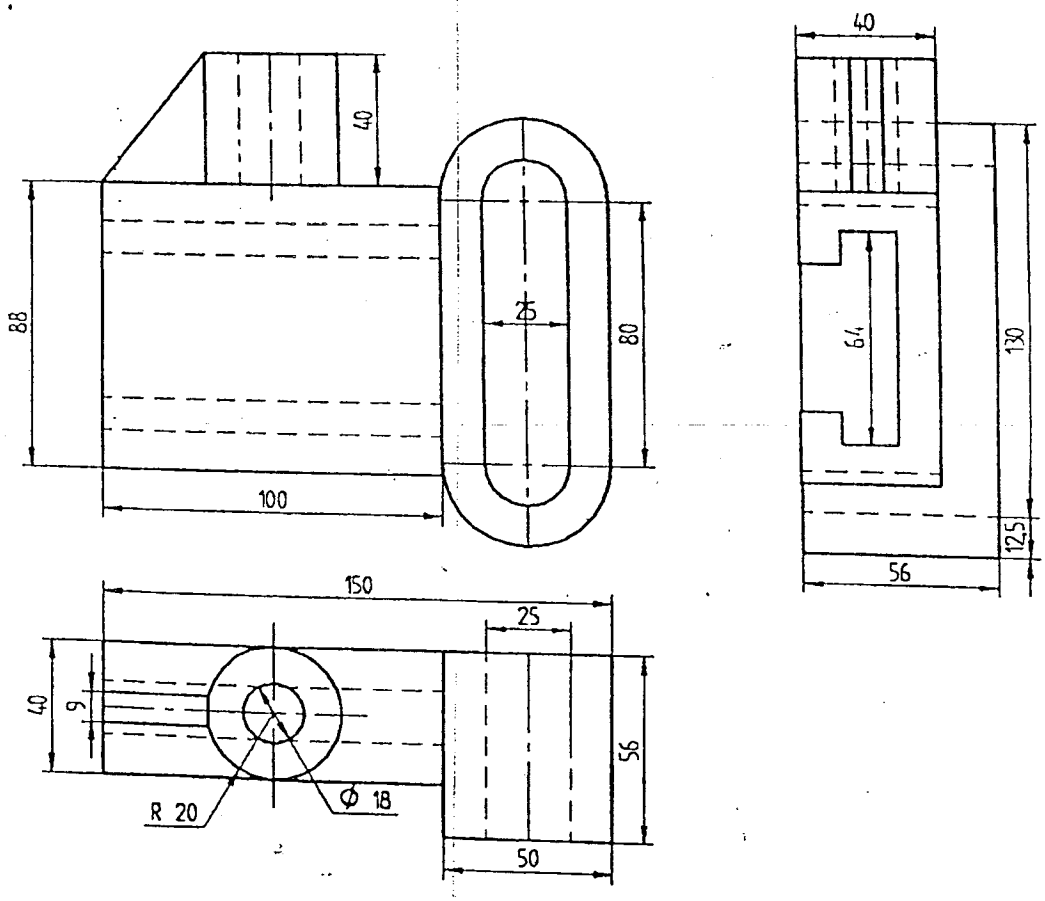


Fig. P3.21

Solution :



Problem 3.22. Fig.P3.22 shows a machine element. Draw the following views:

(a) Sectional Front view
(b) Top view and
(c) Right Side view

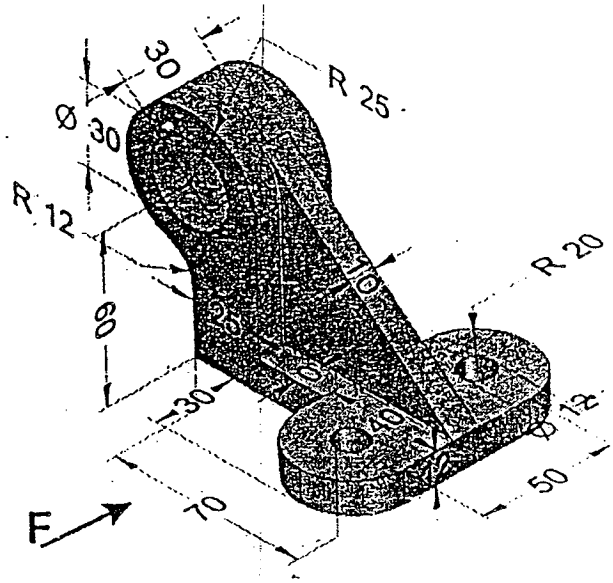
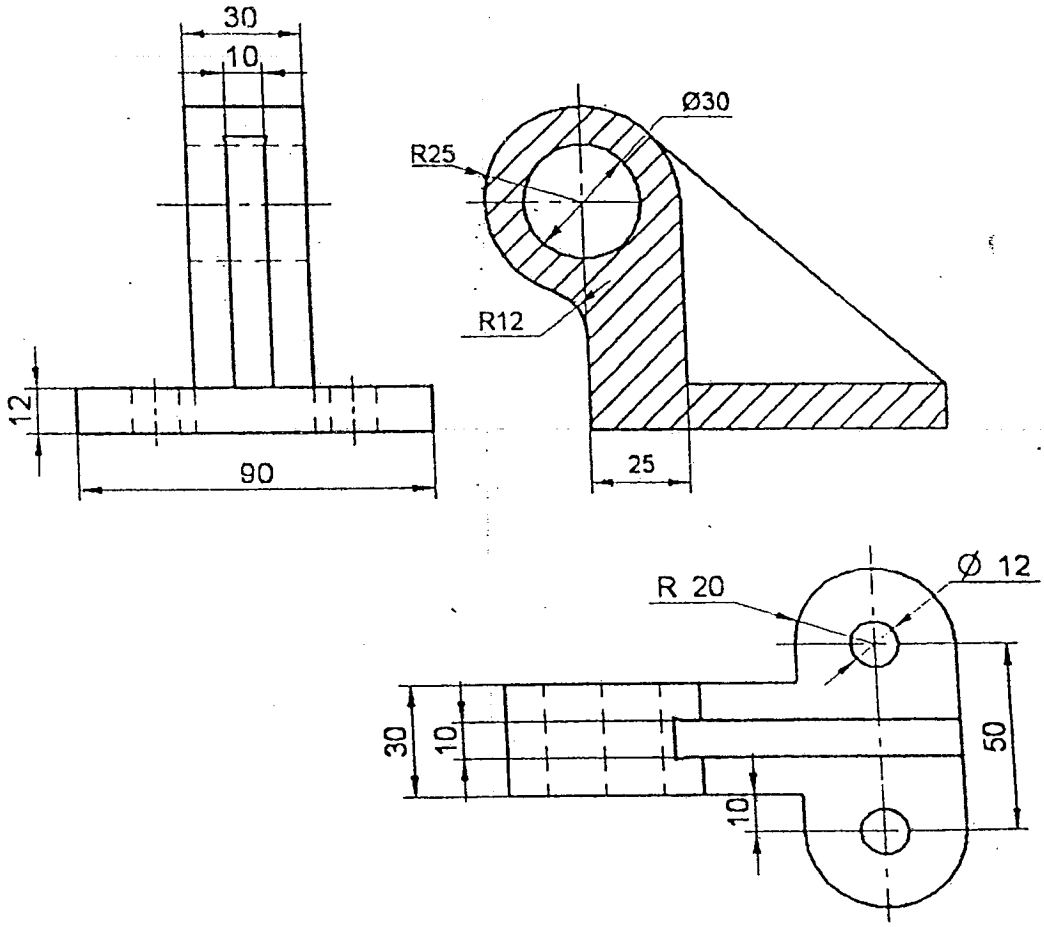


Fig. P3.22

Solution :



Problem 3.23. Fig.P3.23 shows a machine element. Draw the following views:

(a) Sectional elevation
(b) Plan and
(c) Left side view

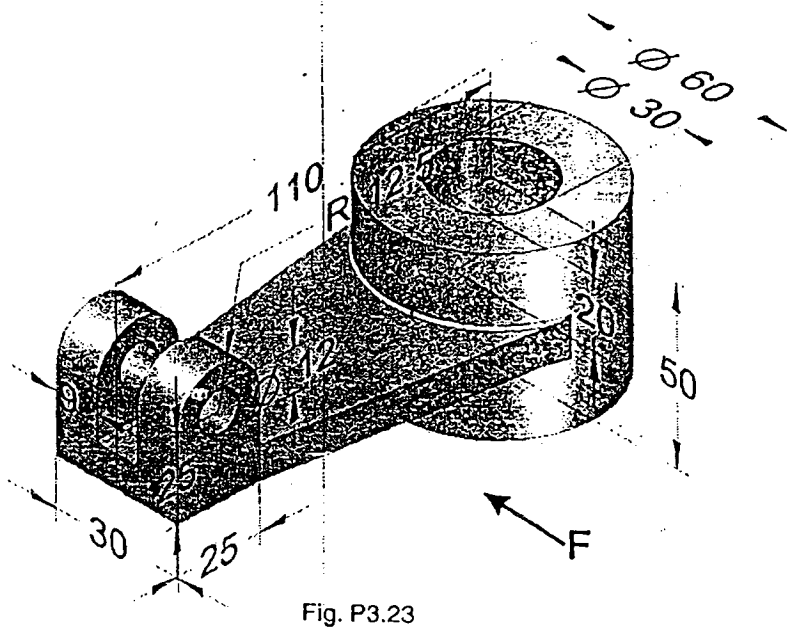
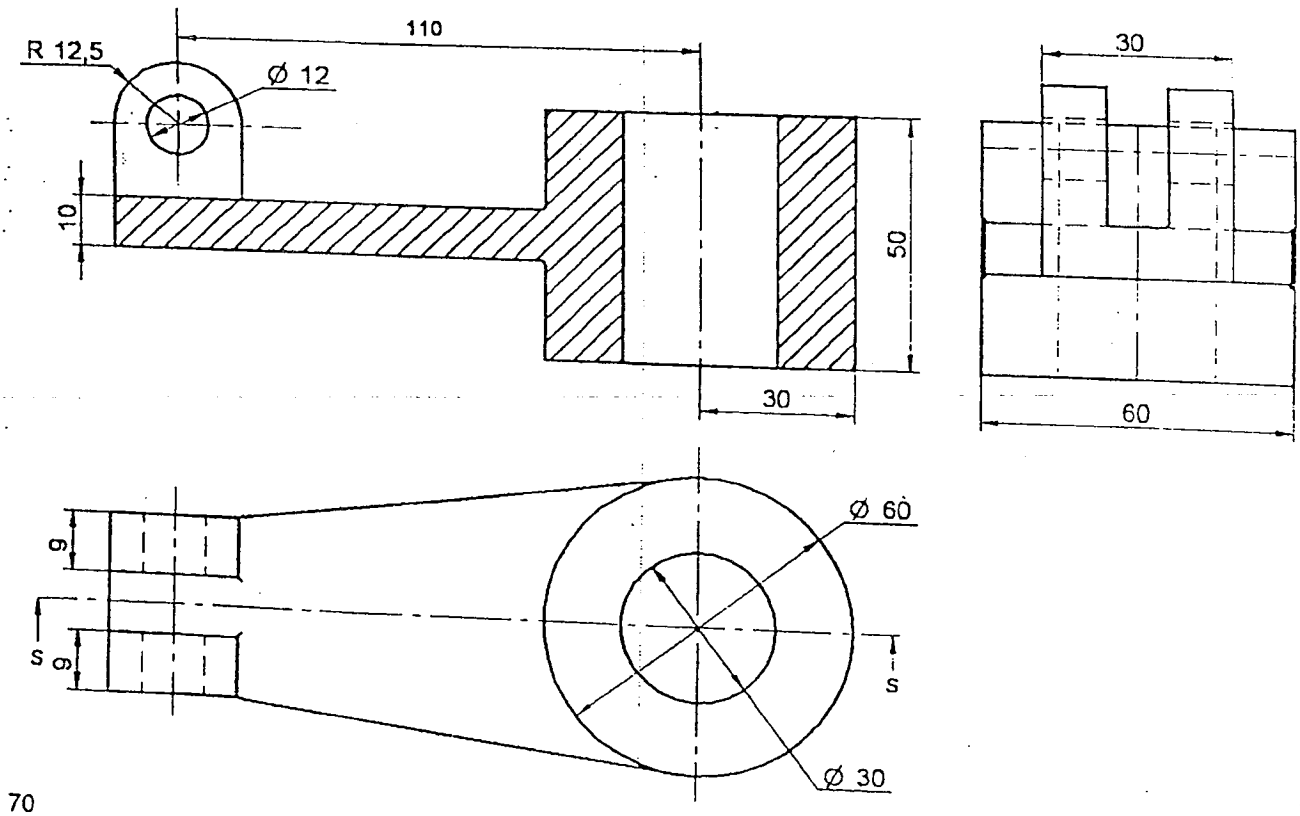


Fig. P3.23

Solution :



Problem 3.24. Fig.P3.24 shows a machine element. Draw the following views:

(a) Sectional elevation
(b) Top view and
(c) Side view from the Left

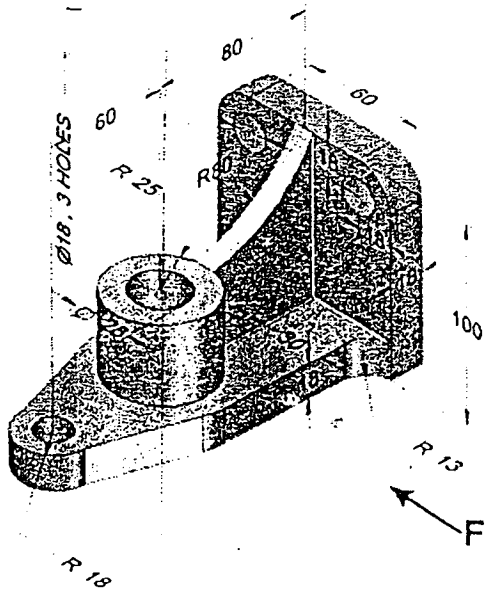
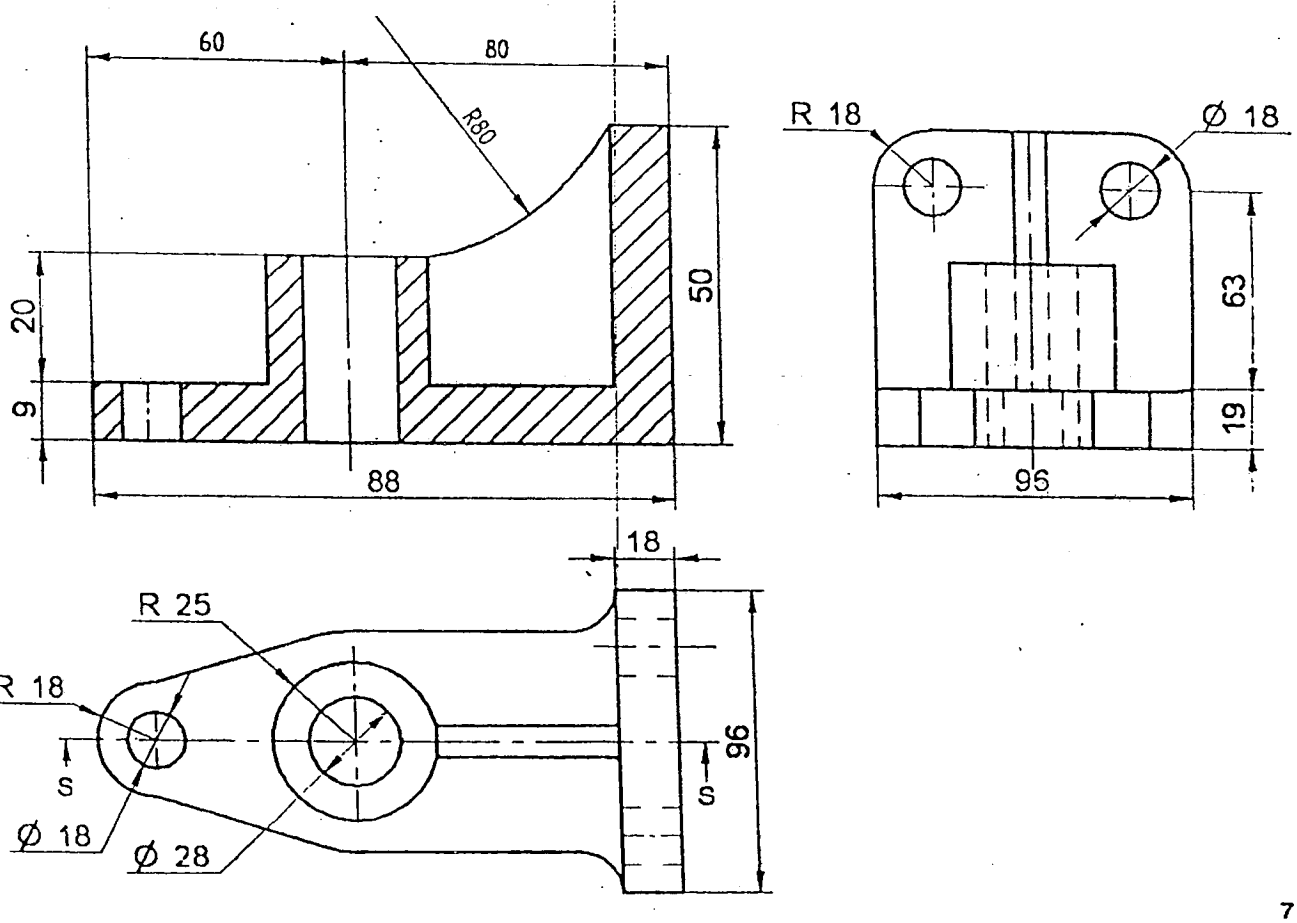


Fig. P3.24

Solution :



Problem 3.25. Fig.P3.25 shows a machine element. Draw the following views:

(a) Elevation
(b) Plan and
(c) Side view from the Left

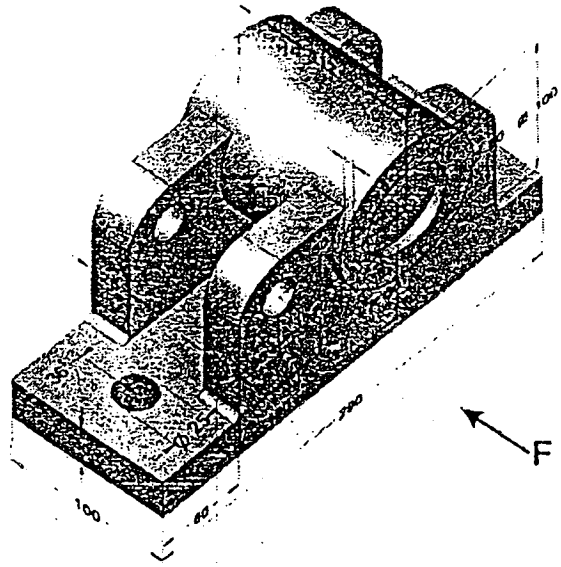
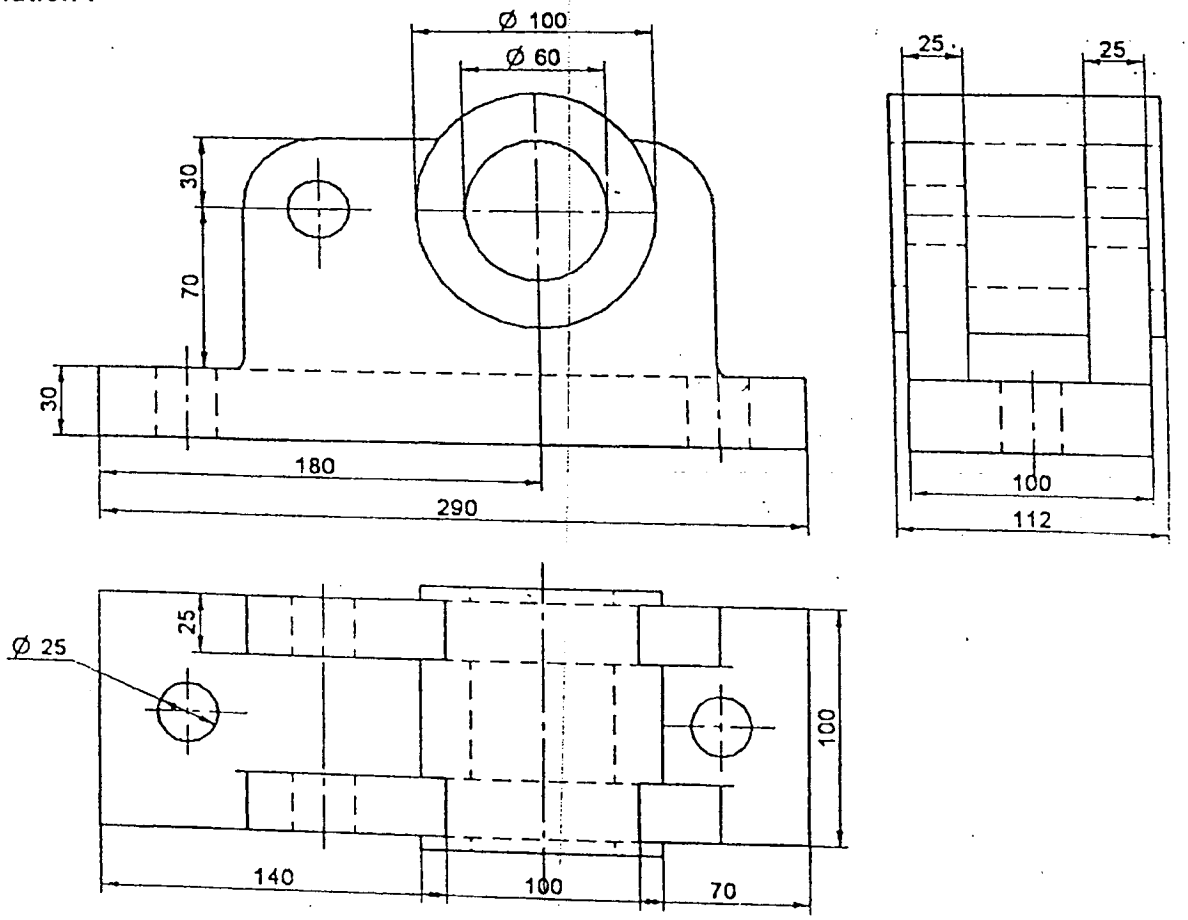


Fig. P3.25

Solution :



Problem 3.26. Fig.P3.26 shows a machine element. Draw the following views:

(a) Sectional front view
(b) Top view and
(c) Side view from the Left

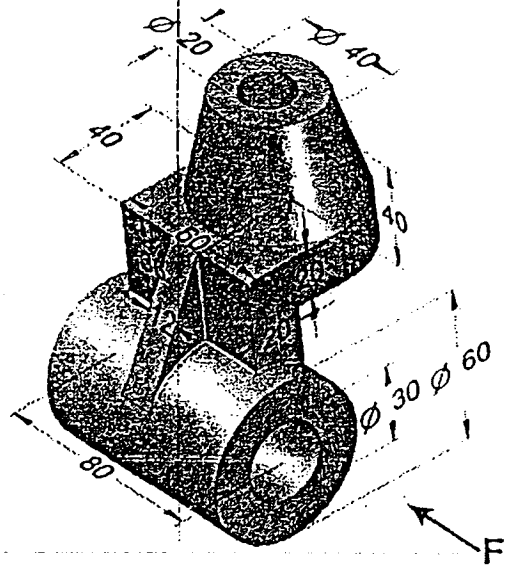
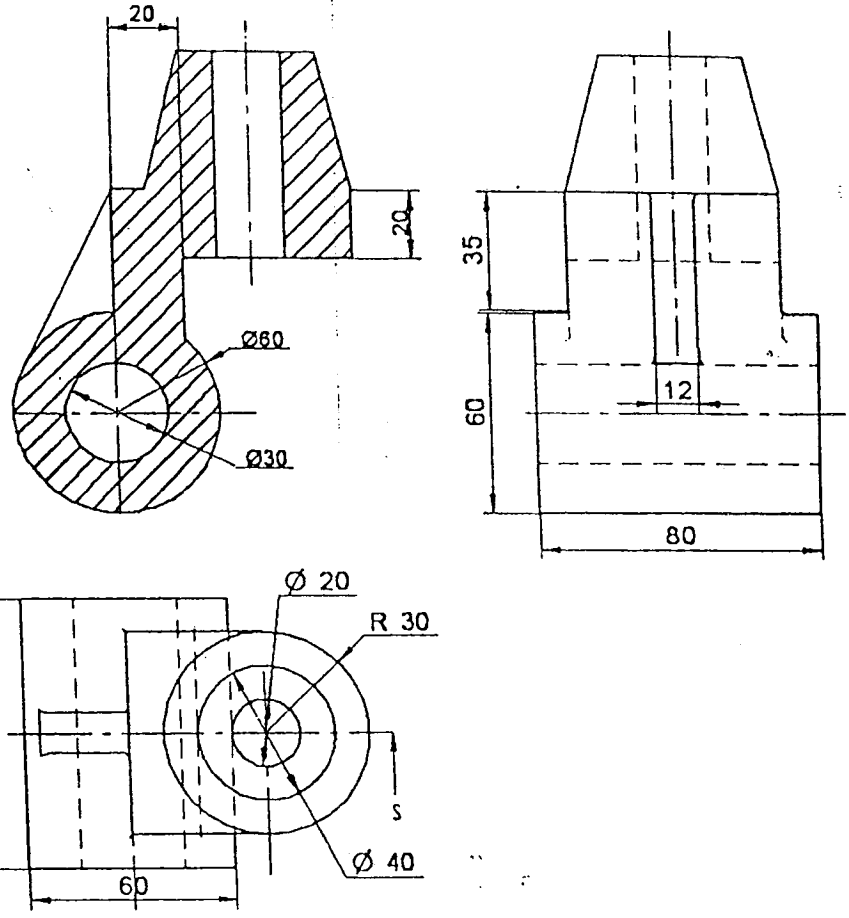


Fig. P3.26

Solution :



Problem 3.27. Fig.P3.27 shows a machine element. Draw the following views:

(a) Sectional front view
(b) Plan and
(c) Side view from the left

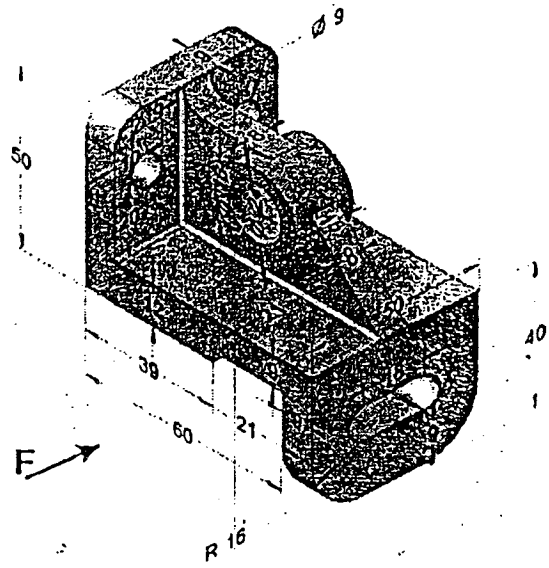
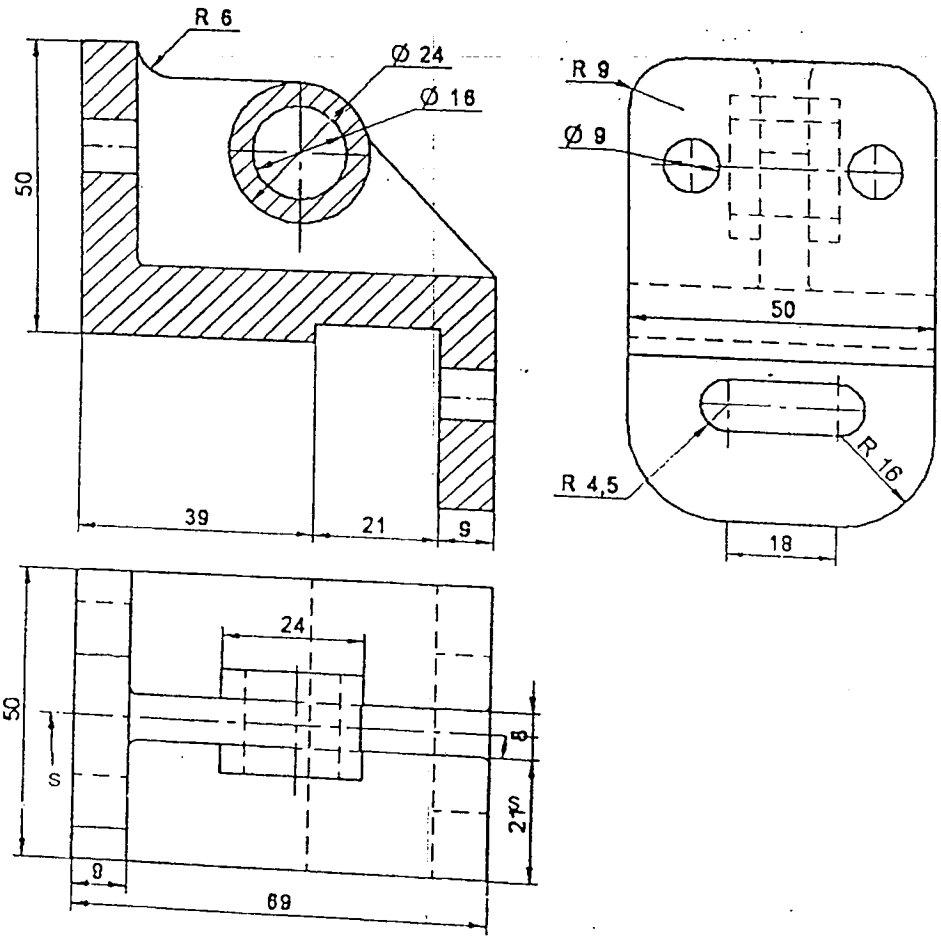


Fig. P3.27

Solution :



Problem 3.28. Fig.P3.28 shows a machine element. Draw the following views:

(a) Front elevation
(b) Top view
(c) Sectional left side view

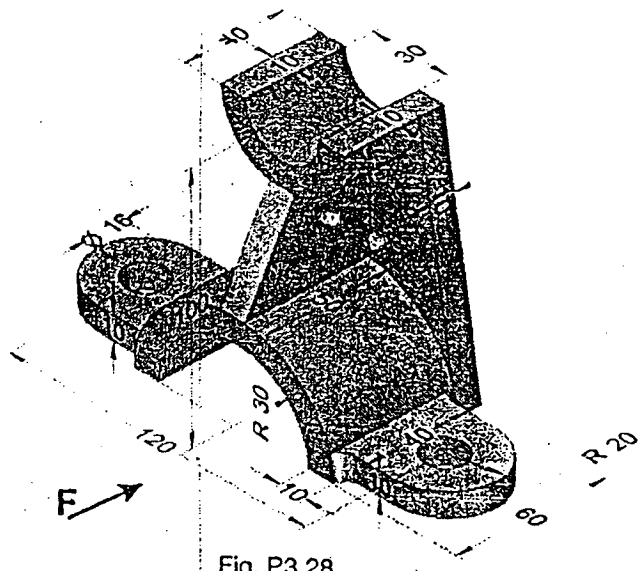
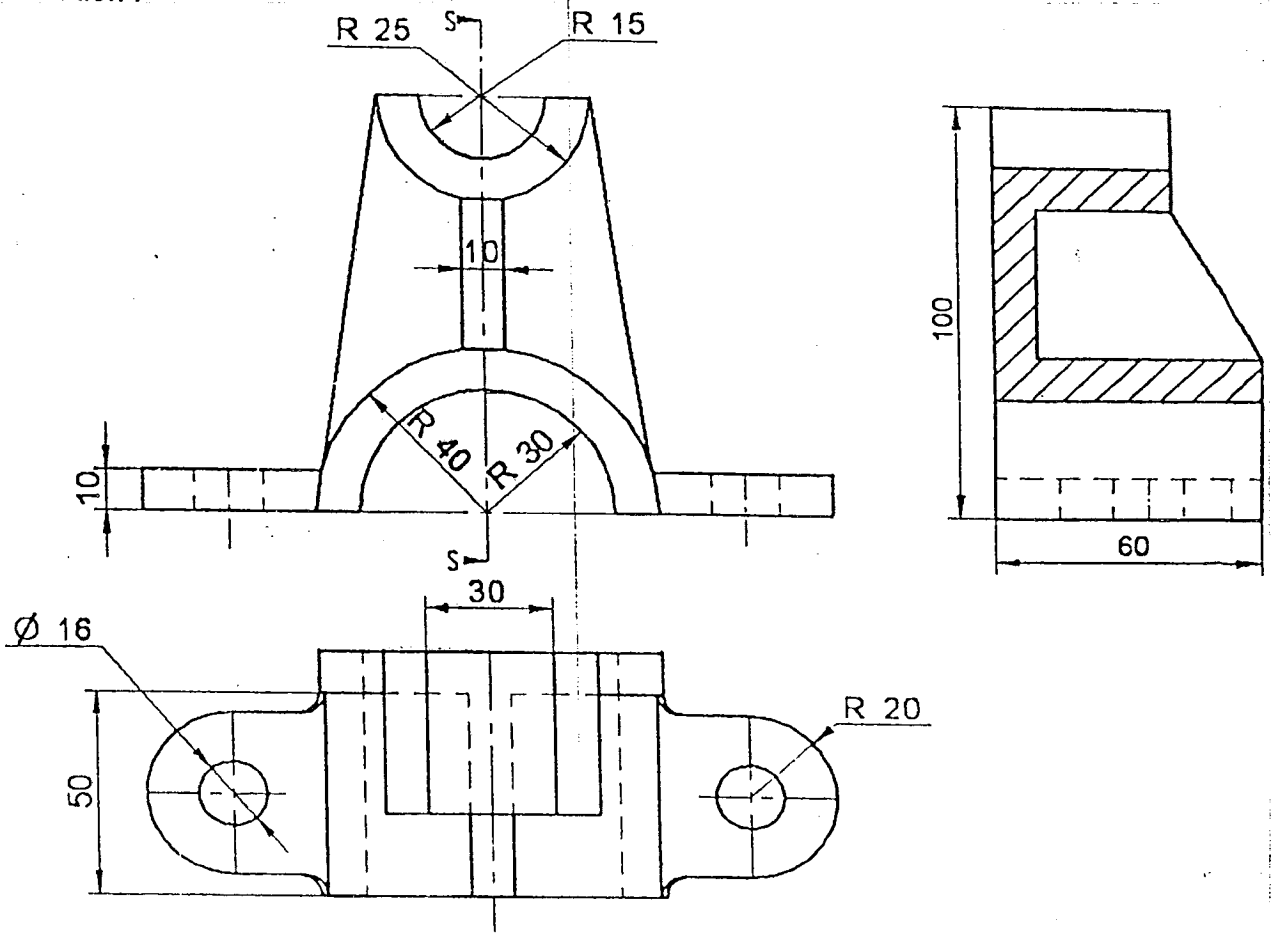


Fig. P3.28

Solution :



Problem 3.29. Fig.P3.29 shows a machine element. Draw the following views:

(a) Front elevation
(b) Top view and
(c) Left side view

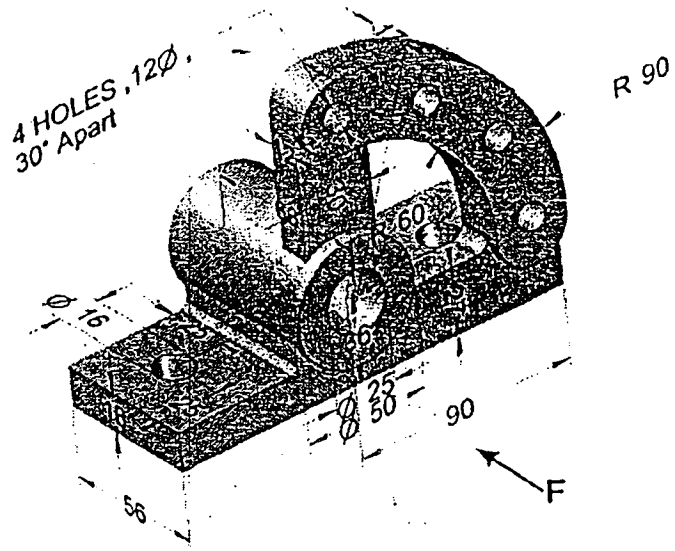
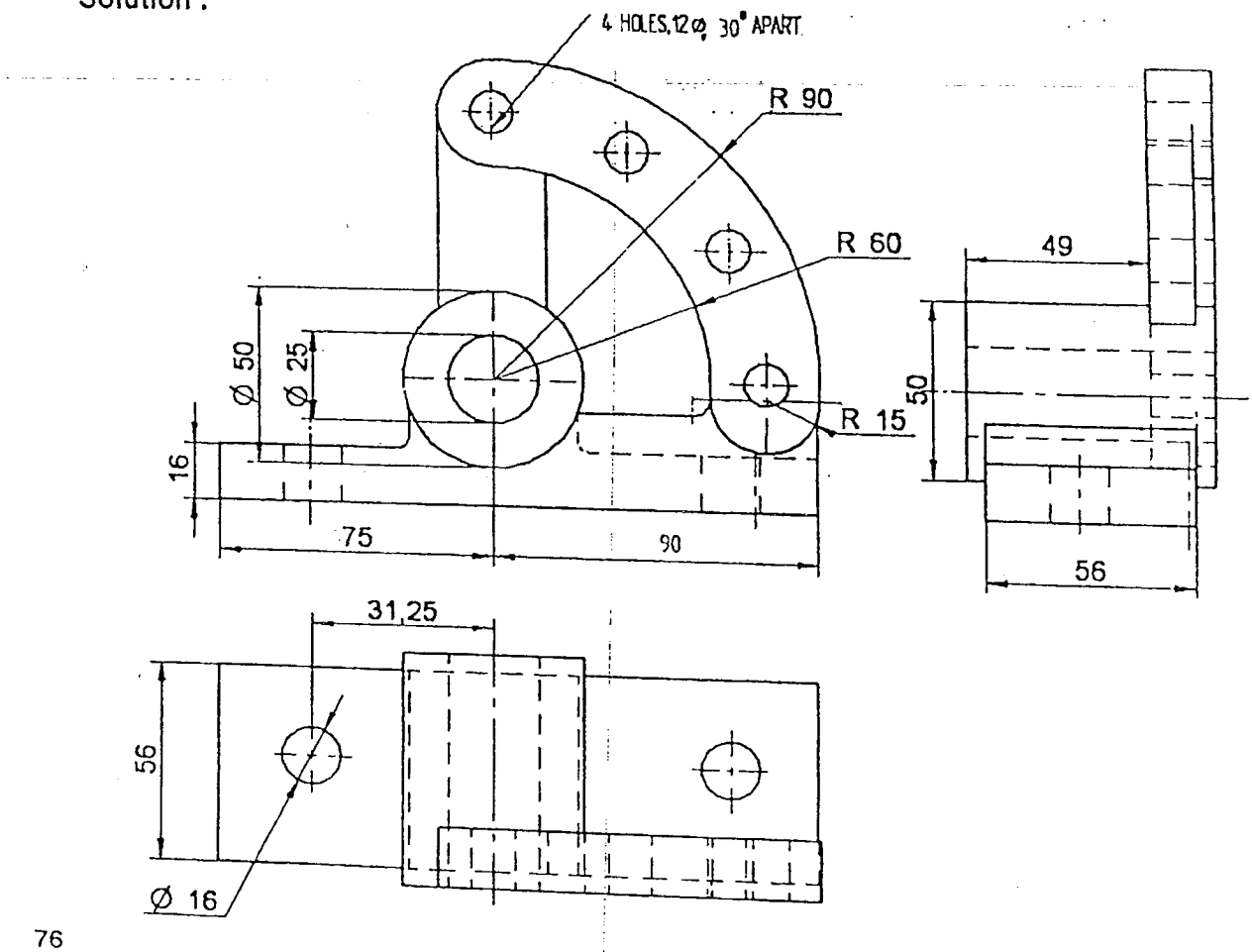


Fig. P.29

Solution :



Problem 3.30. Fig P3.30 shows a machine component. Draw the following views:

(a) Front view
(b) Top view and
(c) Side view from left

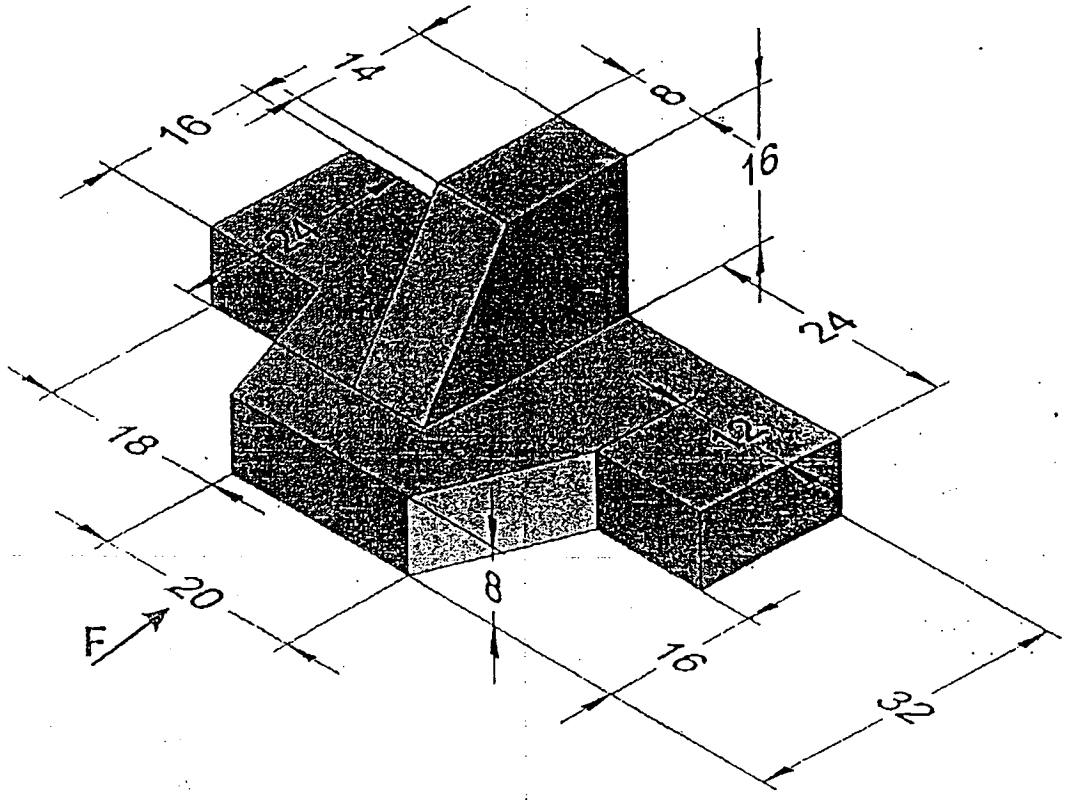
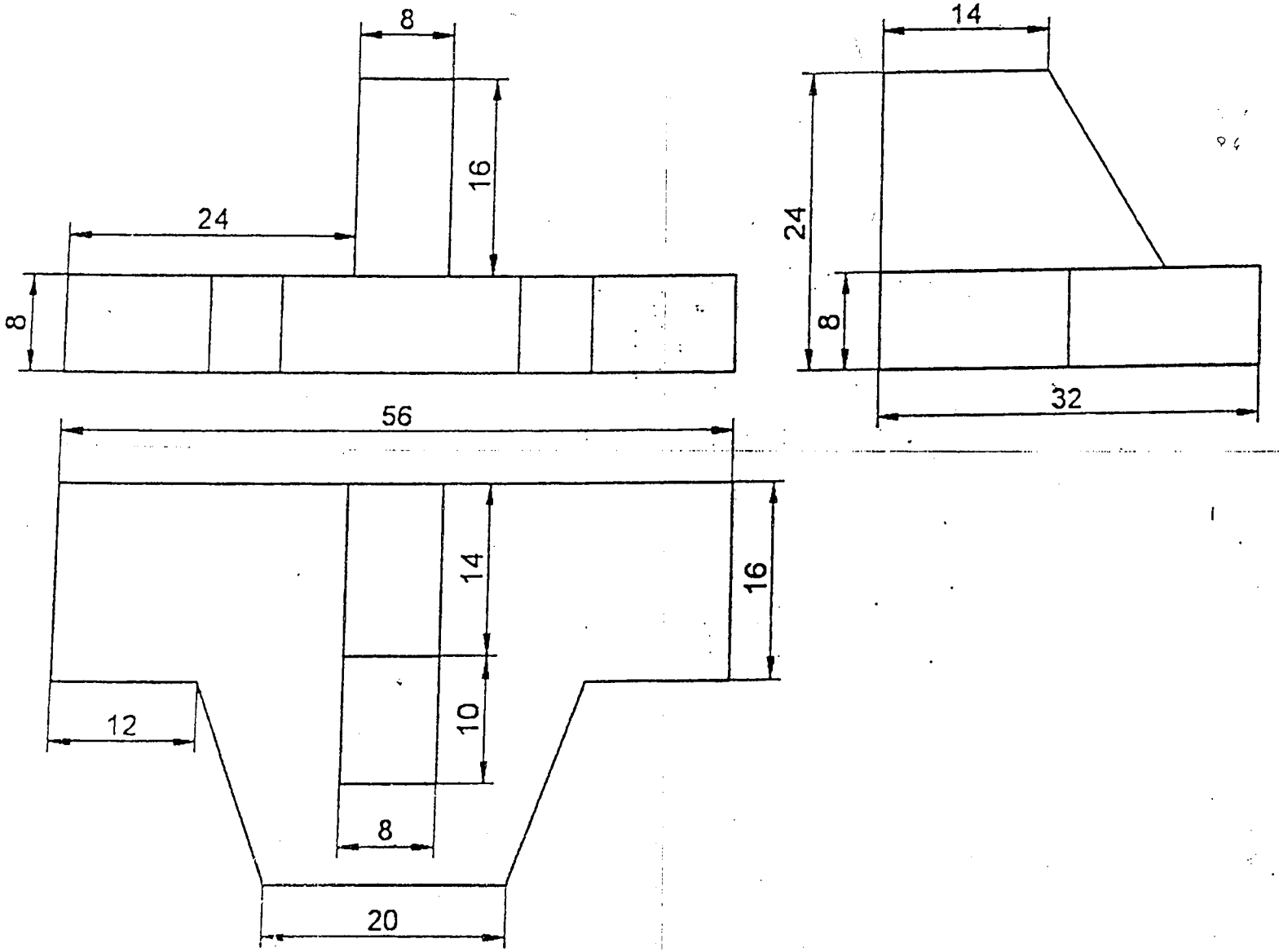


Fig. P3.30

Computer Aided Drafting Procedure

1. Open the **SOFTWARE.** Click on the SOLID **PART** in the **CREATE** dialog box.
2. To construct body of **MACHINE PART**
   a. Select Protrusion from feature tool bar.
   b. Select any one reference plane say XZ plane.
   c. Using **LINE COMMAND**, **CURVE COMMAND** and **CONNECT COMMAND** draw the part drawing as shown in the figure.
   d. Move back to part environment to get the body of the machine part as shown in the figure.
   e. Save the part file by giving the file name as machine part.
3. Move to **DRAFT ENVIRONMENT** retrieve machine part modelling to get front view. Using **PRINCIPAL VIEW COMMAND** get the necessary view as per the problem.
4. Using **FILL COMMAND** select the bounded area which has been sectioned to hatch.
5. Using **DIMENSION COMMAND** and dimension the machine part and finally save the file.


8
16
24
8
14
24
8
32
56
14
16
10
12
8
20

Problem 3.31. Fig P3.31 shows a machine component. Draw the following views:

(a) Front view
(b) Top view and
(c) Side view from left

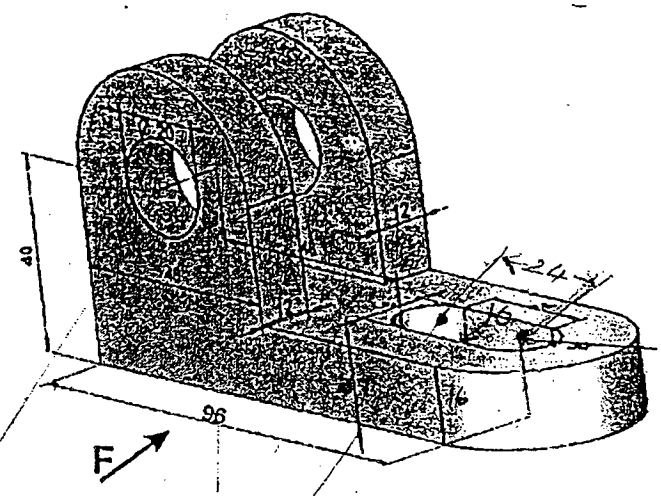
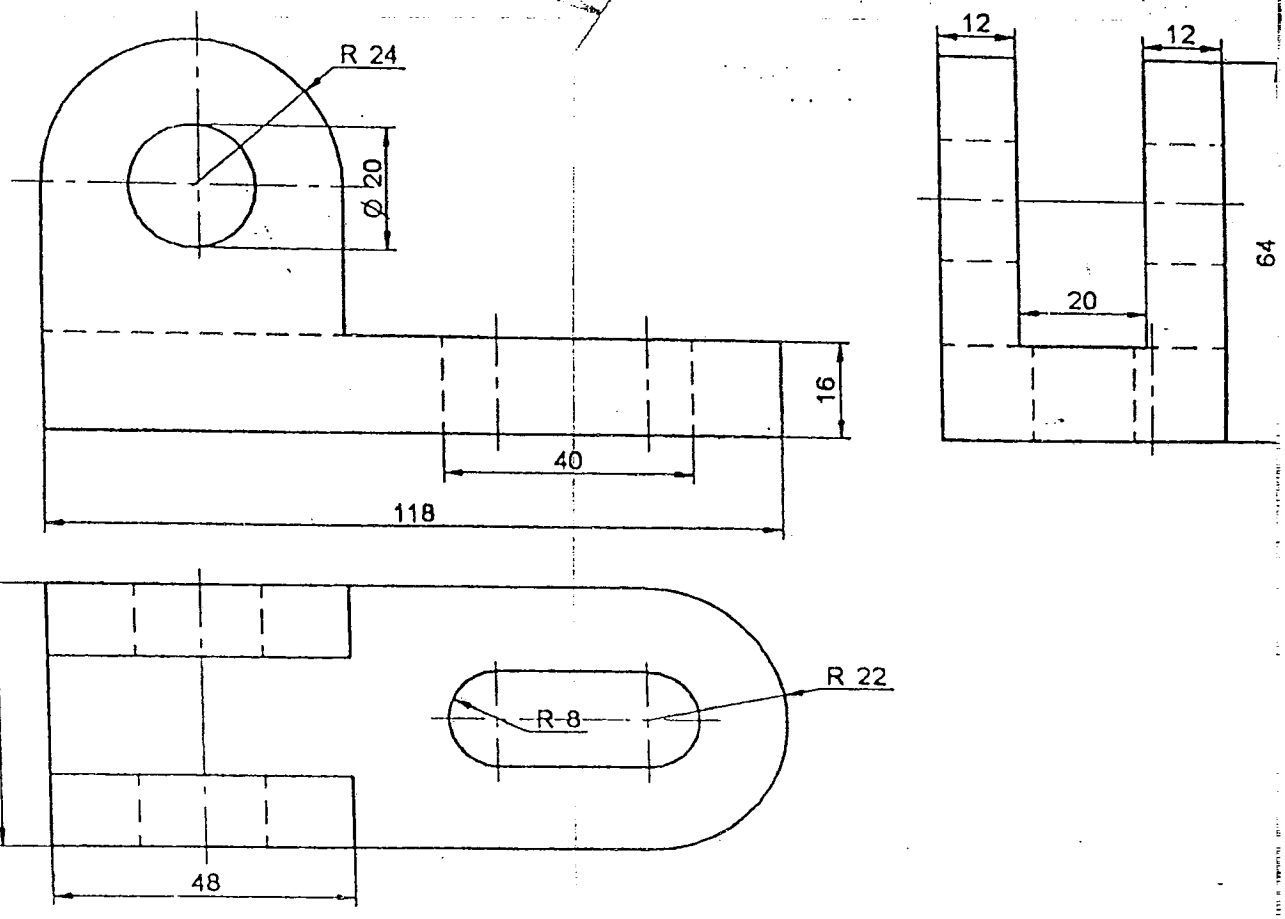


Fig. P 3.31

Solution :



Problem 3.32. Fig P3.32 shows a machine component. Draw the following views:

(a) Front view
(b) Top view and
(c) Side view from left

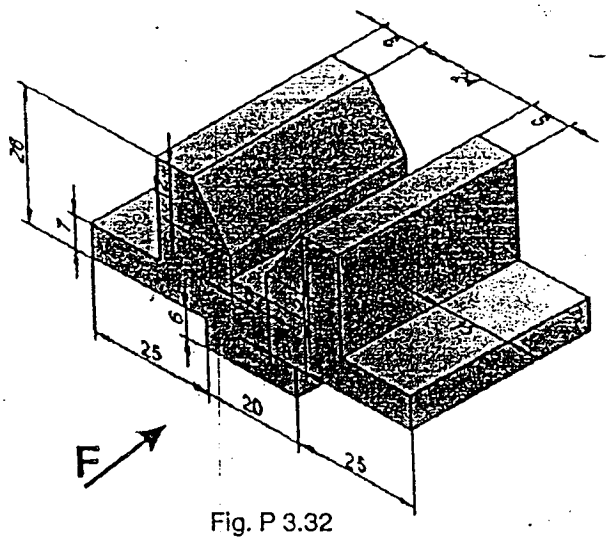
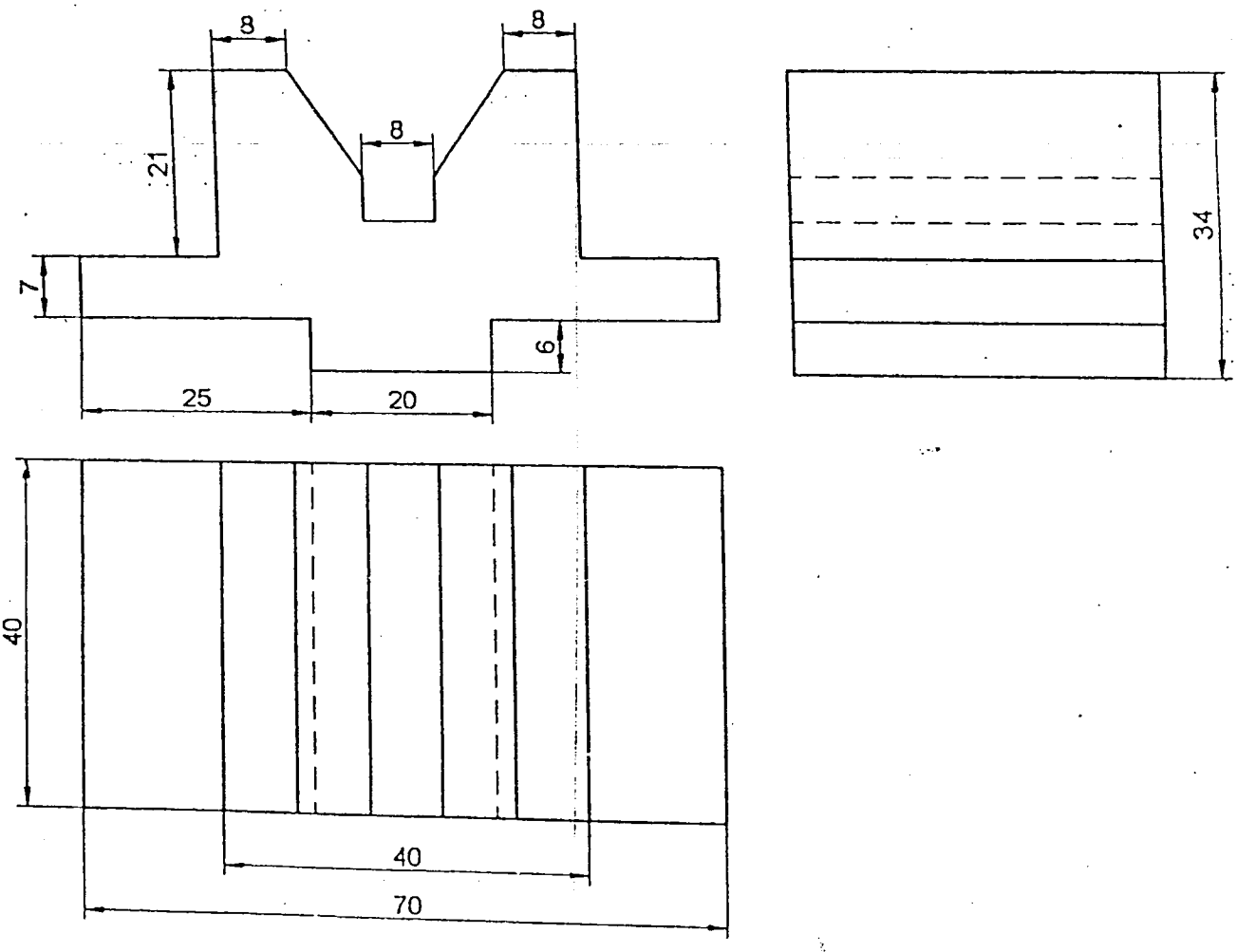


Fig. P 3.32

Solution :



Problem 3.33. Fig P3.33 shows a machine component. Draw the following views:

(a) Front view
(b) Top view and
(c) Side view from left

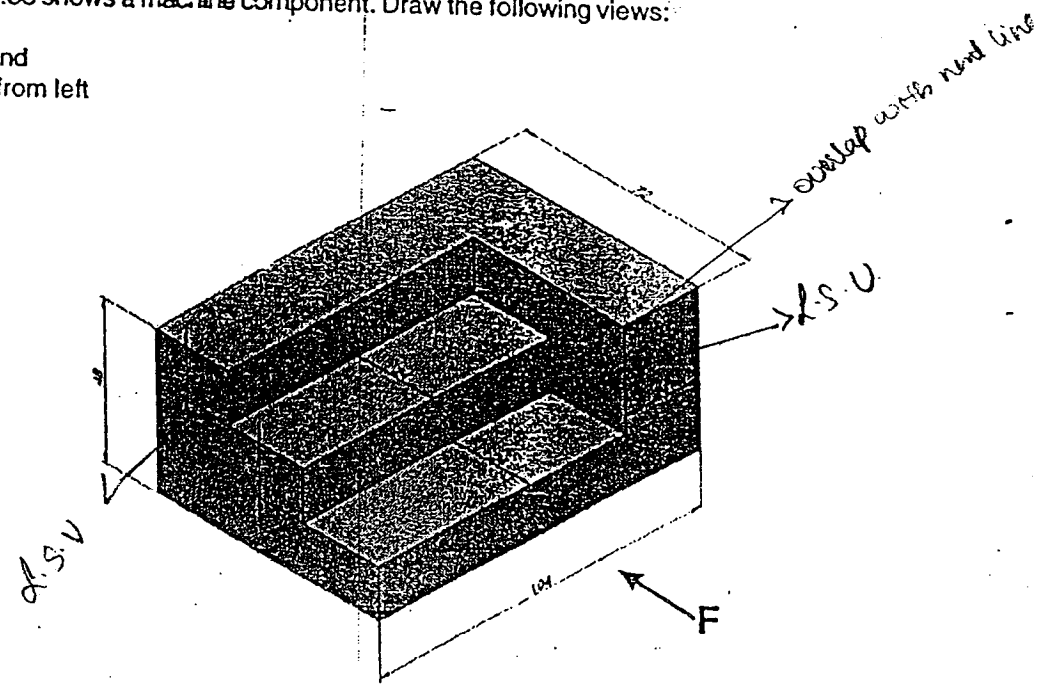
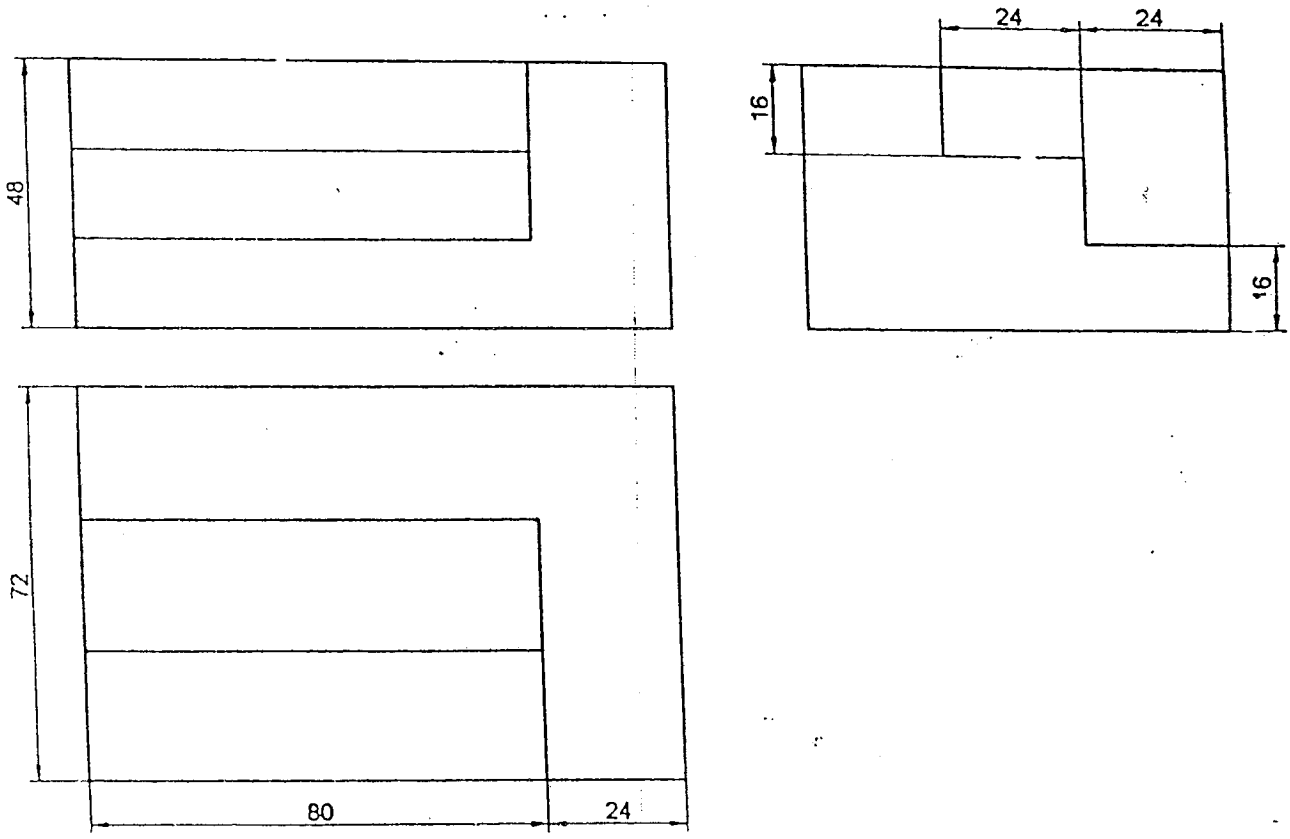


Fig. P 3.33

Solution :



Problem 3.34. Fig P3.34 shows a machine component. Draw the following views:

(a) Front view
(b) Top view and
(c) Side view from left

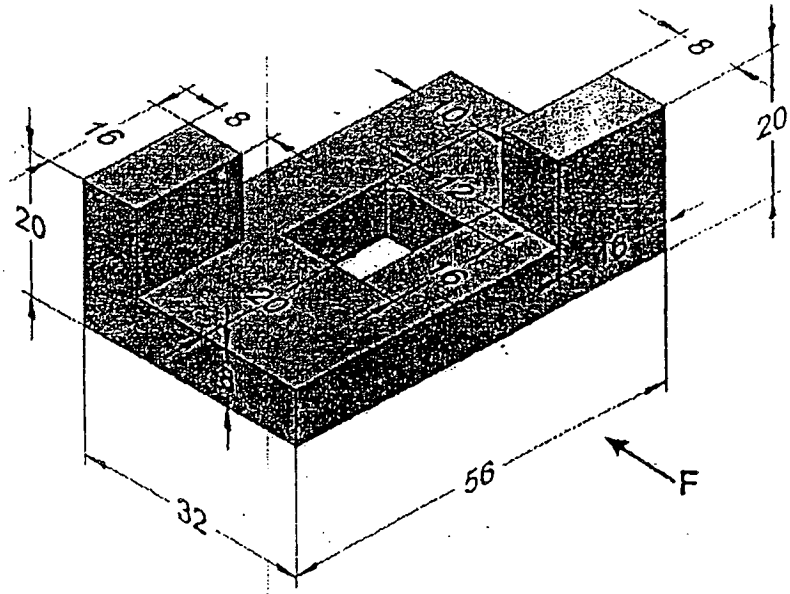
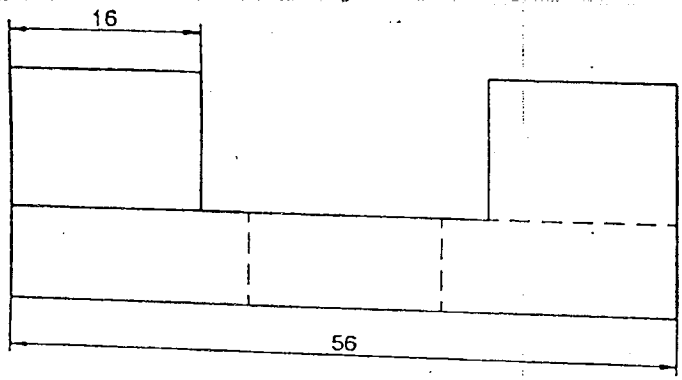
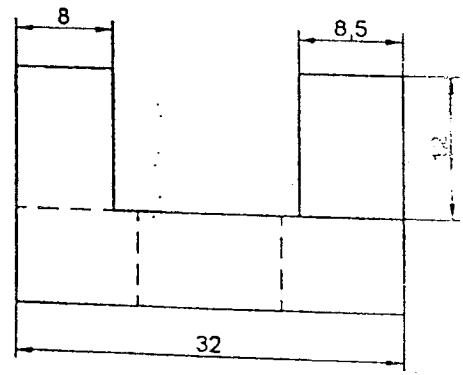
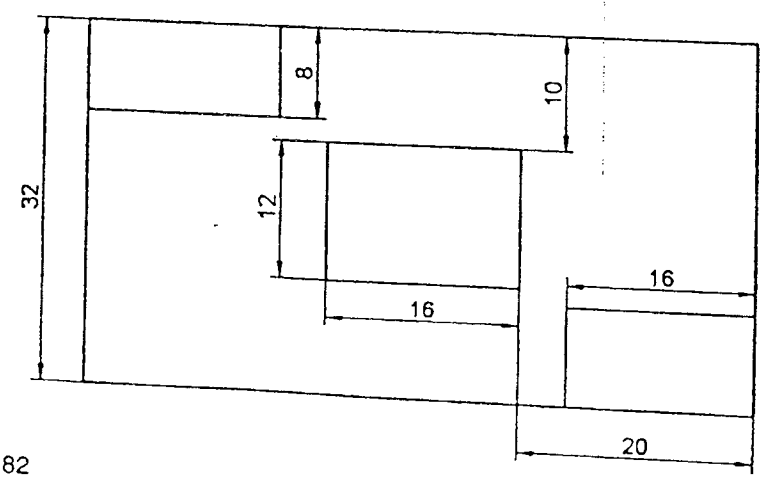


Fig. P 3.34

Solution :







Problem 3.35. Fig P3.35 shows a machine component. Draw the following views:

(a) Front view
(b) Top view and
(c) Side view from left

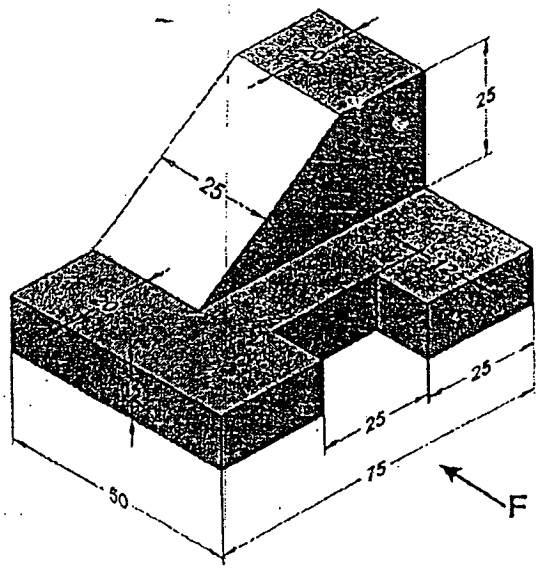
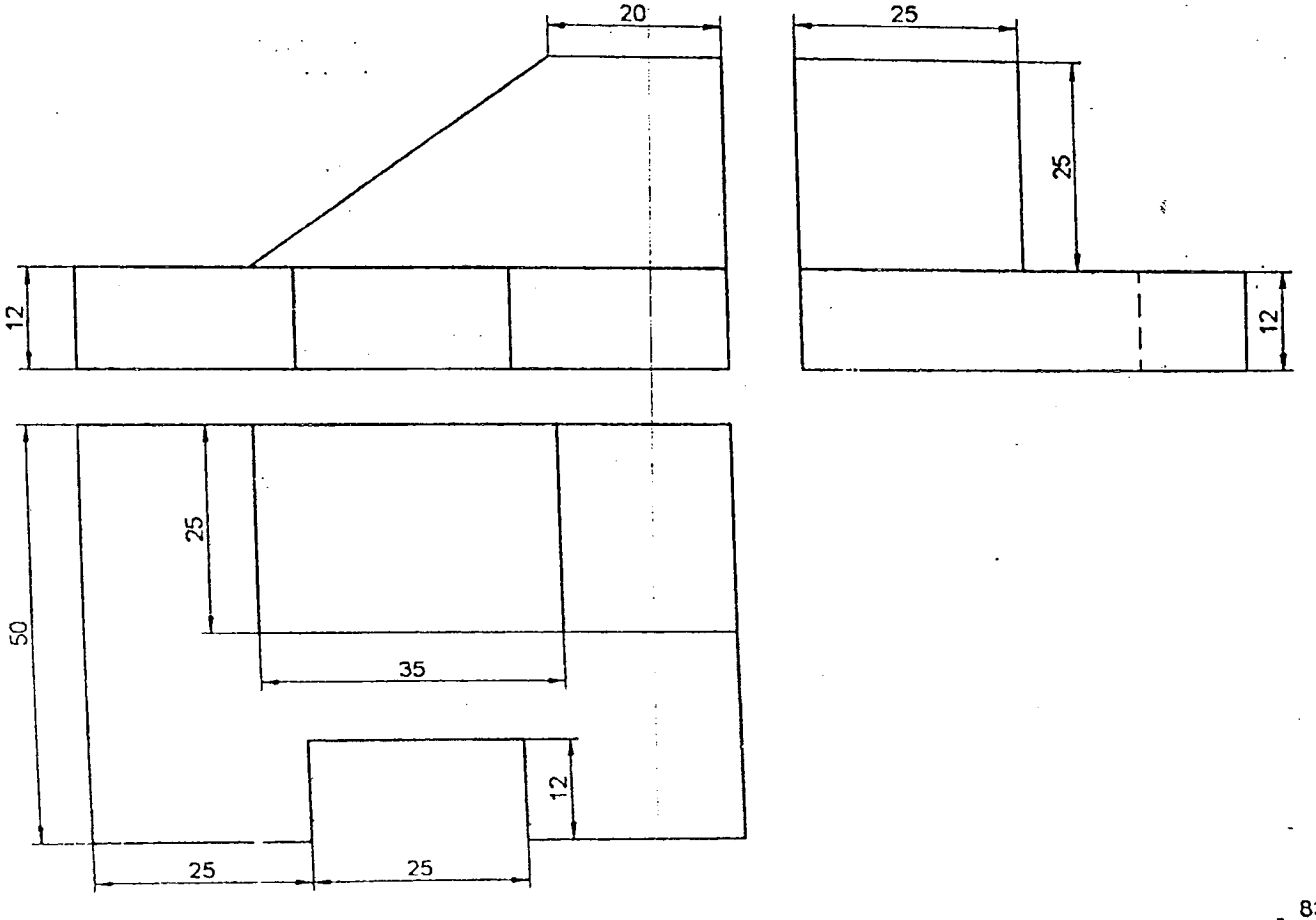


Fig. P 3.35

Solution :



Problem 3.36. Fig P3.36 shows a machine component. Draw the following views:

(a) Front view
(b) Top view and
(c) Side view from left

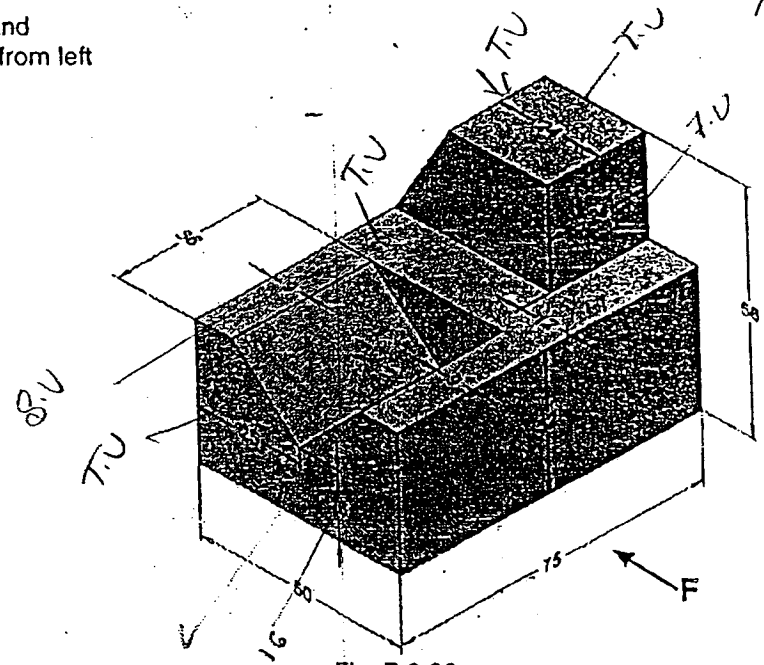
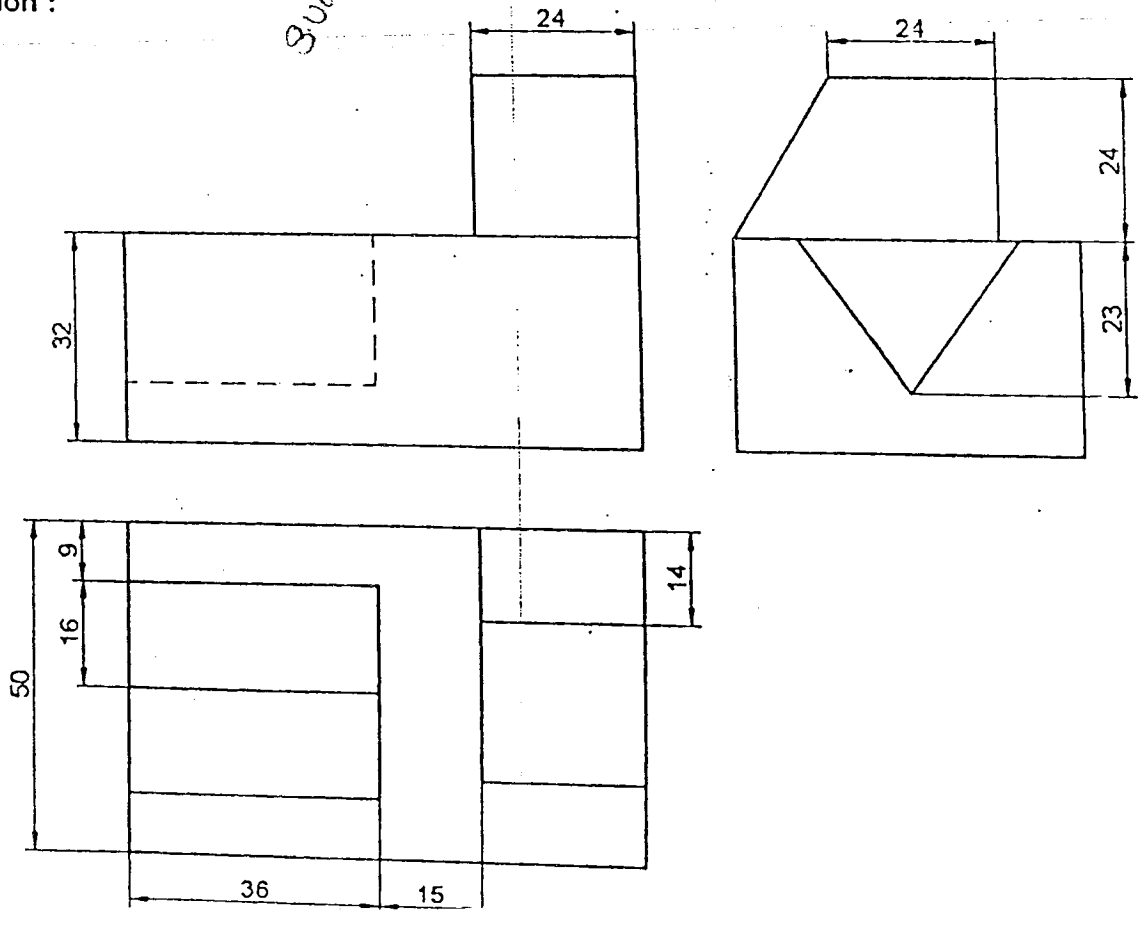


Fig. P 3.36

Solution :



Problem 3.37. Fig P3.37 shows a machine component. Draw the following views:

(a) Front view
(b) Top view and
(c) Side view from left

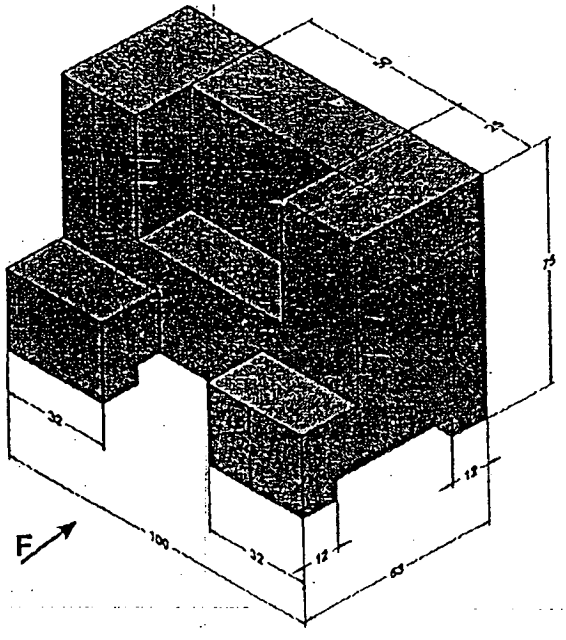
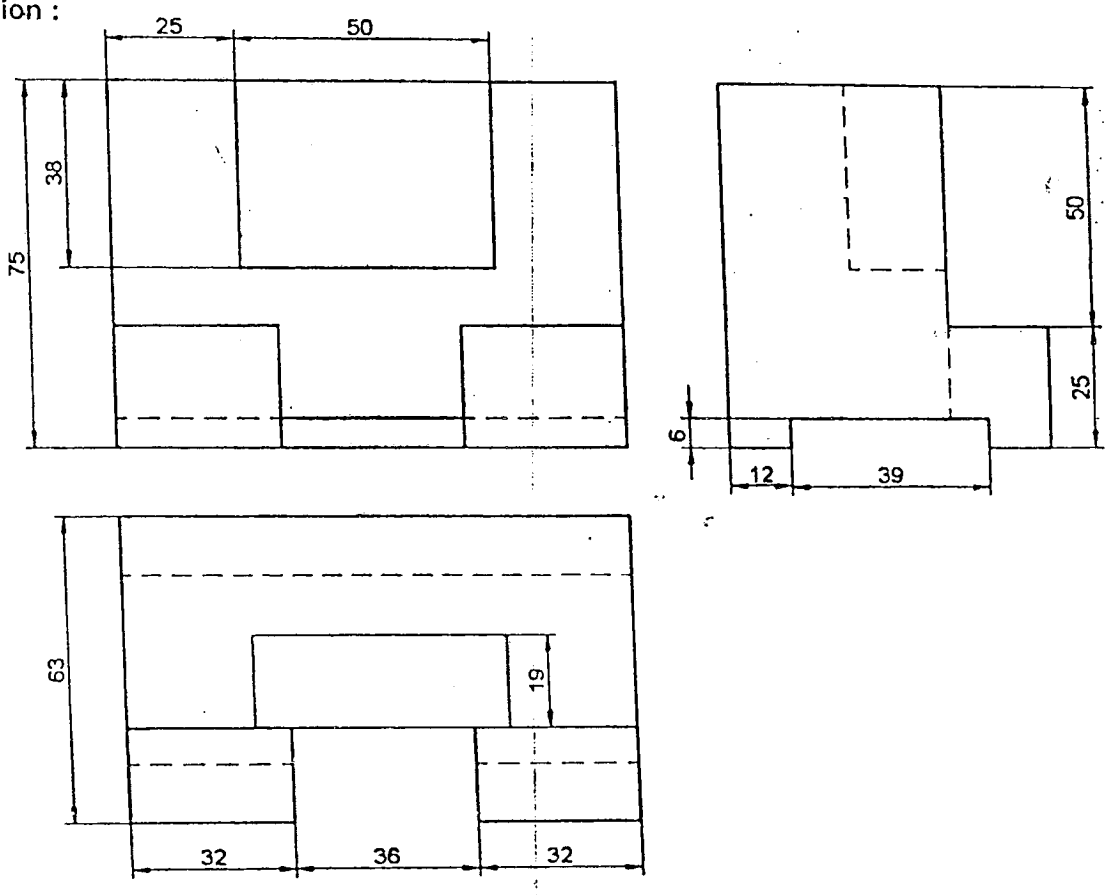


Fig. P 3.37

Solution :



Problem 3.38. Fig P3.38 shows a machine component. Draw the following views:

(a) Front view
(b) Top view and
(c) Side view from left

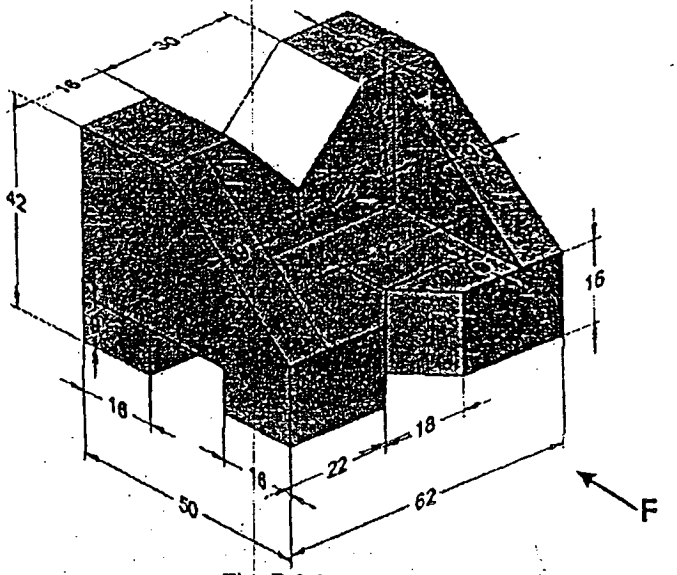
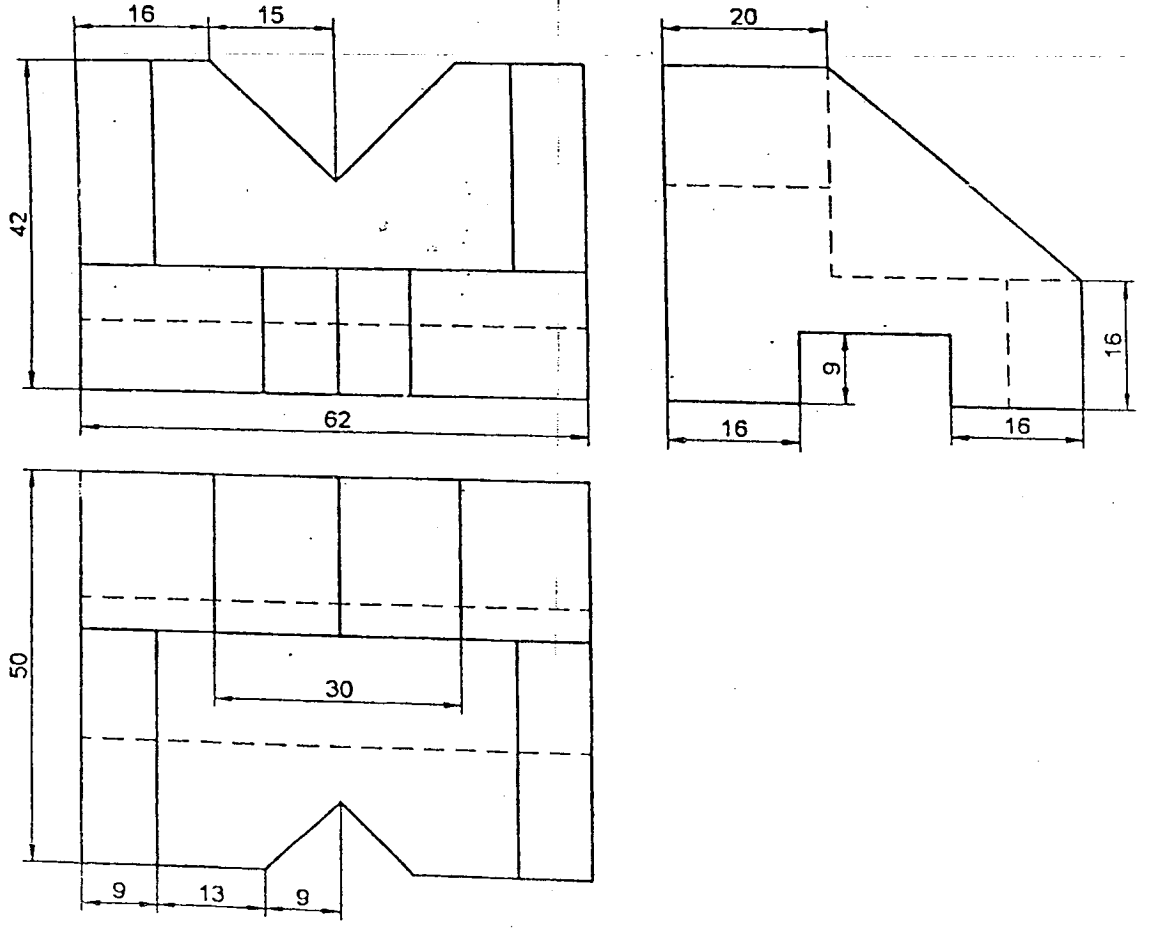


Fig. P 3.38

Solution :



Problem 3.39. Fig P3.39 shows a machine component. Draw the following views:

(a) Front view
(b) Top view and
(c) Side view from left

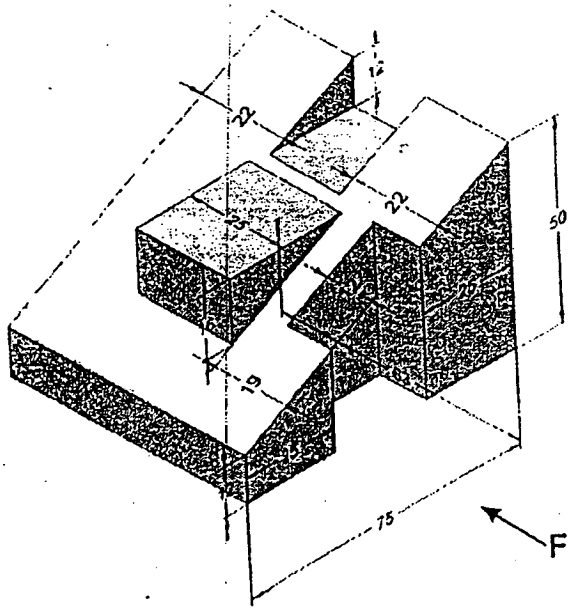
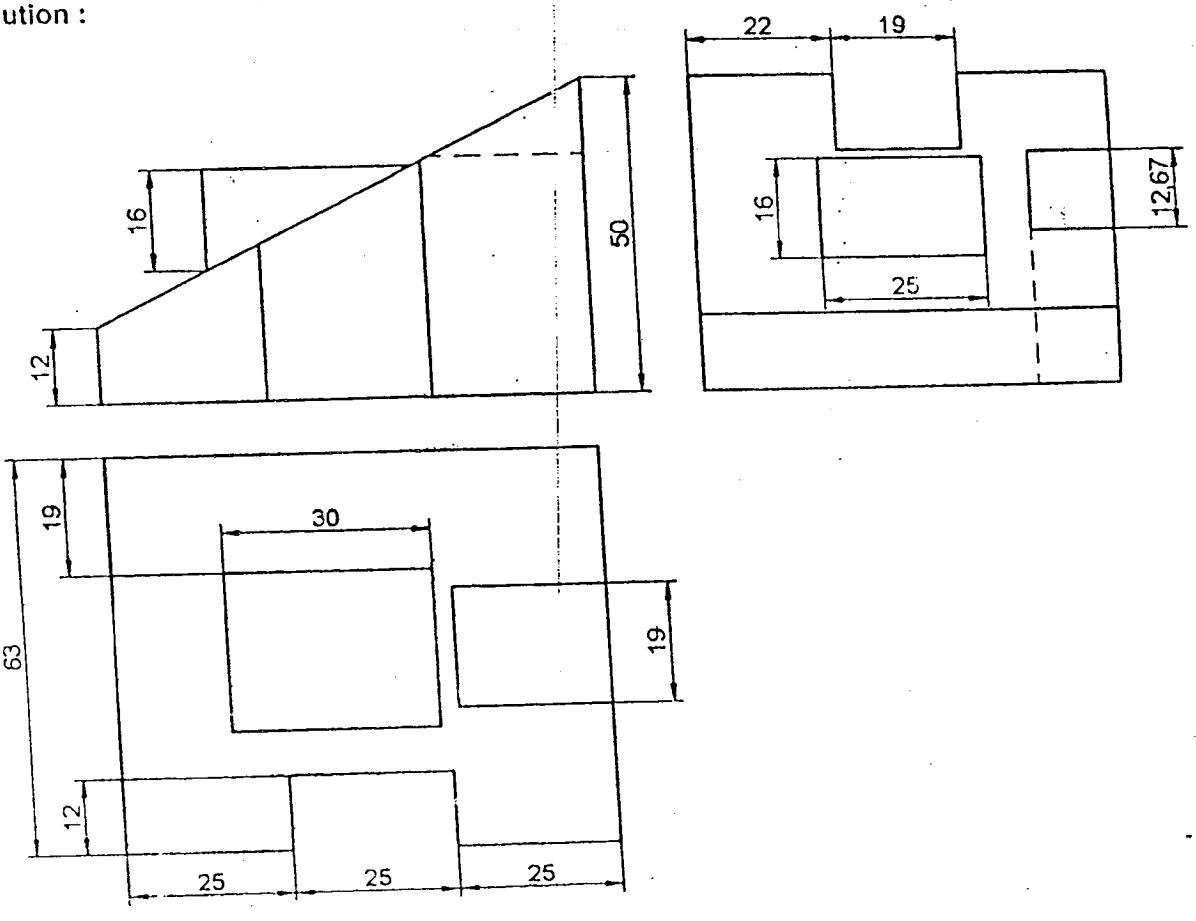


Fig. P 3.39

Solution :



Problem 3.40. Fig P3.40 shows a machine component. Draw the following views:

(a) Front view
(b) Top view and
(c) Side view from left

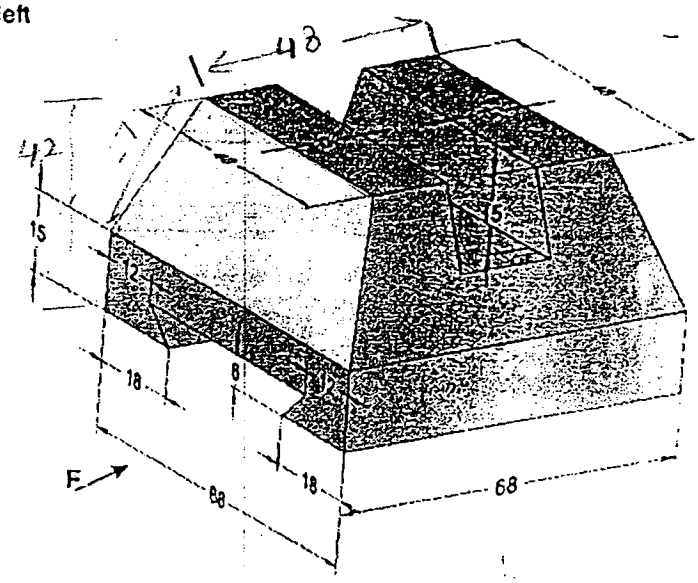
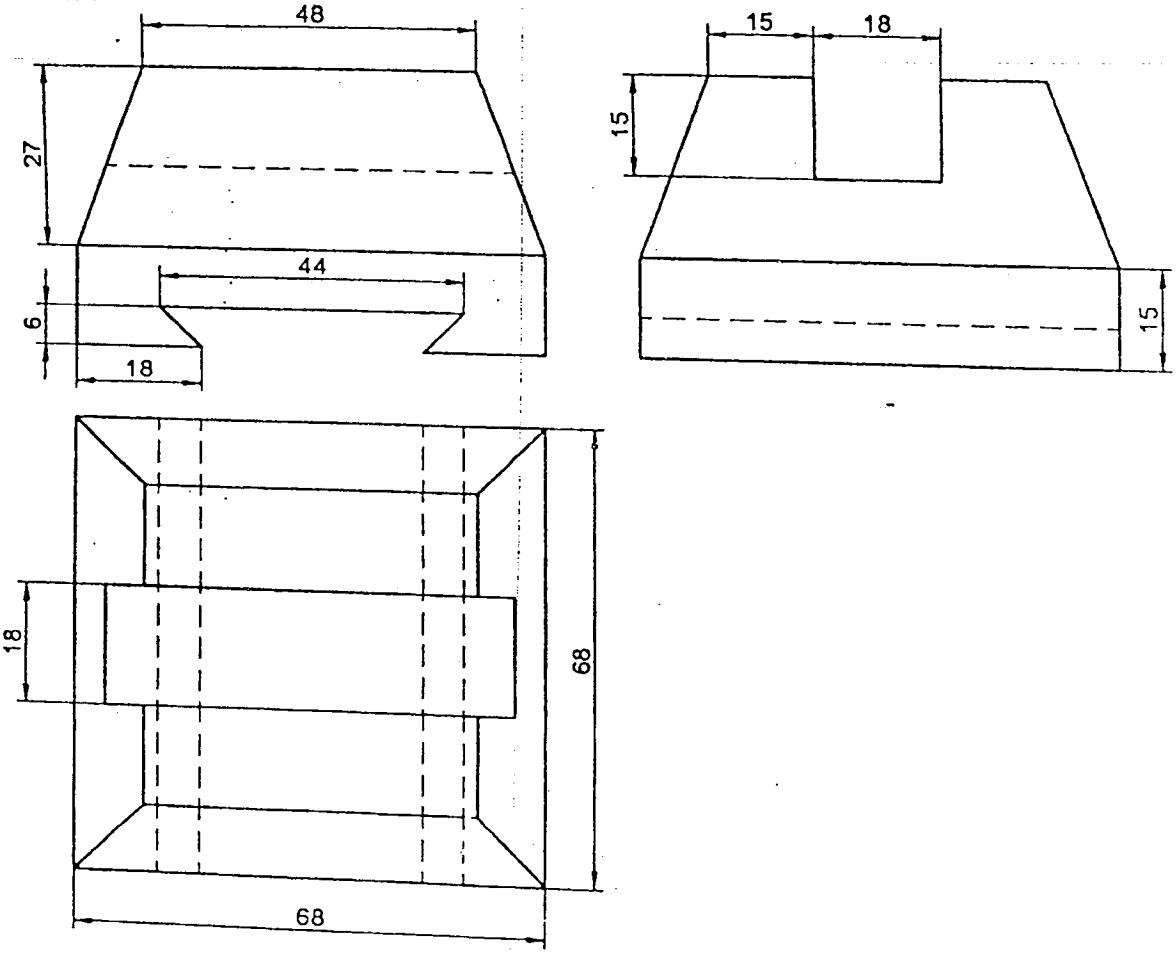


Fig. P 3.40

Solution :



CHAPTER – 4
THREAD FORMS

4.1 INTRODUCTION

When a cylindrical rod is rotated at a constant speed and simultaneously if a point is moved on its surface parallel to the axis, the locus is nothing but a helical path or a thread. A screw thread is nothing but the groove cut along the helical path on the cylindrical surface of the rod then with the threaded groove will be called a screw. This form of groove/ thread will engage in a corresponding threaded hole cut inside a nut or any machine part. The screw and nut are as shown in Fig. 4.1 and 4.2 respectively

Threads are usually cut on a lathe or by a die or by taps. The taps are used for making internal threads on small sized holes.

4.2 THREAD TERMINOLOGY

A straight thread is a ridge of uniform section that follows the helical path on the external or internal surface of a cylinder. If the thread is formed on a conical surface, it is referred as a taper thread. A straight threaded screw and nut is shown in Fig. 4.3.

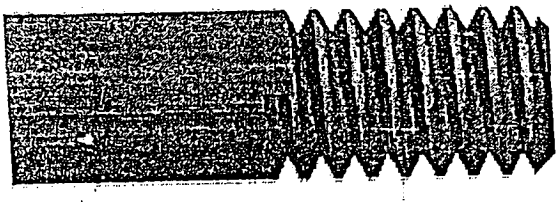


Fig. 4.1 Screw

Fig. 4.2 Nut

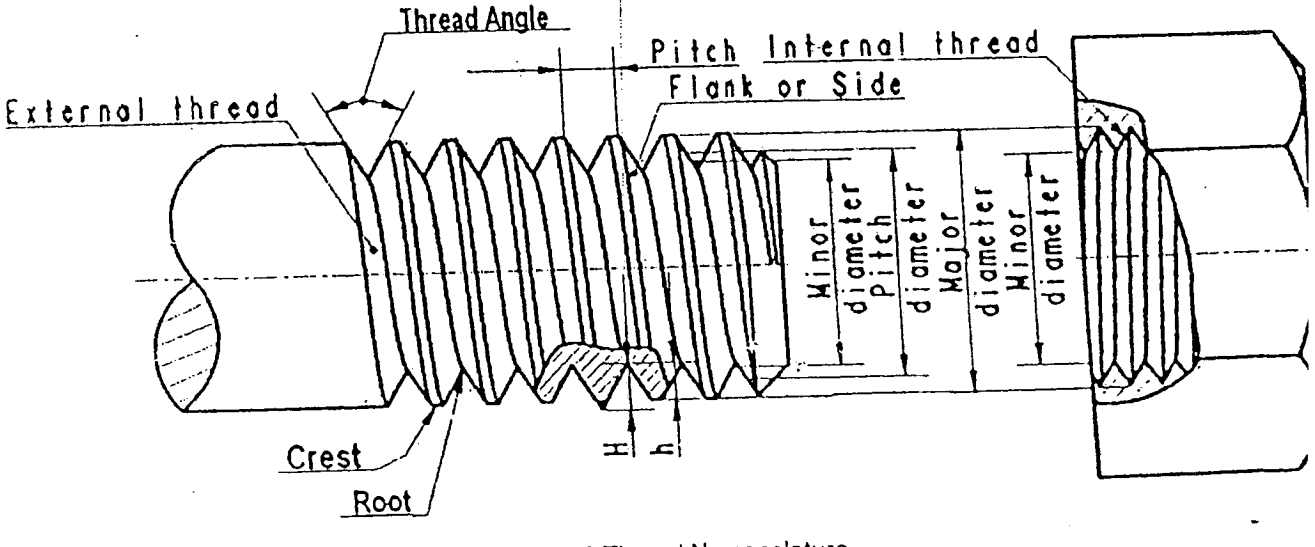


Fig. 4.3 Thread Nomenclature

Crest:

It is the outer-most part of a thread.

Root:

It is the inner-most portion of a thread.

Flank / Side :

It is the surface between the crest and the root.

Thread Angle :

It is the angle between the flanks, measured on an axial plane.

Depth of thread (H):

It is the distance between the crest and the root, measured at right angles to the axis. It is equal to half the difference between the outside diameter and the core diameter

Outside or Major diameter:

It is the diameter at the crest of the thread measured at right angles to the axis of the screw.

Core or Minor diameter:

It is the diameter at the core or root of the thread. It is the smallest diameter of the screw and is equal to the outside diameter minus twice the depth of the thread.

Nominal diameter:

It is the diameter of the cylindrical piece on which the thread is cut.

Pitch :

It is the distance measured parallel to the axis, between a point on one thread form and the corresponding point on the adjacent thread form, i.e. from crest to crest or root to root. It may also be described as the reciprocal of the number of thread forms per unit length i.e., p = 1/n, where n is the number of threads per unit length.

Lead :

It is the distance measured parallel to the axis from a point on a thread to the corresponding point on the same thread after one complete revolution. The lead is equal to the pitch in case of single start thread.

Single thread :

A single (single start) thread is one with lead equal to pitch.

Double thread :

A double thread (double start) is one with lead twice the pitch.

Multiple thread :

A multiple thread (multi thread) is one where the lead is an integral multiple of the pitch, i.e., two or more helices form the thread.

4.3 SECTIONAL VIEWS OF THREADS

Many forms of threads are in use to fasten the parts together, to adjust profile and relation between various parameters. Commonly used thread forms can be classified into

i) ISO Metric
ii) BSW
iii) Square
iv) Acme
v) Sellers Thread

4.3.1 ISO Metric (Unified Thread)

From Fig. 4.4 shows the profile ISO metric thread. The included angle is 60°. It can be noted that the crest of external and internal thread are flat . However, external threads manufactured by rolling will have rounded profile. Apart from ISO metric thread profile, number of other profiles are in use to meet various applications.

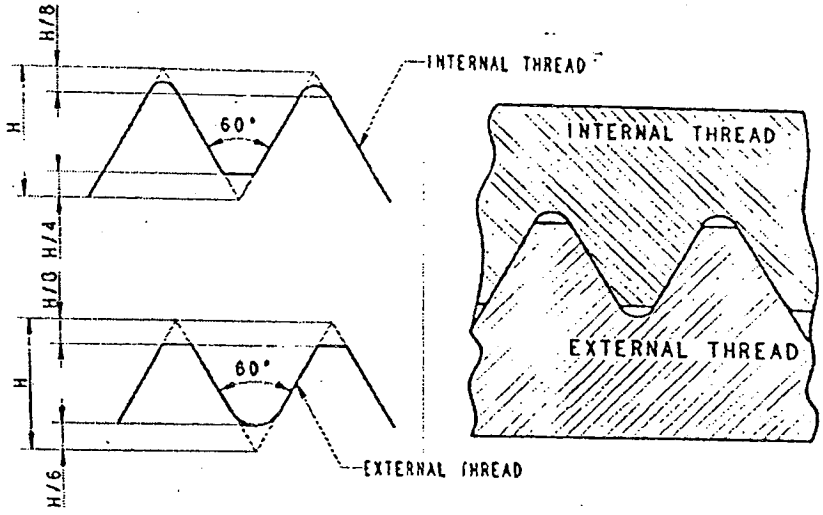


Fig. 4.4 ISO Metric (Unified Thread)

4.3.2 British Standard Whitworth (BSW) Thread

In this form of thread, the thread angle is 55°. The theoretical depth D = 0.96P, where P is the pitch of the thread. 1/6 of the theoretical depth is rounded off at the top and at the bottom. Therefore, the actual depth d = 0.64P. The profile is shown in Fig. 4.5.

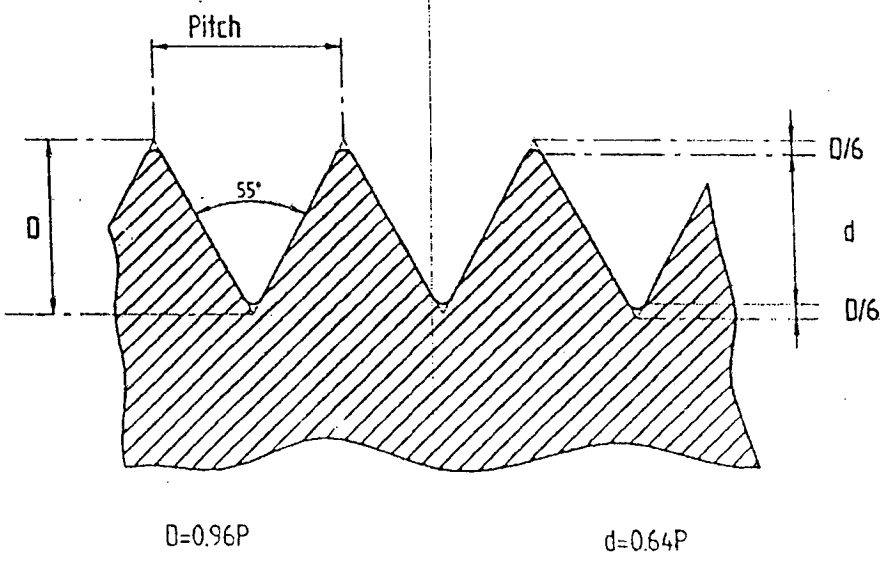


Fig. 4.5 British Standard Whitworth (BSW) Thread

4.3.3 Square Thread

A square thread shown in Fig. 4.6 is ideal for power transmission. The face of square thread is nearly right angle to the axis. Hence, the normal force on the threads acts parallel to the axis and no radial force on the component. This enables large force transmission as in the case or screw jack and similar applications. This thread has its flanks o: sides normal to the axis and hence, parallel to each other. The depth and the thickness of the thread are each equal to half the pitch.

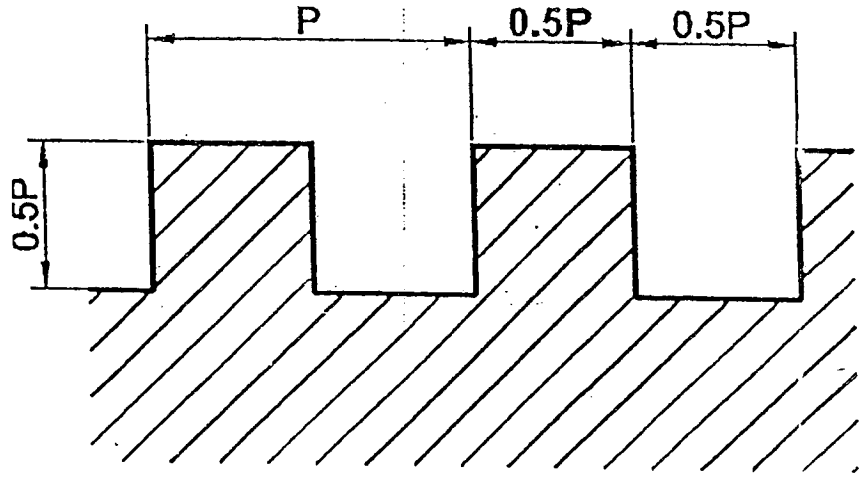


Fig. 4.6 Square Thread

4.3.4 Acme Thread

It is a modified form of a square thread and has largely replaced it. It is stronger than the square thread due to its wide base. It is easier to cut and has the advantage of easy engagement and disengagement of split nut, as on lead screv of a lathe. The included angle is 29°. The proportions are shown in fig. 4.7.

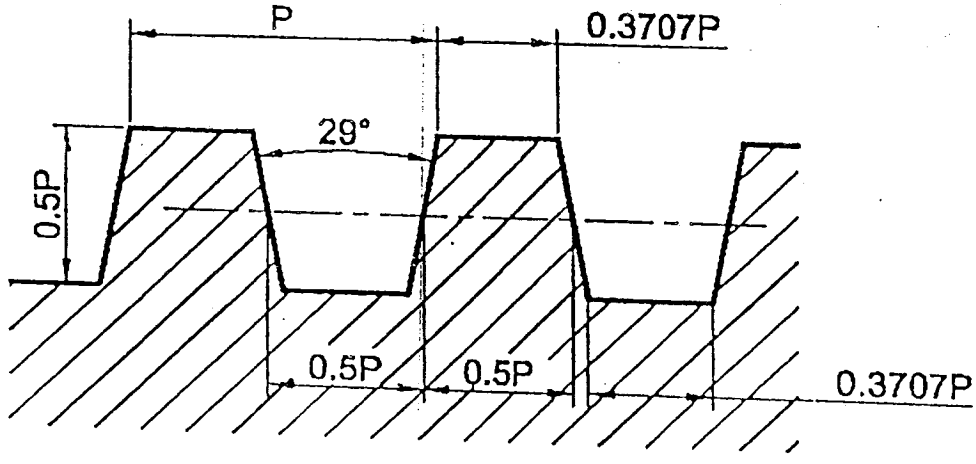


Fig. 4.7 Acme Thread

4.3.5 Sellers Thread

This form of thread is adopted as a standard form in U.S.A. It has an angle of 60°. One-eighth of the theoretical depth is cut-off parallel to the axis of the screw at the top and at the bottom. The crests and the roots of this thread are therefore flat, as shown in fig. 4.8.

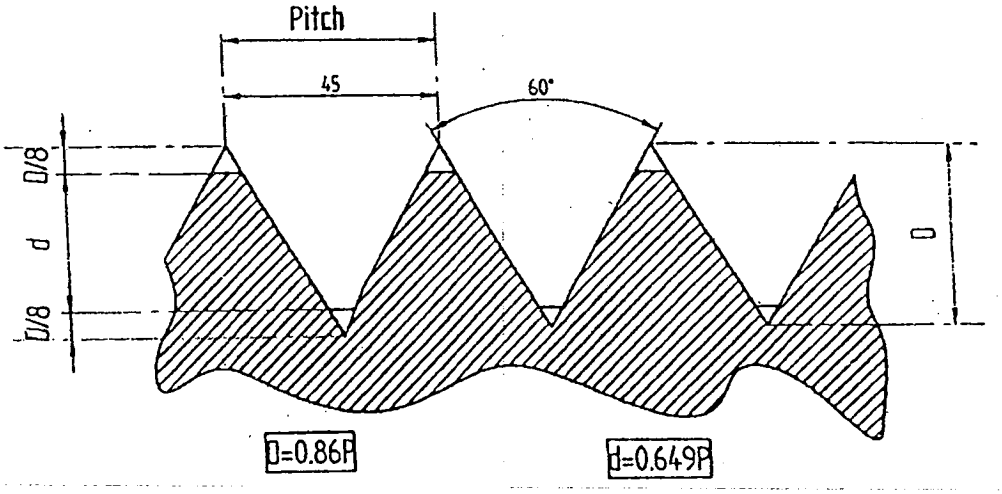


Fig. 4.8 Sellers thread

4.3.6 Buttress thread:

It is a combination of V- and square-threads as shown in fig. 4.9. It is designed to transmit power in only one direc tion and used in large guns, presses, and in other applications of similar high-strength requirements.

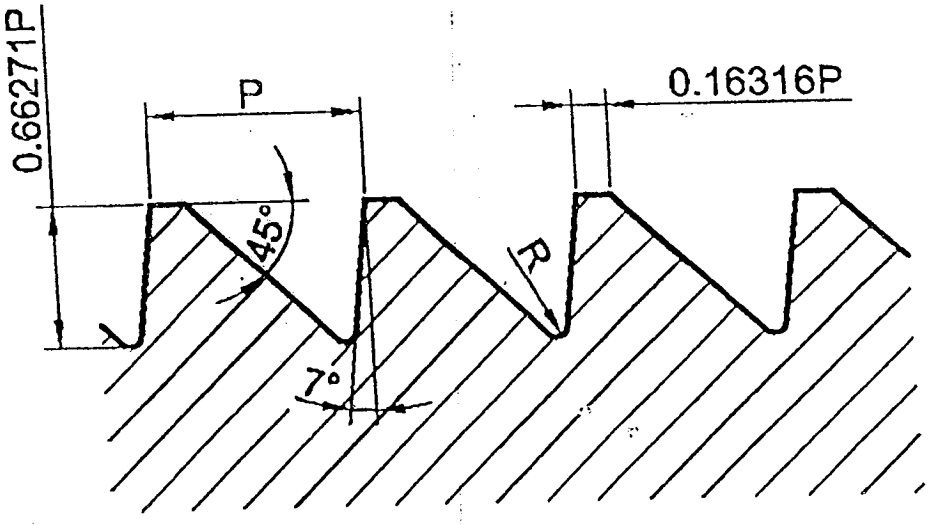


Fig. 4.9 Buttress thread

4.4 COMPUTER AIDED DRAFTING PROCEDURE

1) Open the SOFTWARE. Click on the **DRAWING** in the **CREATE** dialog box.

2) Set up the sheet of required size by clicking the **SHEET SET UP** in the **FILE tab.** Select **"A4 WIDE"** size for this problem.

3) Draw **CONSTRUCTION LINE** by using **LINE COMMAND**  **(DRAWING TOOL BAR)** from which suitable **LINE TYPE** and **THICKNESS** is chosen.

4) Draw line using **LINE COMMAND**  from **DRAWING TOOL BAR**, to draw one thread and angle between thread should be as per the type of thread.

5) Actuate **MIRROR** option from **MOVE COMMAND**  in the **DRAWING TOOL BAR**, make mirror thread.

6) Select **MOVE COMMAND**  from **DRAWING TOOL BAR**, move threads to certain appropriate distances mentioned in dimensions.

7) Pick SCALE option from **MOVE COMMAND**  in **DRAWING TOOL BAR** to scale the figure.

8) Use **LINE COMMAND**  option from **DRAWING TOOL BAR** to line the corners of thread according to dimensions.

9) Draw all necessary **CONSTRUCTION LINES** using **LINE COMMAND**  from **DRAWING TOOL BAR** and setting suitable **LINE TYPE** and **THICKNESS.**

10) Pick **CURVE COMMAND**  option from **DRAWING TOOL BAR**, draw suitable shape of curve.

11) Select **TRIM COMMAND**  from **DRAWING TOOL BAR** and trim out line entities according to drawing.

12) Select **FILL COMMAND**  option from **DRAWING TOOL BAR**, hatch the space left free after drawing all entities.

13) Use **TEXT COMMAND**  option from **DRAWING VIEWS TOOL BAR** to write.

14) Dimension all parts using SMART DIMENSION  from DRAWING VIEWS TOOL BAR.

CHAPTER – 5

FASTNERS

5.1 INTRODUCTION

Fastening is a method of joining two or more parts together using mechanical devices or processes. It may not be possible to manufacture machines or structures as a single part. They are manufactured in parts and fastened together by means of threaded fasteners (bolts and nuts or screws), or unthreaded fasteners (rivets or welding). The joints made by bolts and nuts and screws are called screwed joints and are detachable i.e. the parts can be separated by unscrewing and refastened. The joint made by rivets or welding cannot be separated unless they are cut; hence, these are referred to as permanent joints. The commonly used methods of mechanical fastening are

1. Threaded fasteners
2. Riveted fasteners
3. Welded fasteners

5.2 THREADED FASTENERS

A threaded fastener is a method of joining two or more parts together by means of threaded devices. Threads are formed using a 'tap' for internal threads, a 'die' for external threads. Machine tools are used for internal or external threads when large number of parts or large size parts is required.In the early time, screw threads were made by hand and no interchangeability was possible. In 1841 Sir Joseph Whitworth called for a standard screw thread, and soon Whitworth thread was accepted throughout England. In 1864, United States (US) adopted a thread proposed by William Sellers and it is called Sellers thread. In 1935 American Standard thread with same 60° V forms of Sellers was adopted in US. There was no standardization among countries and one thread would not screw on to another. During World War I, it was a serious inconvenience and in World War II, the problem was so great that the allies decided to do some thing for standardization. In 1948 an agreement was reached on unification of American and British screw threads and the new thread was called Unified screw thread. This allowed the interchangeability of threads between the countries America, Britain, and Canada based on amicable agreement.

In 1946, an international organization for standardization (ISO) committee was formed to develop a single system of metric screw threads. These ISO metric threads are widely used in several applications. The ISO units are known as System International (SI). SI units are replacing all other systems and hence only metric threads are explained in this book.

5.3 APPLICATIONS

(a) **Joining:** Two or more parts are connected by a pair(s) of nut and bolt. It is a temporary fastener because it can be removed without destroying the joint. This type of fastening is used where periodic maintenance is needed, such as water pumps, automobiles, etc.

(b) **Adjustment:** Adjustment is the process of modifying or locating the position of a part. A screw is used to lift or lower the inclination as in case of a LCD projector. Measuring devices such as micrometers use screw for adjusting their settings.

(c) **Power transmission:** Mechanical transmission is the process of transmitting force from one machine component to the other. The transmission can be in same direction or in a different direction. Screw jacks, worm gears are examples of power transmission.

5.4 SPECIFICATION

Specification: Metric thread specifications are based on ISO recommendations. A basic designation is shown in Fig. 5.1. In the figure, the notation M24 X 3 means M specifies it as a metric thread, followed by 24 mm diameter, followed by the multiplication symbol X and 3 mm pitch.

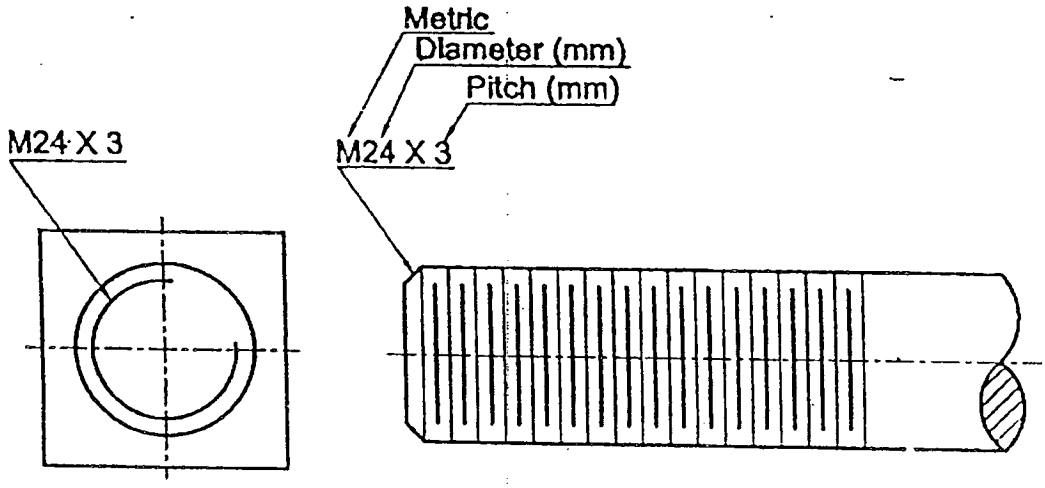


Fig. 5.1 Specification of Threads

5.5 REPRESENTATION OF THREADS IN DRAWINGS

Threads in an assembly drawing are shown in Fig. 5.2. It is conventioned not to section a bolt, a stud, a nut or any solid part engaged with threads, unless it is necessary to show some internal details. Note that when external and internal threads are sectioned in assembly, the threads have to be shown as in the fig. 5.2. When the part is not sectioned, threads are represented by convention

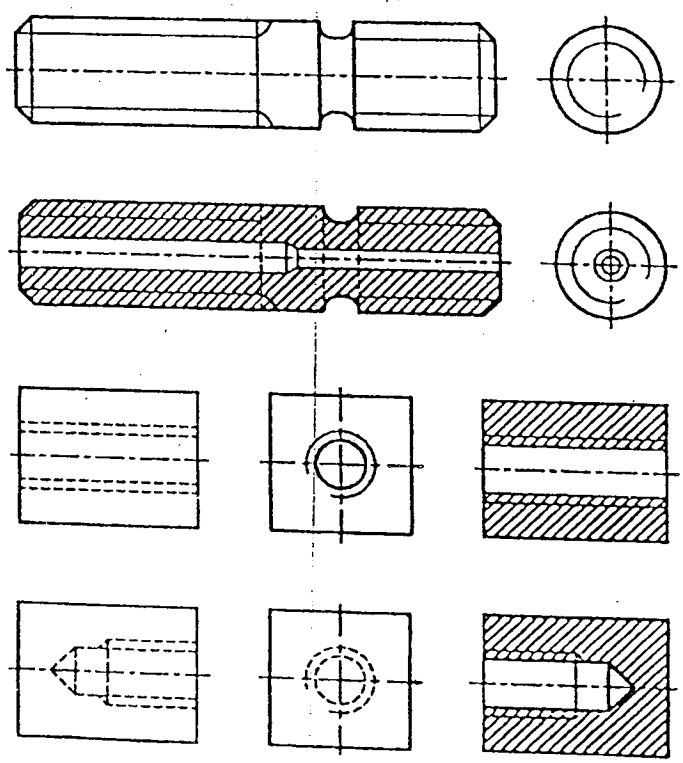


Fig. 5.2 Specification of Threads

5.6 RIGHT HAND AND LEFT HAND THREADS

Screw threads may be right hand or left hand depending on the direction of helix formation. A right hand thread advances into a nut when turned clockwise and a left hand thread advances into a nut when turned counter clockwise direction. Right and left hand threads are shown in Fig. 5.3.

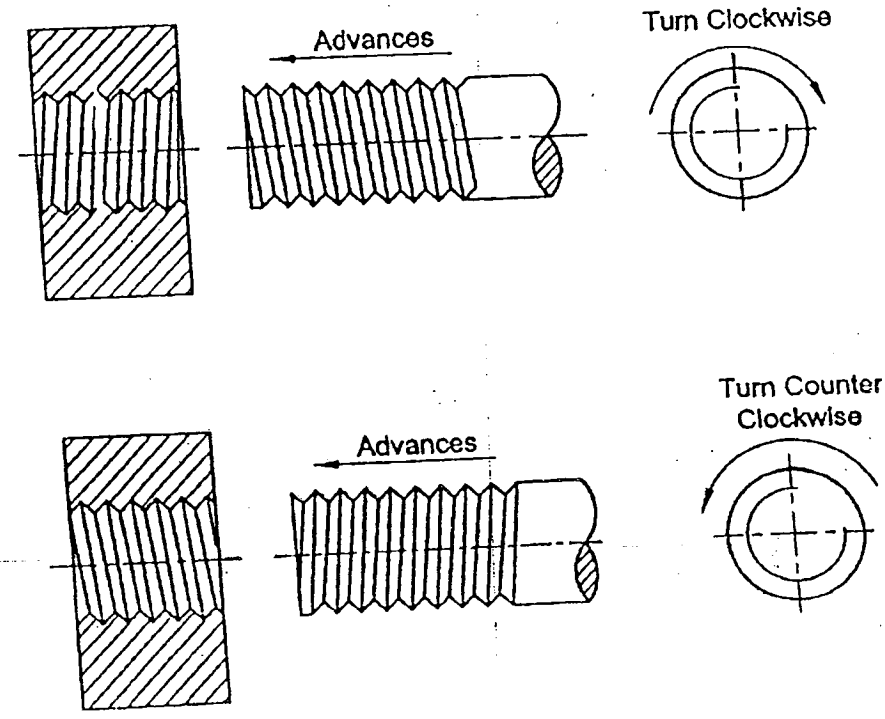


Fig. 5.3 Right Hand and Left Hand Threads

5.7 SINGLE AND MULTI-START THREADS

A single start thread, as the name implies, consists of a single continuous ridge for which the lead is equal to the pitch. The depth of the thread depends on the pitch. When large lead is required, the pitch is greater and the depth of the thread is large and hence smaller is the core diameter, reducing the strength of the fastener. To overcome this drawback, multi-start threads are used.

Multiple start threads consist of two or more ridges running side by side. Lead may be increased by increasing the number of starts, without increasing the pitch.

For a double start thread lead is equal to two times the pitch and for triple start it is three times the pitch. A single start V-thread is shown in Fig. 5.4, and double and triple start threads are shown in (b) and (c) respectively. Double start and triple start square threads are shown in (d) and (e) respectively.

In double start threads, two separate threads are cut, starting at diametrically opposite points to each other. In triple start threads, three separate threads are cut, with starting at points 120° apart on the circumference of the screw. On a drawing of a single start thread, a root is opposite to a crest; in case of double or quadruple start threads, a root is drawn opposite to a root. In one turn, a double start thread advances twice that of a single start, and a triple start thread advances three times that of single start.

Multiple start threads are used wherever quick motion is desired. They are not suitable for large power transmission. Typical application of multi-start threads are fountain pens, tooth paste caps, valve stems etc. The multi-start threads on a valve stem enables quick action in opening and closing the valve. Multiple start threads can be recognized and counted by observing the number of thread starts on the end of a screw.

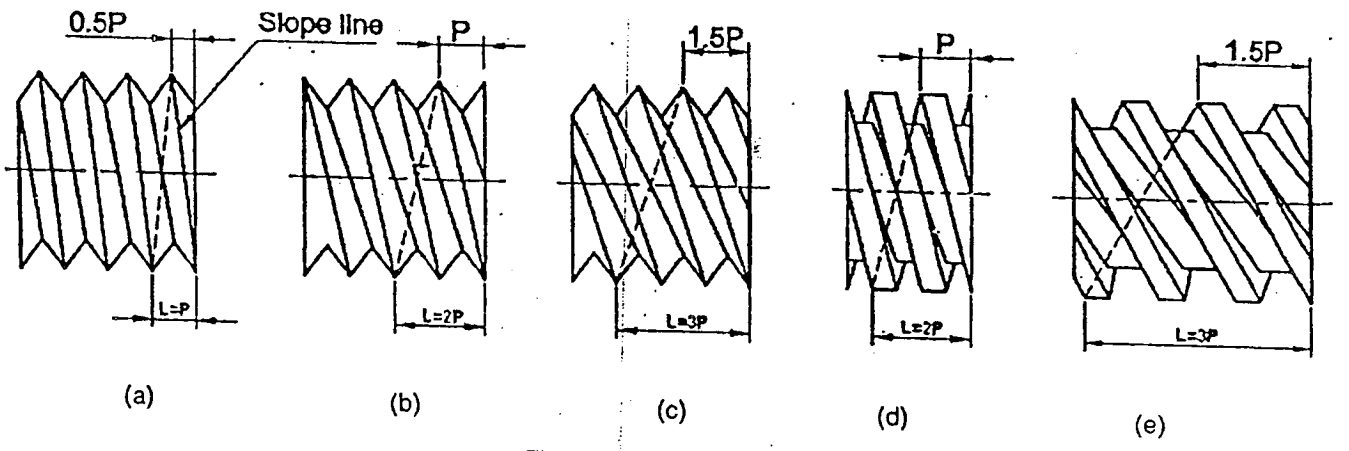


Fig. 5.4 Multiple Threads

5.8 BOLTS AND NUTS

A bolt is a round rod consisting of a head on one end and threads on the other end to accommodate nut. The bol passes through clearance holes in two or more aligned parts and the nut secures the parts together. Details of heads for hexagonal and square bolts and nuts and a bolted joint are shown in Fig. 5.10 and 5.12 respectively. As a conven tion, bolts and nuts should not be shown in section.

The bolts are named depending on the geometry of the head. If the head is hexagonal form, it is known as hexagonal bolt, and if the head is square form, it is known as square bolt. Metric series bolts and nuts are produced in hexagonal form, and square form is produced in inch series. Standard bolts and nuts are shown in Fig.5.5. The bolt heads and nuts are flat with chamfers to remove sharp corners. The chamfer angle is 15°-30° for hexagonal heads and nuts, and 30° for square heads and nuts. Both are represented at 30° on drawing for simplicity. Hexagonal geometry has an advantage that spanner can be repositioned after a 60° rotation. This minimizes the space for operation of spanner and relatively large force can be applied as rotation angle is small and large normal component is available. Square head makes the provision for large rotation of the bolt. When bolt head has to be accommodated in a slot, square form is preferred as it provides better area of contact.

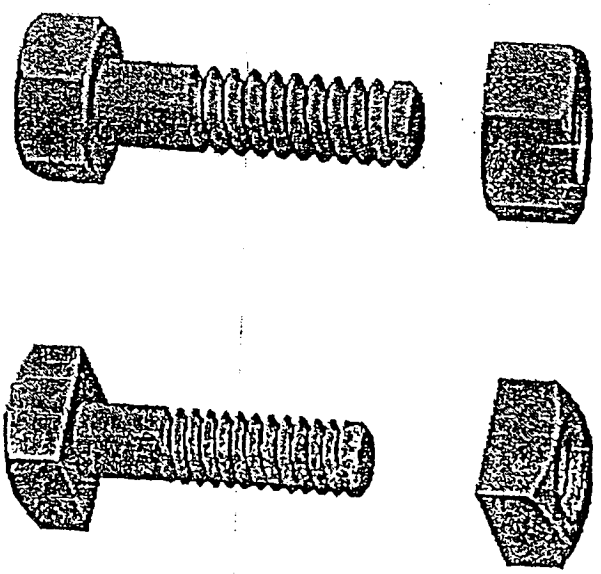


Fig. 5.5 Standard Bolts and Nuts

5.9 WASHERS

A washer is a cylindrical piece of metal placed below the nut to provide smooth bearing surface for the nut to turn on . it spreads the pressure of the nut over a greater area. It also prevents the nut from cutting into the metal and thus, allows the nut to be screwed-on more tightly.

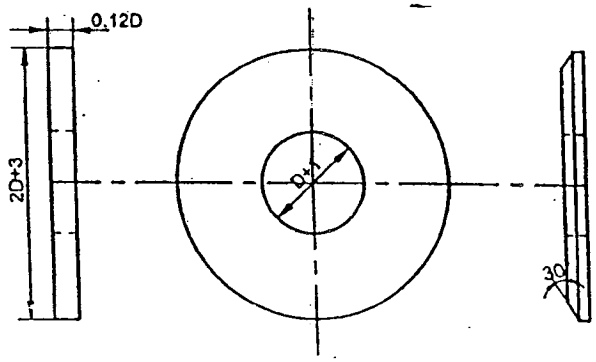


Fig. 5.6 Washer

5.10 SCREWS

A screw is a threaded element with head on one end and threads on its body. The main difference between a bolt and screw is that a bolt is normally used to tighten or loosen using a nut, while a screw is normally expected to mate with internal threads in a part and tighten or loosen using the head. Following are the different types of screws

(I) CAP SCREWS: Cap screws have longer threads than bolts. It passes through a clearance hole in one part and screws into another part. They are usually made with hexagonal head. They can also be made with slotted head. Cap screw joints and approximate sizes of cap screws are shown in Fig 5.7.

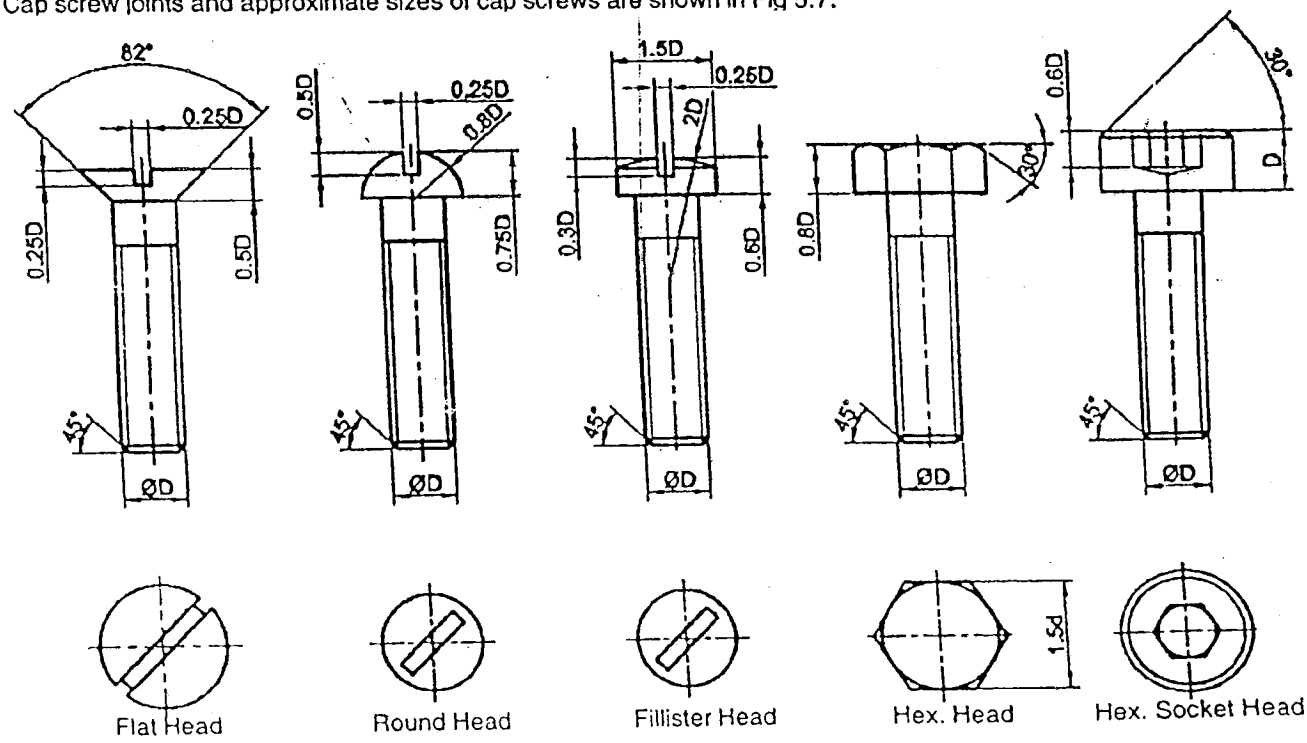


Fig. 5.7 Cap Screws

A machined screw is similar to cap screw, but is smaller in size. One end is provided with a slotted head or hexagonal head and threaded end may screw into the mating part or may be used as a nut. Machine screw joints and approximate sizes of these screws are shown in Fig. 5.8.

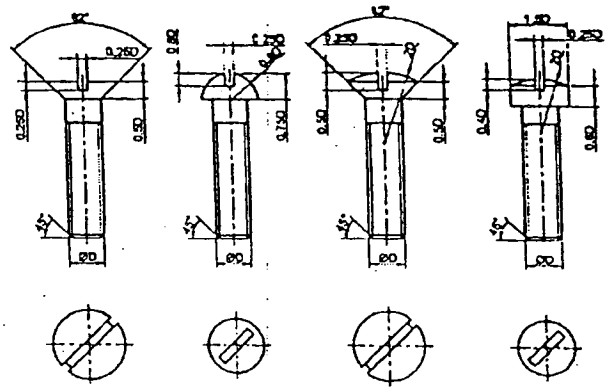


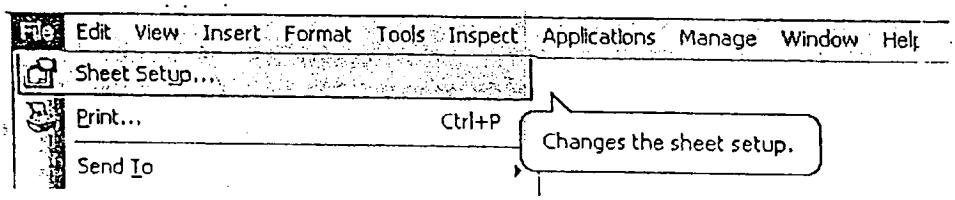
Fig. 5.8 Machine Screws

5.9 DRAWING HEXAGONAL BOLT HEAD AND NUT

Fig. 5.9 shows the procedure for drawing hexagon head bolt and nut with washer.

Computer Aided Drafting Procedure

1. Open the SOFTWARE. Click on the DRAWING in the CREATE dialog box.
2. Set up the sheet of required size by clicking the SHEET SET UP in the FILE. Select A4 wide size for this problem.



3. Select RECTANGLE COMMAND from DRAWING TOOL BAR to draw bolt according to standard dimension.
4. Pick ARC COMMAND from DRAWING TOOL BAR draw arc, to make square bolt as shown.
5. Extend the lines on either side of rectangle according to drawing to suitable lengths, which represents the nut. This can be actuated by LINE COMMAND from DRAWING TOOL BAR.
6. Pick ARC COMMAND option from DRAWING TOOL BAR to draw arc on either side of nut.
7. Draw washer in between nut and bolt using LINE COMMAND from DRAWING TOOL BAR.
8. Draw top view by extending lines from front view using LINE COMMAND from which suitable LINE TYPE and THICKNESS is chosen.
9. Drawing process is repeated for top view as in front view, according to drawing.
10. To draw side view by extending lines from front view using LINE COMMAND from which suitable LINE TYPE and THICKNESS is chosen.

11. Draw circle using **CIRCLE COMMAND** option from **DRAWING TOOL BAR** and process is continued as per drawing using suitable options.
12. Pick **CURVE COMMAND** option from **DRAWING TOOL BAR**, draw to suitable shape using the option.
13. Draw all necessary CONSTRUCTION LINES using **LINE COMMAND** from **DRAWING TOOL BAR** and setting suitable **LINE TYPE** and **THICKNESS.**
14. Use **TRIM COMMAND** to trim out the entities which are not necessary.
16. Use **FILLET COMMAND** option from **DRAWING TOOL BAR** to fillet the corners of nut.
17. Use **TEXT COMMAND** option from **DRAWING VIEWS TOOL BAR** to write.
18. Using **SMART DIMENSION COMMAND** from **DRAWING VIEWS TOOL BAR** to dimension the square bolt and nut as shown in figure.

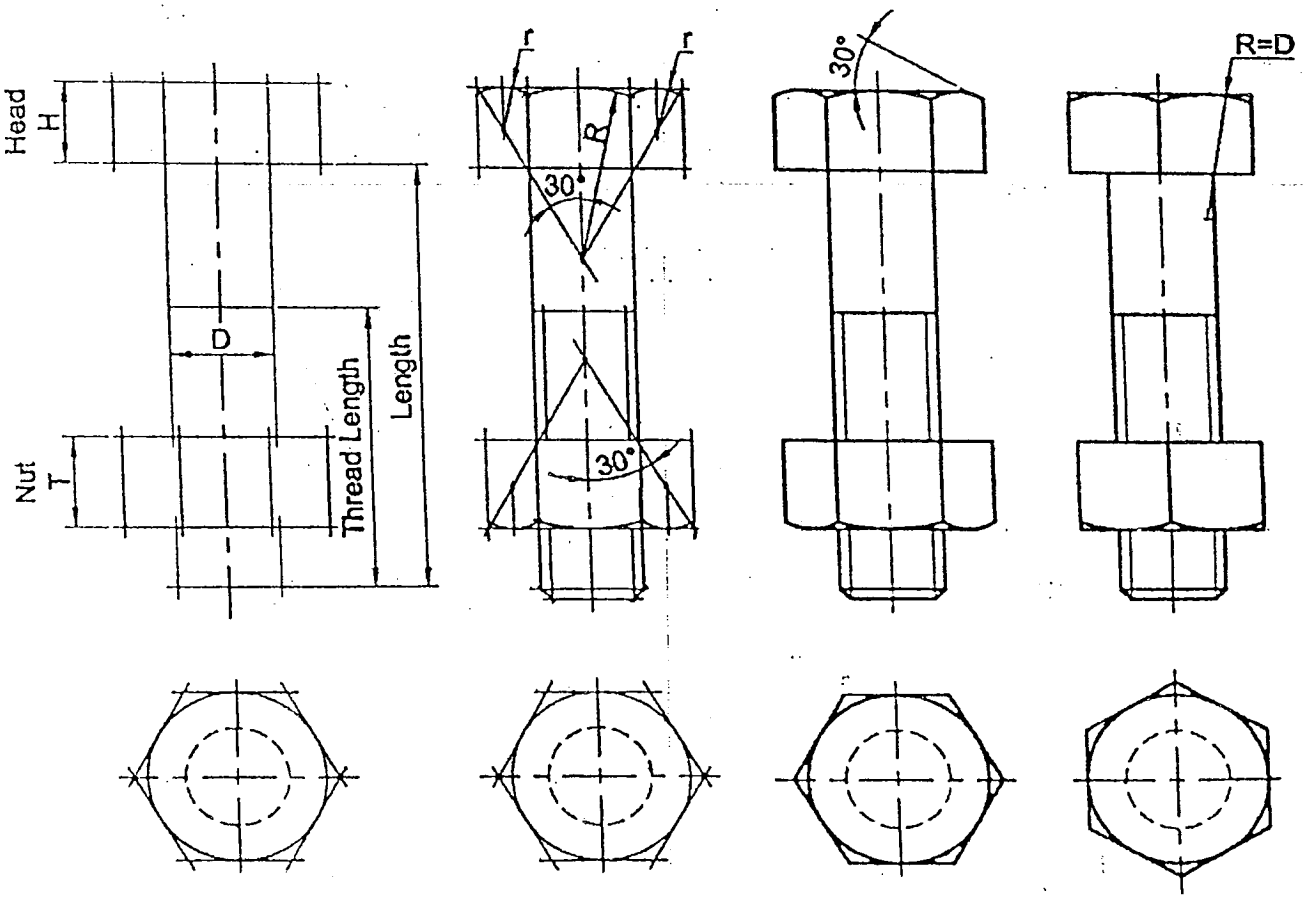


Fig. 5.9 Procedure of Drawing Hexagonal Head Bolt and Nut

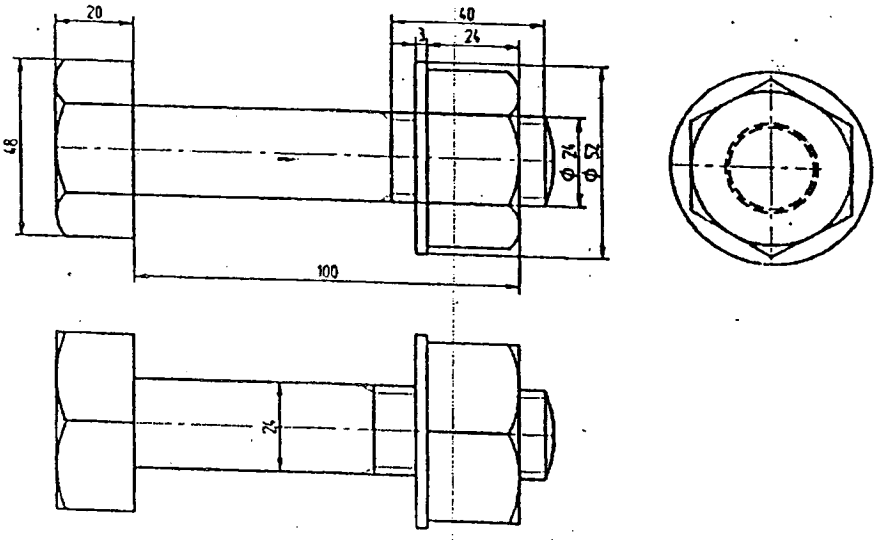


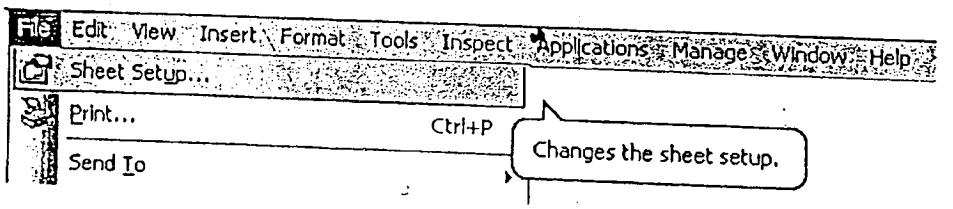
Fig. 5.10 Drawing Views of Hexagonal Head Bolt and Nut with washer

5.12 DRAWING SQUARE HEAD BOLT AND NUT

Fig. 5.11 shows the procedure for drawing square head bolt and nut.

Computer Aided Drafting Procedure

1. Open the SOFTWARE. Click on the **DRAWING**  in the **CREATE** dialog box.
2. Set up the sheet of required size by clicking the **SHEET SET UP** in the **FILE.** Select **A4 wide size** for this problem.



3. Select **RECTANGLE COMMAND**  from **DRAWING TOOL BAR** to draw bolt according to standard dimension.
4. Pick **ARC COMMAND**  from **DRAWING TOOL BAR** draw arc, to make square bolt as shown.
5. Using **LINE COMMAND**  from **DRAWING TOOL BAR** show threaded part of the bolt.
6. Using **LINE COMMAND**  from **DRAWING TOOL BAR** and selecting suitable **LINE TYPE** and **LINE THICKNESS** draw the axis of the bold.
7. Select **RECTANGLE COMMAND**  from **DRAWING TOOL BAR** to draw nut according to standard dimension.
8. Pick **ARC COMMAND**  from **DRAWING TOOL BAR** draw arc, to make square nut as shown.
9. Using **LINE COMMAND**  from **DRAWING TOOL BAR** draw the washer as shown.

10. To draw the side view, use **EXTEND COMMAND** from the front view.
11. Using **LINE COMMAND** from **DRAWING TOOL BAR** draw the side view according to the visibility.
12. Using **CIRCLE COMMAND** draw the circle, choosing line type and line thickness complete the side view as shown.
13. To draw the top view use **EXTEND COMMAND** from the front view.
14. Using **LINE COMMAND** and **ARC COMMAND** complete the top view as shown in figure.
15. Select **TRIM COMMAND** to trim out the entities which are not necessary.
16. Using **SMART DIMENSION COMMAND** from **DRAWING VIEWS TOOL BAR** to dimension the square bolt and nut as shown in figure.

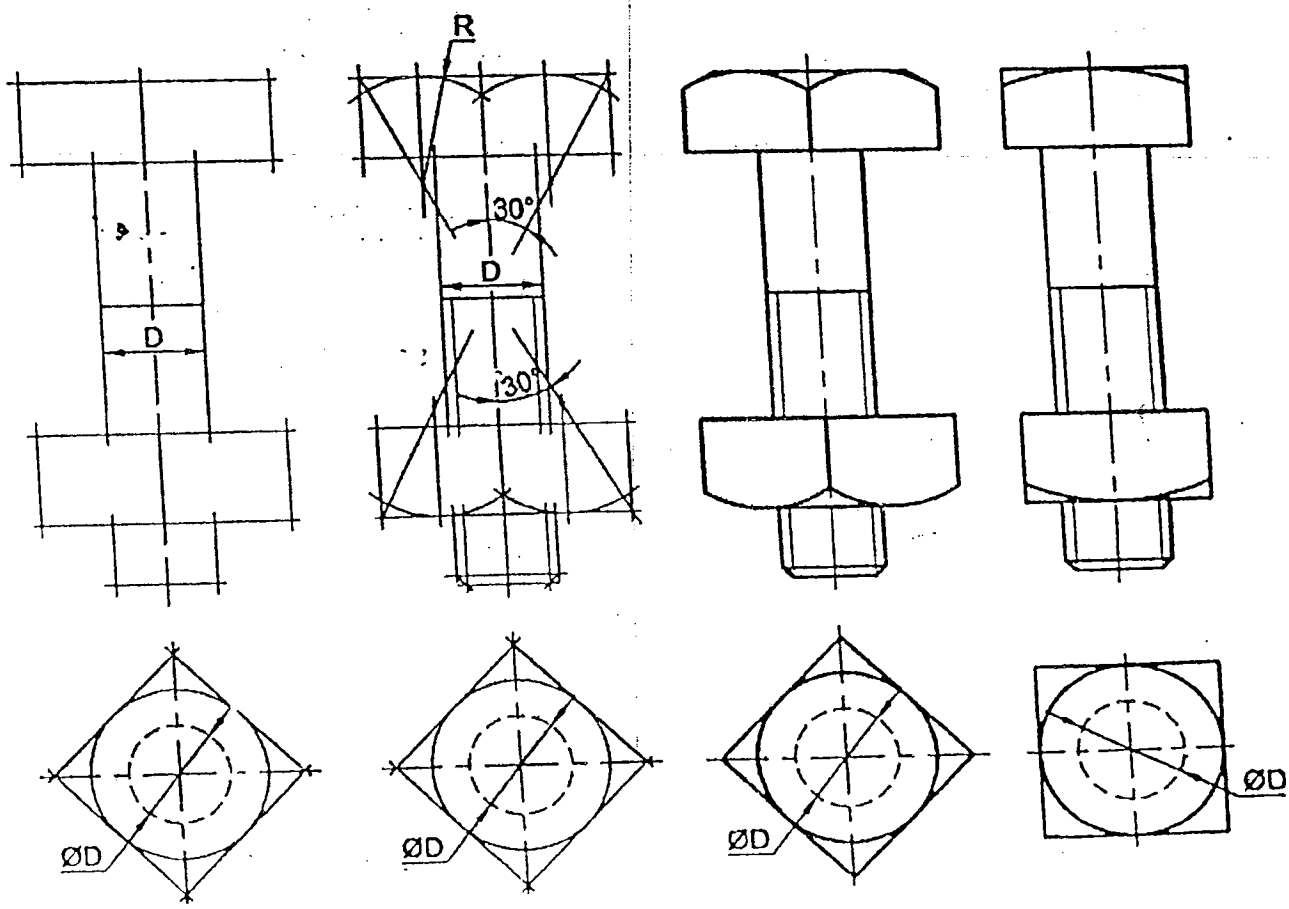


Fig. 5.11 Procedure of Drawing Square Bolt Head and Nut

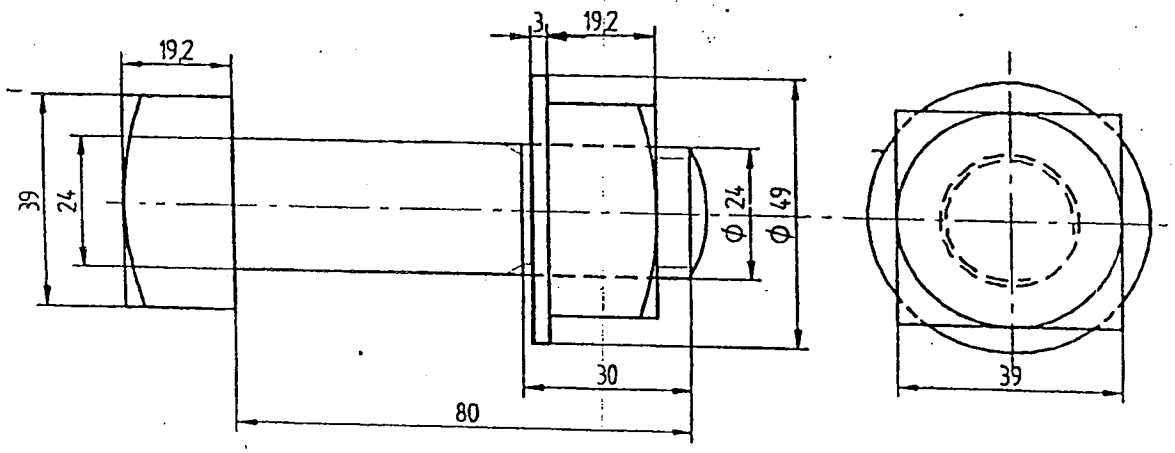


Fig. 5.12 Drawing Views of Square Bolt Head and Nut

CHAPTER – 6

KEYS AND JOINTS

6.1 INTRODUCTION

Keys, cotters and pin joints are in the temporary fastener family which join two components to transmit force and motion from one element to another.

Keys are the most common temporary fasteners for motion transmitting connections and the major function of them is to prevent relative rotation between the members connected by keys and keyways.

6.2 KEYS

Keys are elements used to prevent relative motion between two connecting elements. They are made of steel as they are subjected to shearing and crushing loads. A part of it lies in a groove called the key seat cut in a shaft and other part extends above the shaft and fits into the key way cut in a hub. After the assembly, a part of the key is in the shaft and a part is in connecting element such as pulley, gear, wheel, sleeve etc. The key may have taper along its length to facilitate the assembly. In order to have same strength as that of the shaft, keys are made with the same material of the shaft, usually medium carbon steels. Fig. 6.1 shows the parts of a keyed joint and its assembly.

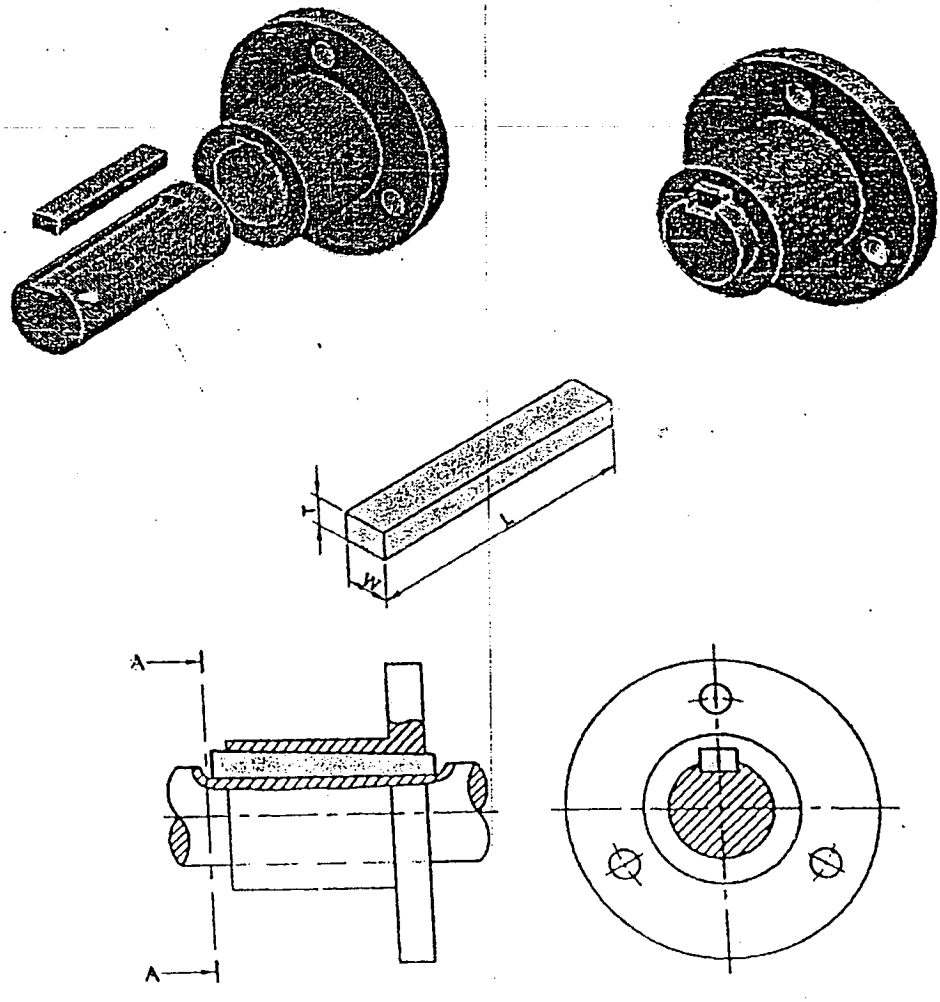


Fig. 6.1 Keyed Joint

6.3 TYPES OF KEYS

Based on the geometry, keys are classified as sunk keys, saddle keys and round keys.

6.3.1 SUNK KEYS

These are widely used in practice for heavy-duty torques applications. They may be either square or rectangular in cross section. Half the thickness of the key fits into the key way of the shaft and the other half in the key way of the hub.

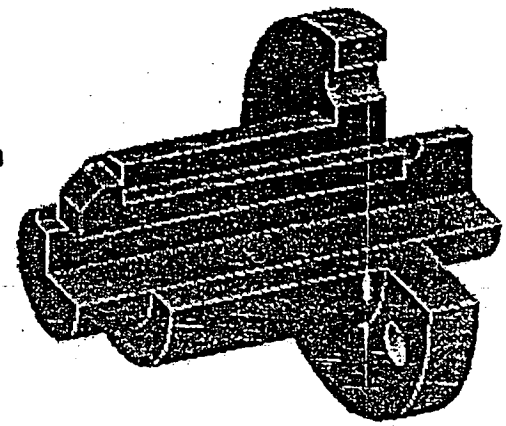
Sunk keys may be further classified into (i) taper keys, (ii) parallel or feather keys, and (iii) woodruff keys

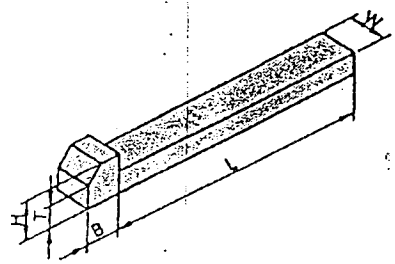
6.3.2 Taper Sunk Key

The cross sections of these keys are square or rectangular, uniform in width and tapered in thickness. The top surface is tapered to 1:100, keeping the bottom surface flat. Hence, the keyway in the shaft is parallel to the axis and the keyway in the hub is tapered. Such a key is shown in Fig. 6.2.

It is easy to remove a taper sunk key by applying force from the exposed small end. Some times the small end may not be accessible, and in such cases the bigger end of the key is provided with a head called gib and key is called gib head key. A gib head key in assembly is shown in Fig. 6.2. The proportions for a gib head are as follows :

Width of Key, W = 0.25D+2mm
Thickness, T = 0.66 W
Width of Gib Head, B = 1.5T
Height of Gib Head, H = 1.5T
Length, L





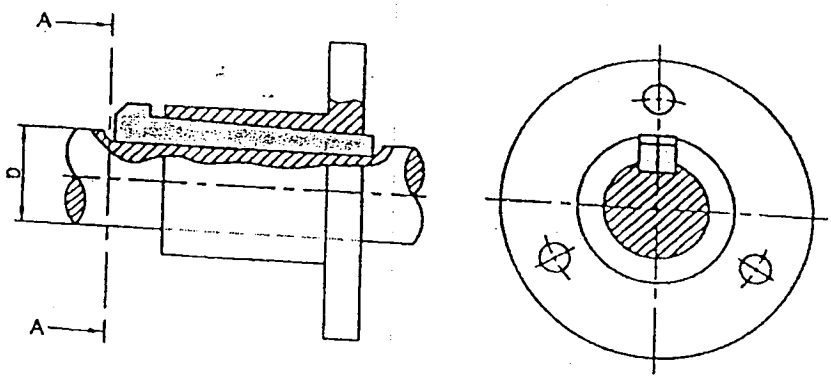


Fig. 6.2 Taper sunk Key

6.3.3 Parallel or Feather Keys

These are sunk keys with uniform width and thickness. These keys are used in the mechanical devices such as clutches, gearboxes where mounted elements (clutch plates and gears) require axial movement. Hence, they should be able to slide over the shaft. The clearance between the key and keyway in the parts enable the sliding of parts.

The key may be fastened into the keyway of the shaft by two or more screws as shown in Fig. 6.3. It may be fixed to the hub as shown in Fig. 6.3.

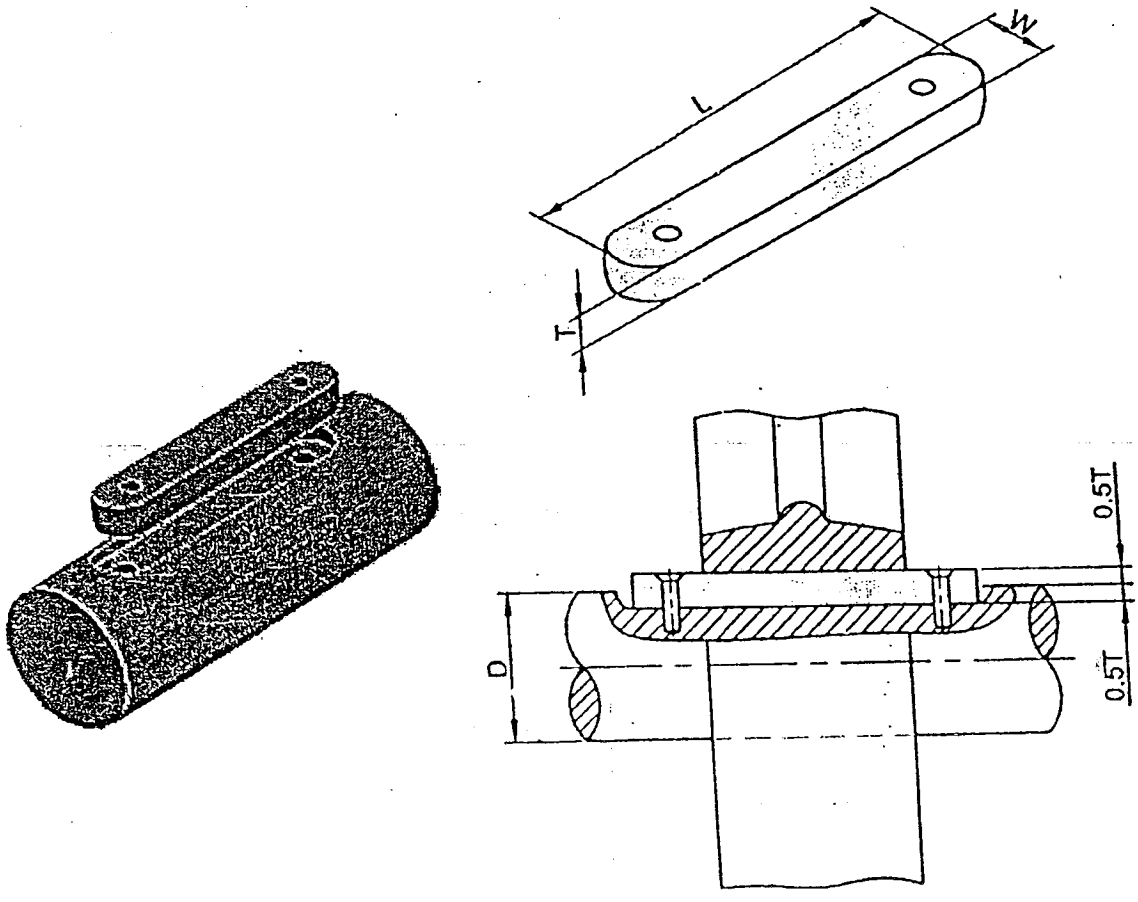


Fig. 6.3 Parallel or Feather Key

6.3.4 Woodruff Key

This key is a segment of a circular disc of uniform thickness. The bottom may be flat or round. The key seat in a shaft is semi-cylindrical with the same radius as that of the key and cut to a depth such that half the width of the key extends above the shaft and fits in o the hub as shown in Fig. 6.4. Woodruff keys are widely used with tapered shafts in machine tools and automobiles. The proportions of Woodruff keys are as follows

Diameter of the Shaft	= D
Thickness of the key, W	= 0.25 D
Diameter of the key, d	= 3W
Height of the key, T	= 1.35 W
Depth of the key into the hub, T1	= 0.5 W + 0.1 mm
Depth of the key in the shaft, T2	= 0.85 W

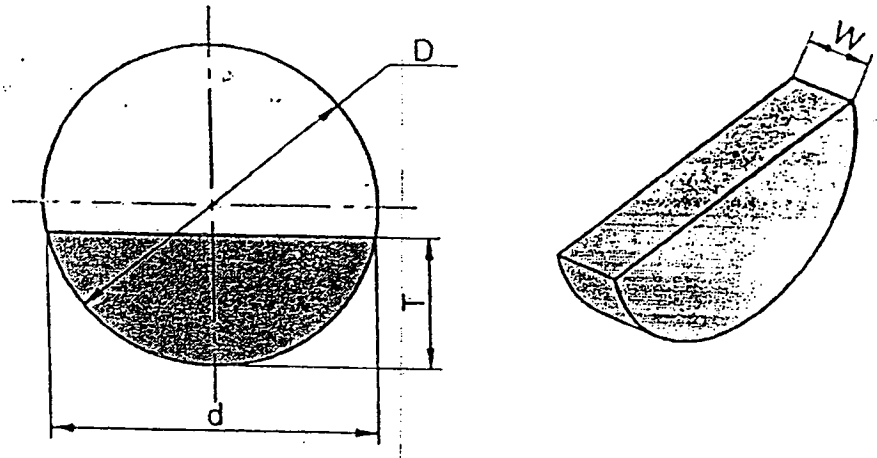


Fig. 6.4 Woodruff Key

6.3.5 PEG FEATHER KEY

In this key, a peg is provided in the middle of the key as shown in Fig. 6.5. The peg fits into a hole provided in the hub of mounted part. The key and mounted part move axially as a single unit in the shaft. The clearance fit between the shaft and key enables a free movement of the mounted part

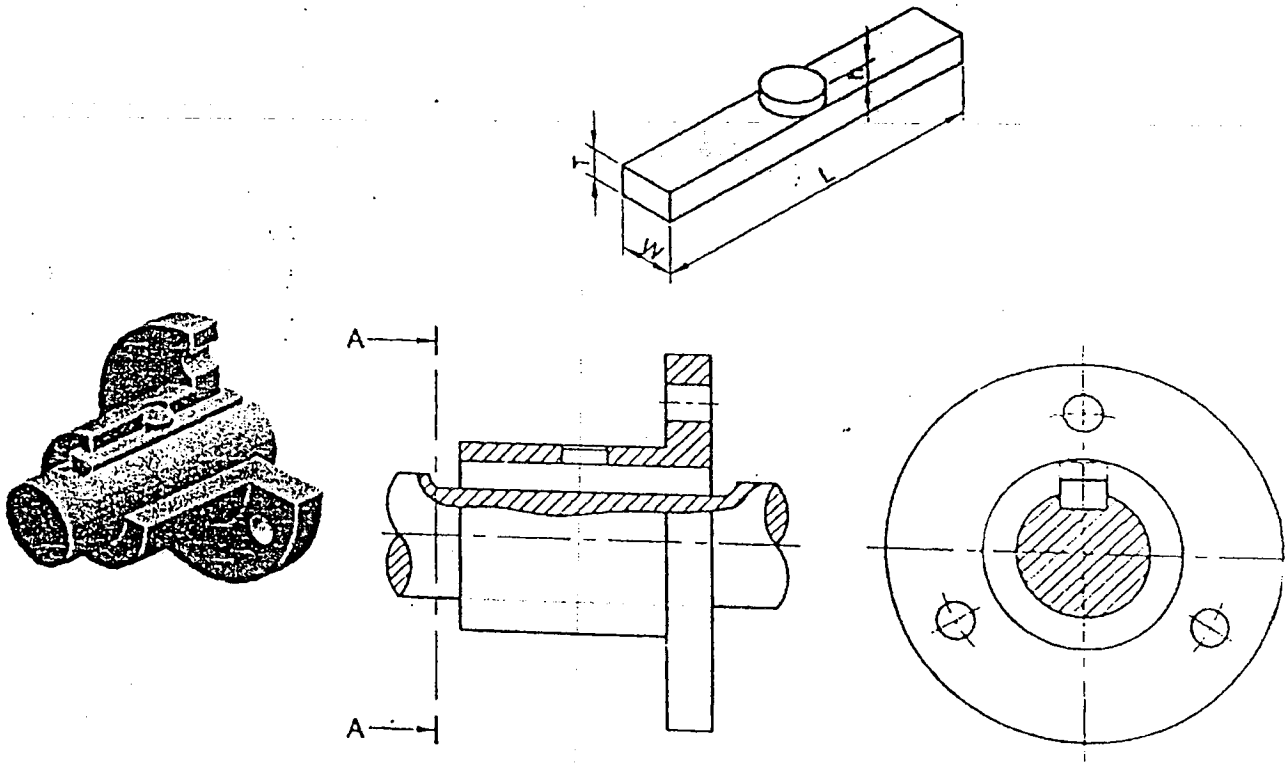
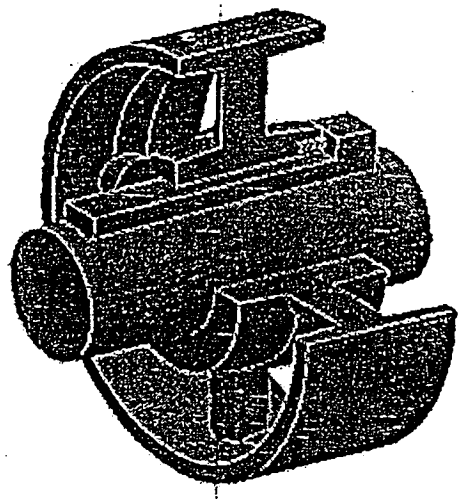
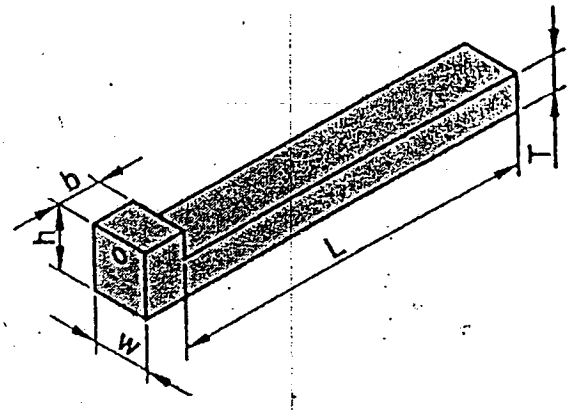


Fig. 6.5 Peg Feather Key

6.3.6 SINGLE HEADED FEATHER KEY

This key is provided with a head at one end, and it is fixed to the hub of the part by a screw as shown in Fig. 6.6. The key and hub of the part form a single unit and move axially.





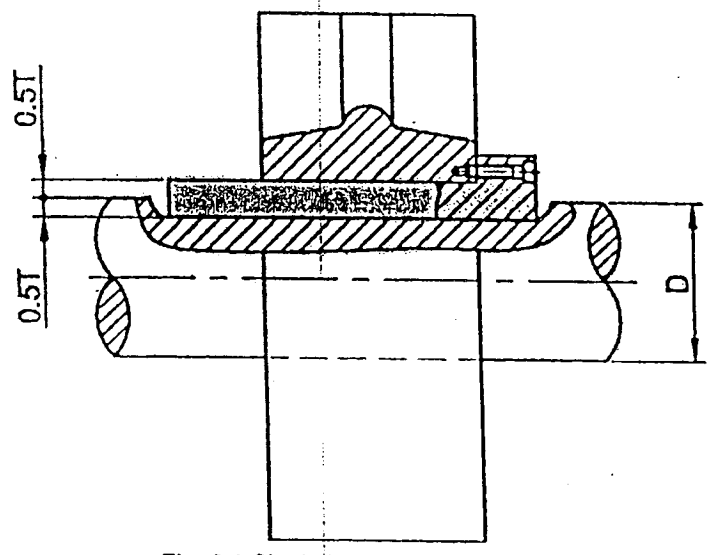


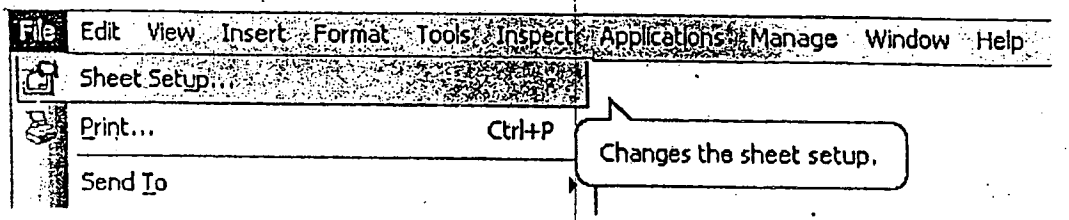
Fig. 6.6 Single Headed Feather key

6.4 COTTER JOINT (SOCKET AND SPIGOT TYPE)

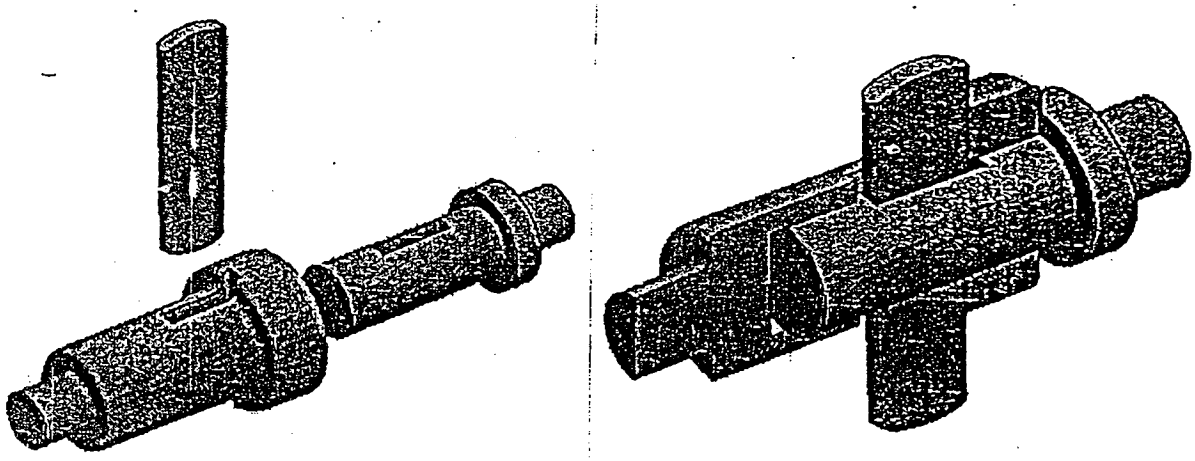
In this type of joint, one end of a rod is made into socket by enlarging the diameter as shown in Fig. 6.7. One end of a second rod is made spigot. Slots are cut in both socket and spigot. After assembling the socket and spigot ends, a cotter is inserted through the slots forming a joint. The cotter comes into contact with the two rods on the opposite sides, leaving clearance on the other two sides as shown in figure.

Computer Aided Drafting Procedure

1. Open the SOFTWARE. Click on the **DRAWING** in the **CREATE** dialog box.
2. Set up the sheet of required size by clicking the **SHEET SET UP** in the **FILE.** Select **A4 wide** size for this problem.



3. Draw axis line by using **LINE COMMAND** from **DRAWING TOOL BAR,** select the appropriate line type and line thickness.
4. Calculate the entitites in term of "d" (given) into numerical values.
5. Using **LINE COMMAND** and **CURVE COMMAND** draw socket as shown.
6. Using **FILLET COMMAND** from **DRAWING TOOL BAR** fillet the corners of the socket.
7. Using **LINE COMMAND** and **CURVE COMMAND** draw spigot as shown.
8. Using **FILLET COMMAND** from **DRAWING TOOL BAR** fillet the corners of the spigot.
9. Using **LINE COMMAND** and **ARC COMMAND** draw the cotter to connect socket and spigot providing clearance as shown.
10. As per the section given using **FILL COMMAND** hatching is done as shown.
11. Using **EXTEND COMMAND**, **LINE COMMAND** and **CIRCLE COMMAND** complete the side view.
12. As per the section given using **FILL COMMAND** hatch the side view.
13. Select **TRIM COMMAND** to trim out the entities which are not necessary.
14. Finally, select the **SMART DIMENSION COMMAND** from **DRAWING VIEWS TOOL BAR** to dimension the cotter joint as shown in figure.



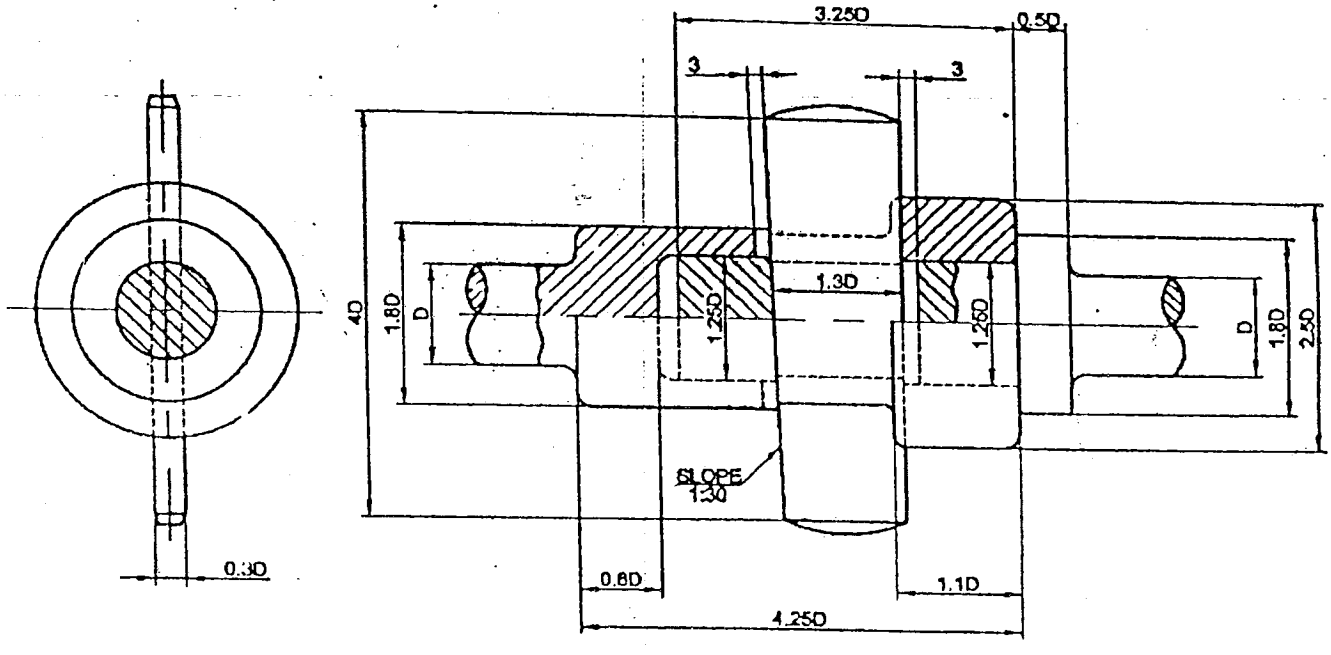


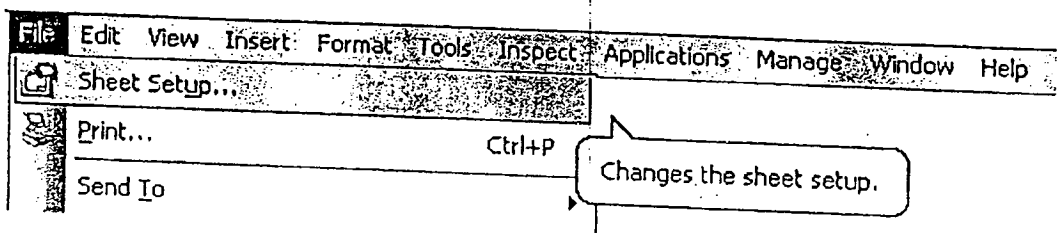
Fig. 6.7 Cotter Joint (Socket and Spigot Type)

6.5 KNUCKLE JOINT (PIN JOINT)

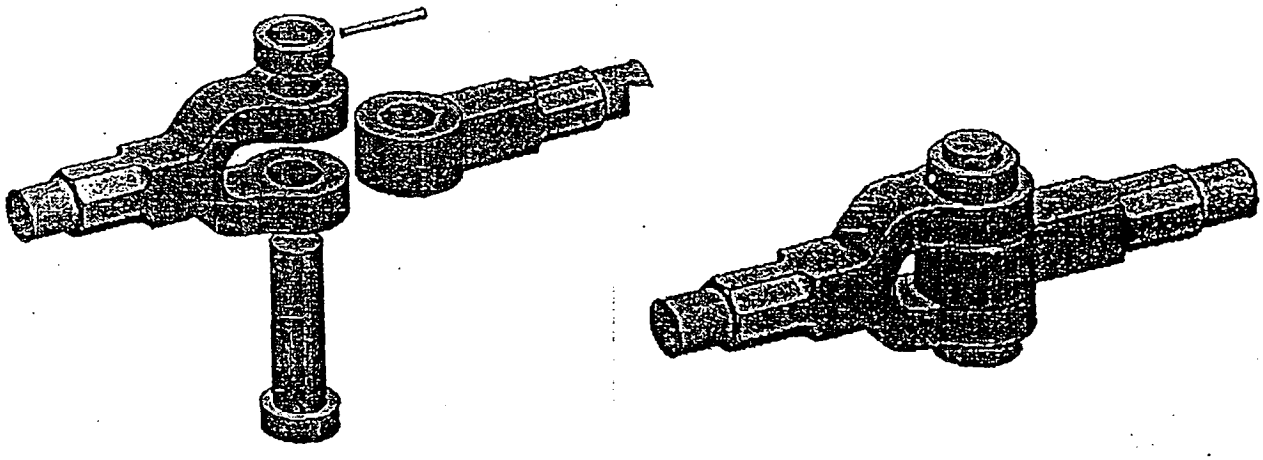
It is a pin joint to fasten two circular rods with their axes interesting. A knuckle joint is shown in Fig. 6.8. One end of the rod is formed into an eye and other end into a fork. The eye end of the rod is placed through the holes. The pin is held in the position by means of a collar and a taper pin. After the assembly, the rods are to swivel about the central pin. Knuckle joints are used in air brakes of locomotives, suspension links etc.

Computer Aided Drafting Procedure

1. Open the SOFTWARE. Click on the DRAWING in the CREATE dialog box.
2. Set up the sheet of required size by clicking the SHEET SET UP in the FILE. Select A4 wide size for this problem.



1. Draw axis line by using LINE COMMAND from DRAWING TOOL BAR, select the appropriate line type and line thickness.
2. Calculate the entitites in term of "d" (given) into numerical values.
3. Using LINE COMMAND , ARC COMMAND and CURVE COMMAND draw eye end as shown.
4. Using LINE COMMAND , ARC COMMAND and CURVE COMMAND draw fork end as shown.
5. Using LINE COMMAND draw the pin as shown.
6. Using LINE COMMAND from DRAWING TOOL BAR draw collar as shown.
7. Using LINE COMMAND from DRAWING TOOL BAR draw the taper pin as shown.
8. As per the section given using FILL COMMAND hatching is done in front view as shown.
9. Select EXTEND COMMAND , LINE COMMAND , CURVE COMMAND , ARC COMMAND and CIRCLE COMMAND to complete the top view of knuckle joint.
10. Select TRIM COMMAND to trim out the entities which are not necessary.
11. Finally, select the SMART DIMENSION command from DRAWING VIEWS TOOL BAR to dimension the knuckle joint as shown in figure.



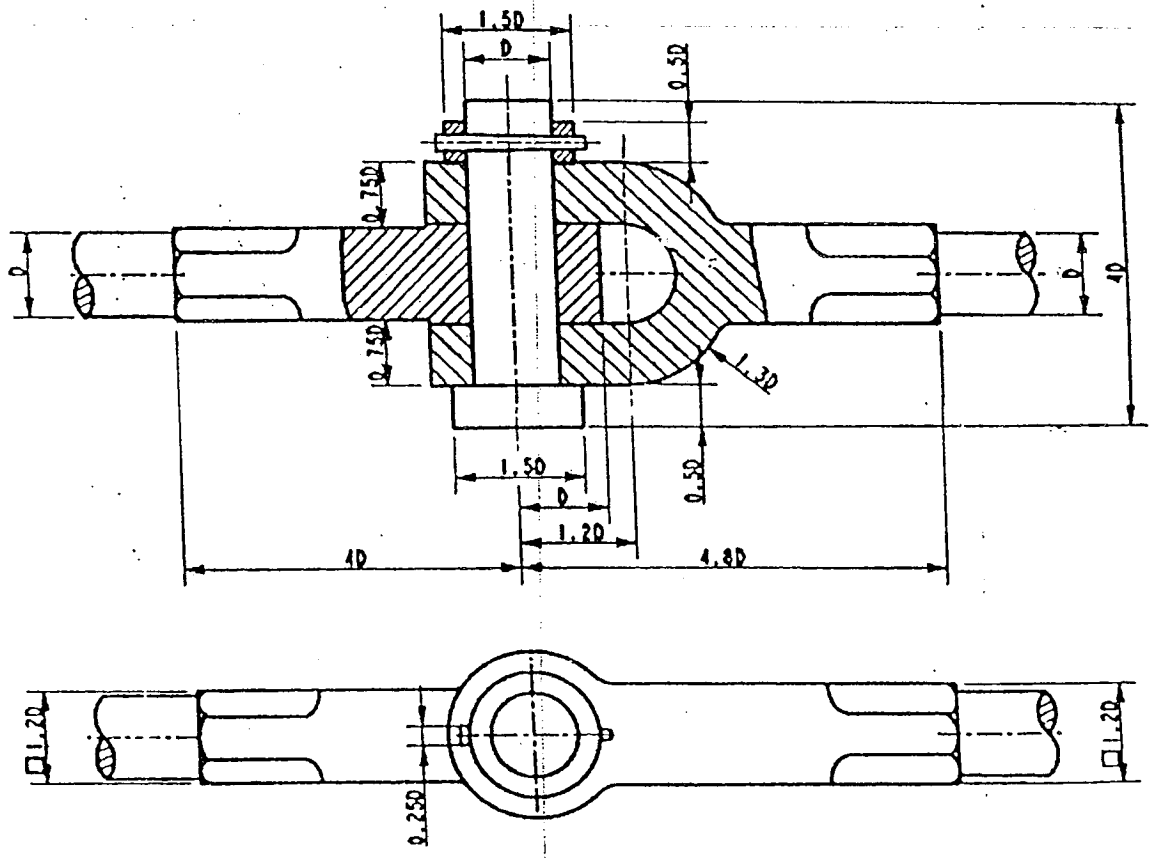


Fig. 6.8 Knuckle Joint (Pin Joint)

CHAPTER – 7
RIVETED JOINTS

7.1 RIVETED JOINTS

In riveted joints, rivets are used to fasten two or more plates or metallic parts permanently. Riveting is one of the methods used for producing a rigid and permanent joint. Parts joined by means of riveted joints can not be disassembled without chipping off the rivet heads from one side of the joint. These joints are used in manufacturing of boilers, ship building, bridges, trusses etc.

7.2 RIVETS

A rivet is a rod of cylindrical cross section consisting of three parts viz., head, shank, and tapered tail as shown in Fig. 7.1. A rivet is specified by the diameter of shank. The length of the tail is kept about 1.25 times the diameter of rivet. Another head is formed from this portion during riveting. Mild steel (C 30) is commonly used material for rivets. Wrought iron, copper and aluminum alloys are used for special applications.

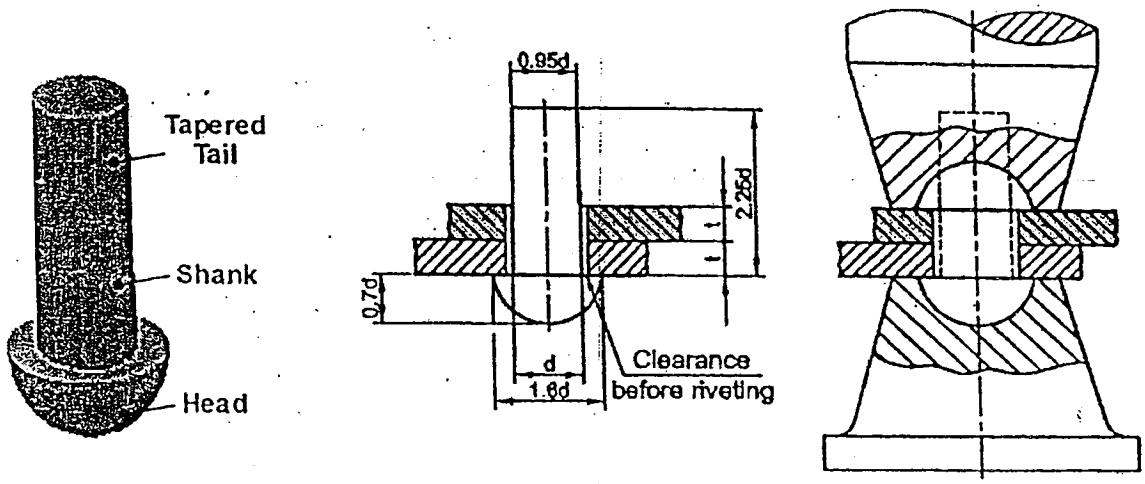


Fig. 7.1 Rivet and Riveting

7.3 RIVETING

It is the process of forming a riveted joint. A rivet is placed in the holes drilled through the two or more parts to be joined. These holes are slightly larger (about 1 to 1.5 mm) than the diameter of the rivet. Any burr formed during drilling the hole is removed by a small counter sinking for easy insertion of the rivet. The tail end of the rivet is inserted into the holes of parts, such that the shank portion will align with parts to be riveted. The head of the rivet is held fast against the adjoining part, while the tail end is made into another rivet head by applying pressure when it is either in cold or hot condition.

The hot rivet is easy to work on and binds the parts more closely on cooling on account of contraction of metal. The pressure appeared to form the rivet head is either by hammering or through hydraulic or pneumatic means. While forming the rivet head, the shank portion will bulge uniformly due to the compression forces and closes the gap between the rivet and parts.

Riveting is done in cold if rivets are small size or when they are made with ductile materials such as copper, aluminum. When the work is to be done fast or on large scale, machine riveting is employed. The heads formed by machine riveting are more uniform and holes in the parts are filled more completely due to steady pressure.

7.4 CAULKING AND FULLERING

7.4.1 Caulking

Caulking is an operation in which the outer edges of the parts are hammered and driven-in by caulking tool to prevent leakage through the joint. The edges of the parts are beveled with about 80°. The caulking tool is in the shape of a blunt chisel as shown in Fig.7.2.

7.4.2 Fullering

Fullering is similar to caulking except that fullering tool is equal to the width of the edges of the plates as shown in Fig.7.2. Fullering is also employed to produce a leak proof joint similar to caulking. Both caulking and fullering operations are carried out by applying pneumatic pressure.

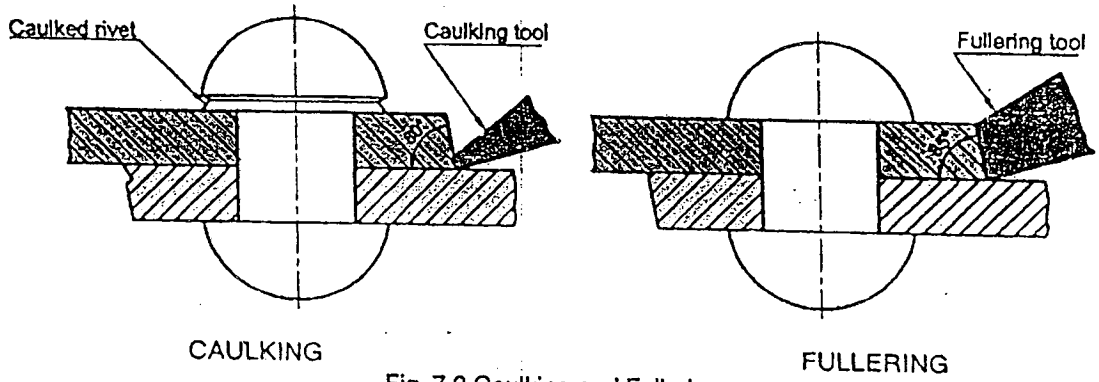
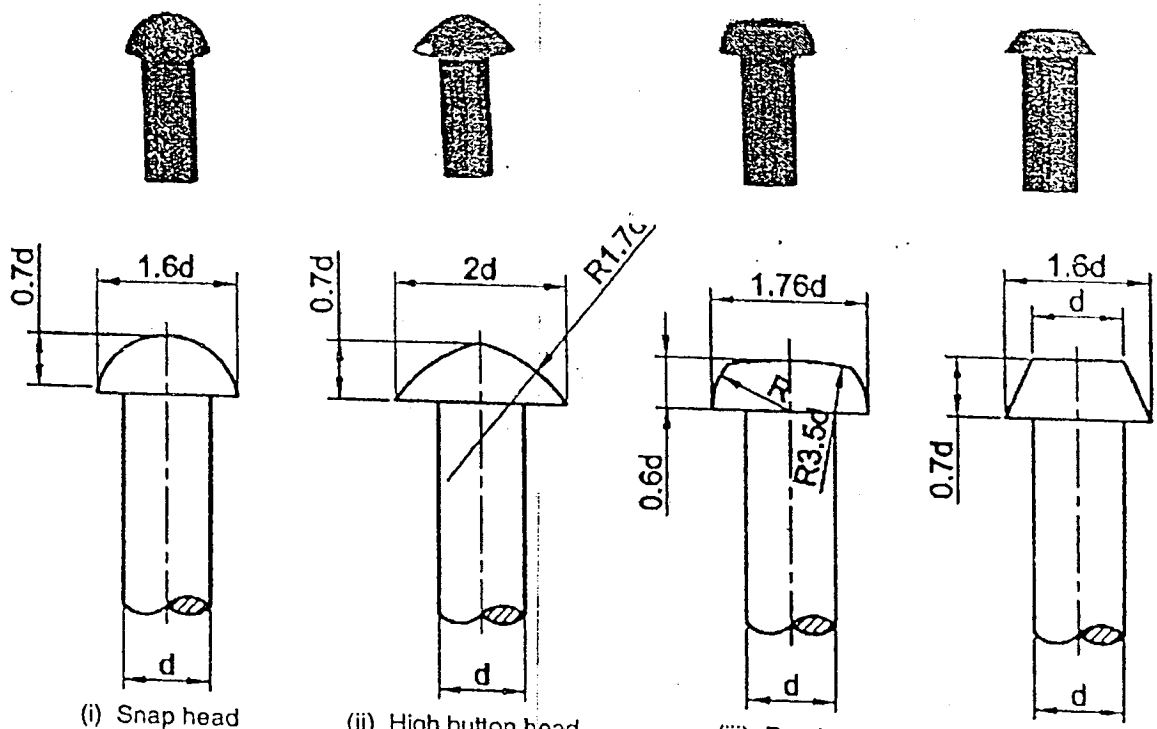


Fig. 7.2 Caulking and Fullering

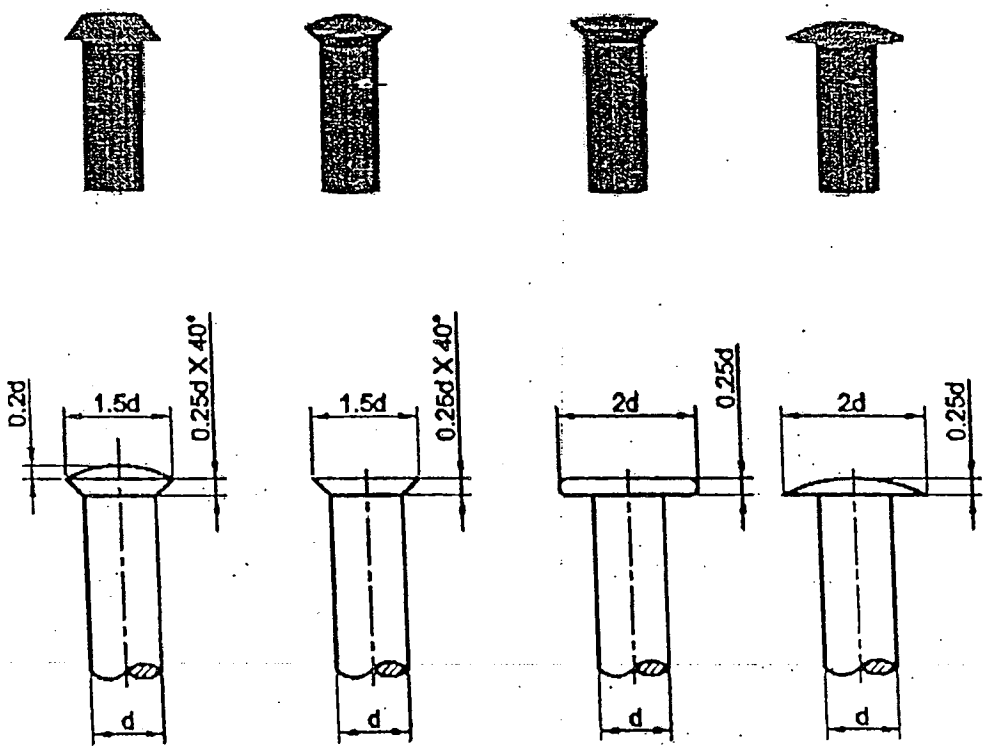
7.5 RIVET HEADS

Various types of rivet heads and their proportions recommended by BIS for general engineering applications are shown in Fig.7.3 Fig. 7.4.



(i) Snap head (ii) High button head (iii) Pan head (iv) Cone head

Fig. 7.3 Types and Proportions of Rivet Heads



(v) Round top counter sunk head (vi) Flush counter sunk head (vii) Flat head (viii) Trust head

Fig. 7.4 Types and Proportions of Rivet Heads

7.6 DIMENSIONS OF RIVETED JOINTS

The dimensions such as diameter of the rivet, pitch, and margin shown in Fig.7.5 are obtained by design calculations. For elementary work, the following empirical relations may be used.

(i) $d = 6\sqrt{t}$

(ii) $p = 3d$

(iii) $m = d$ or $1.5\ d$

where

t = thickness of plate

d = diameter of the rivet

p = pitch (distance between the centers of adjacent rivets in the same row)

m = margin (the distance between the edge of the nearest rivet hole to the edge of the plate, or the distance between the center of the nearest row of rivets to the edge of plate)

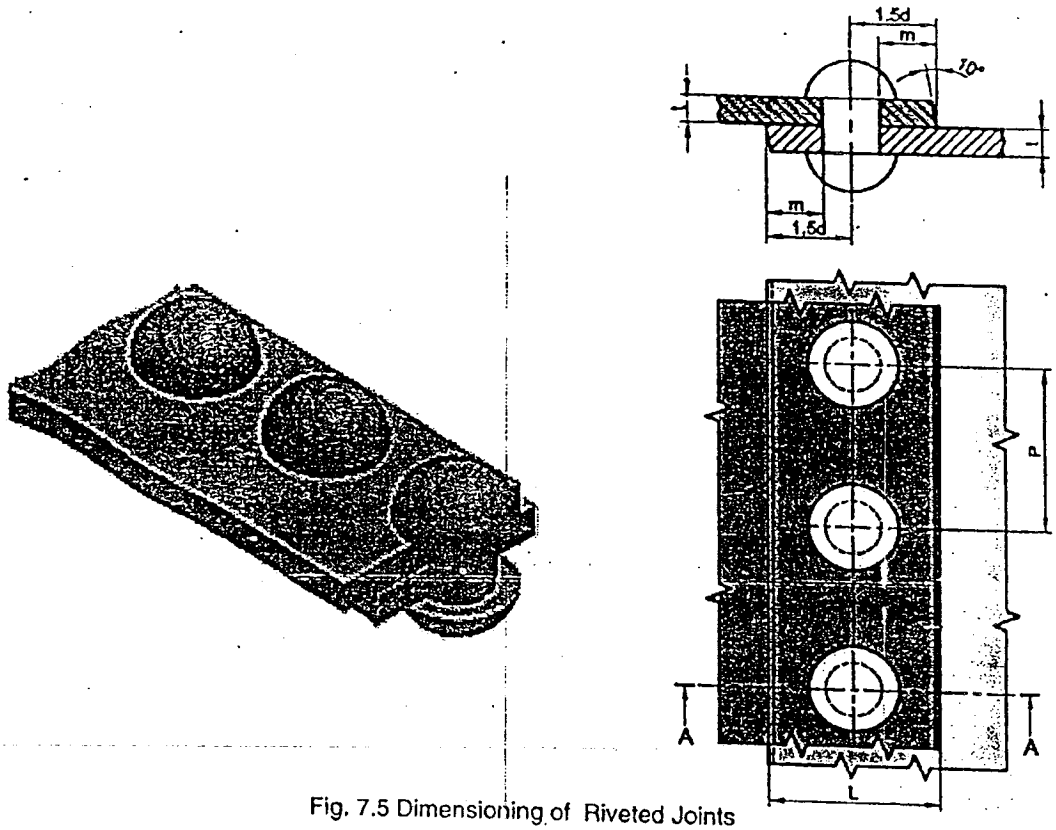


Fig. 7.5 Dimensioning of Riveted Joints

7.7 TYPES OF RIVETED JOINTS

7.7.1 Lap Joints

When the members to be connected overlap each other, it is known as ***lap joint.*** When the joint is made with only one row of rivets, it is called ***single riveted lap joint.*** A pictorial view along with front elevation and top view of a single riveted lap joint are shown in Fig.7.5. The width of the over lap L is equal to 3d (diameter of the rivet + 2 times the margin).

A joint is called double riveted, triple riveted etc. as per the number of rows in the joint. When two or more rows of rivets are required, they may be arranged in (i) chain or (ii) zigzag formation. A double riveted chain joint is shown in Fig.7.6. The rivets in the adjacent rows are placed in the same line which is perpendicular to the row line. If the rows are treated as vertical line, chain line may be treated as horizontal lines as shown in the figure. The distance between the rows of rivets is called ***row pitch*** p_r, and should not be less than 0.8 p, or 2d + 6 mm.

A double riveted zigzag joint is shown in Fig.7.7. The rivets in the adjacent rows are staggered and placed in between those of previous row. The distance between the center of the rivet in one row and the center of the nearest rivet in the adjacent row is called ***diagonal pitch,*** p_d given by the relation $p_d = (2p+d)/3$. The row pitch for zigzag riveting, p_r, is 0.6 p or 2d. Fig. 7.8 shows the orthographic views of these joints.

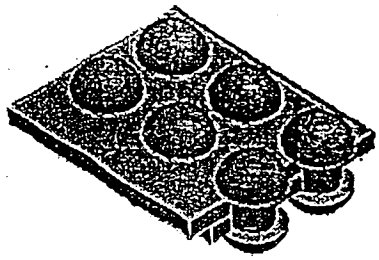


Fig. 7.6 Chain Riveting

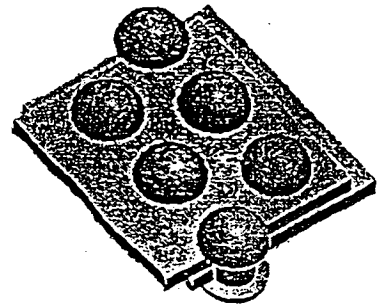


Fig. 7.7 Zig-zag Riveting

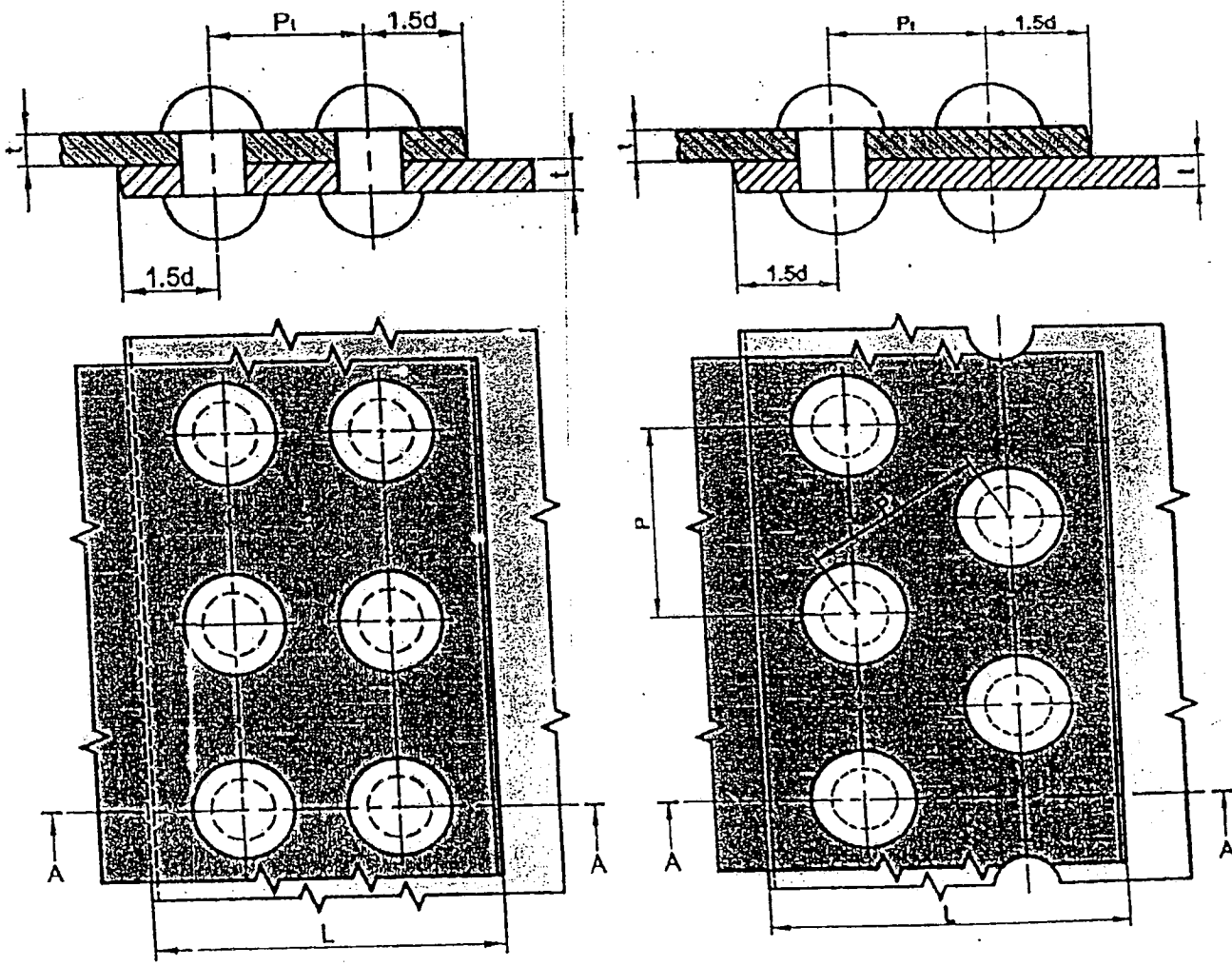


Fig. 7.8 Double Riveted Chain and Zigzag Lap Joints

7.7.2 Butt Joints

In a butt joint, the edges of the plates to be connected are butted against each other. The joint between them is covered by cover plates (butt-plates) or cover straps (butt- straps) on one side or both sides. The butting edges of the plates are squared and outer edges of the cover plate(s) are beveled. Single riveted single strap and double strap butt joints are shown in Fig 7.9.

The thickness of straps (t_1 or t_2) are given by the following relations

t_1 = t to 1.125 t

t_2 = 0.7 t to 0.8 t

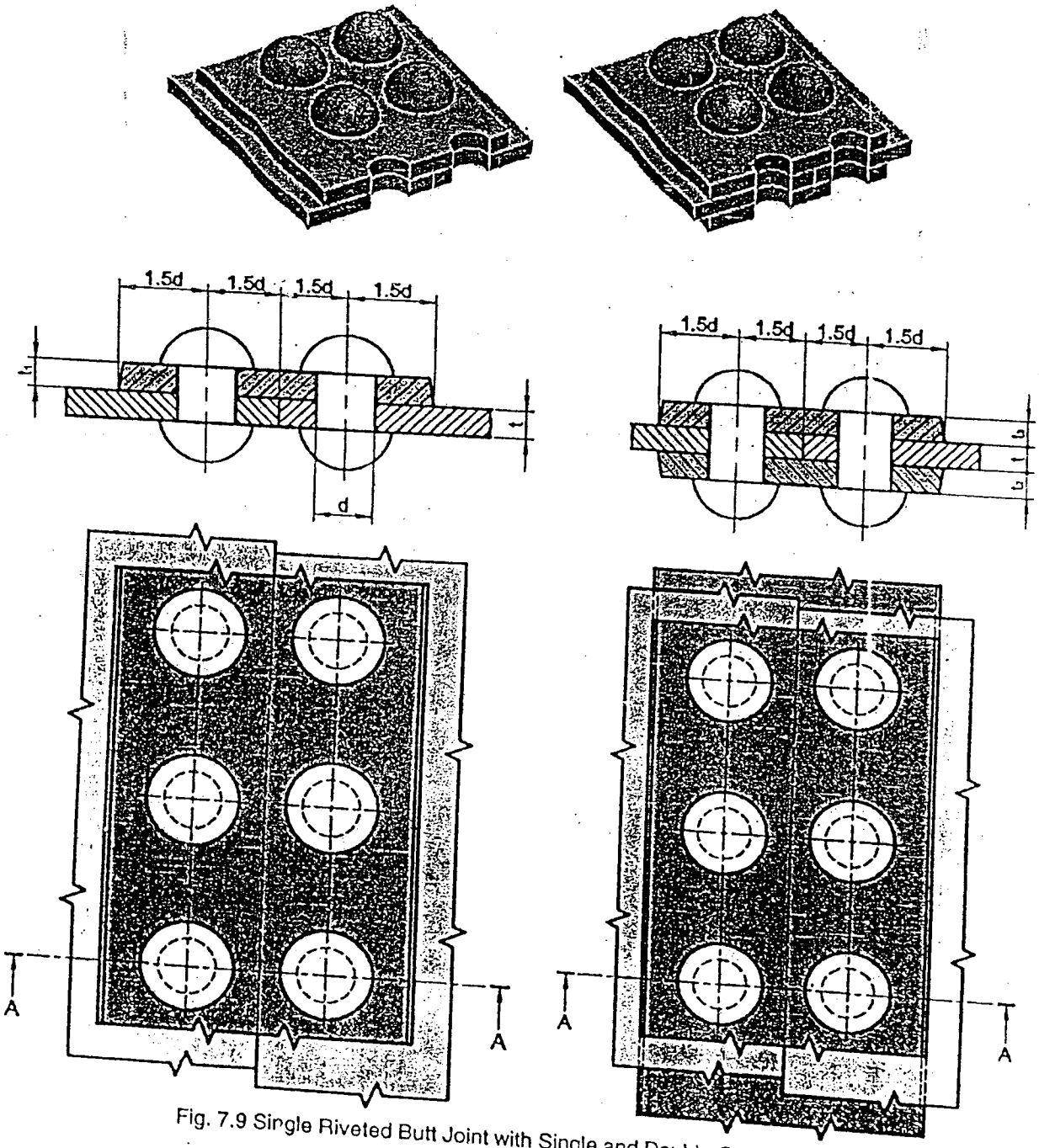


Fig. 7.9 Single Riveted Butt Joint with Single and Double Cover Straps

A double riveted, double strap chain and zigzag butt joint are shown in Fig.7.10 and 7.11 respectively

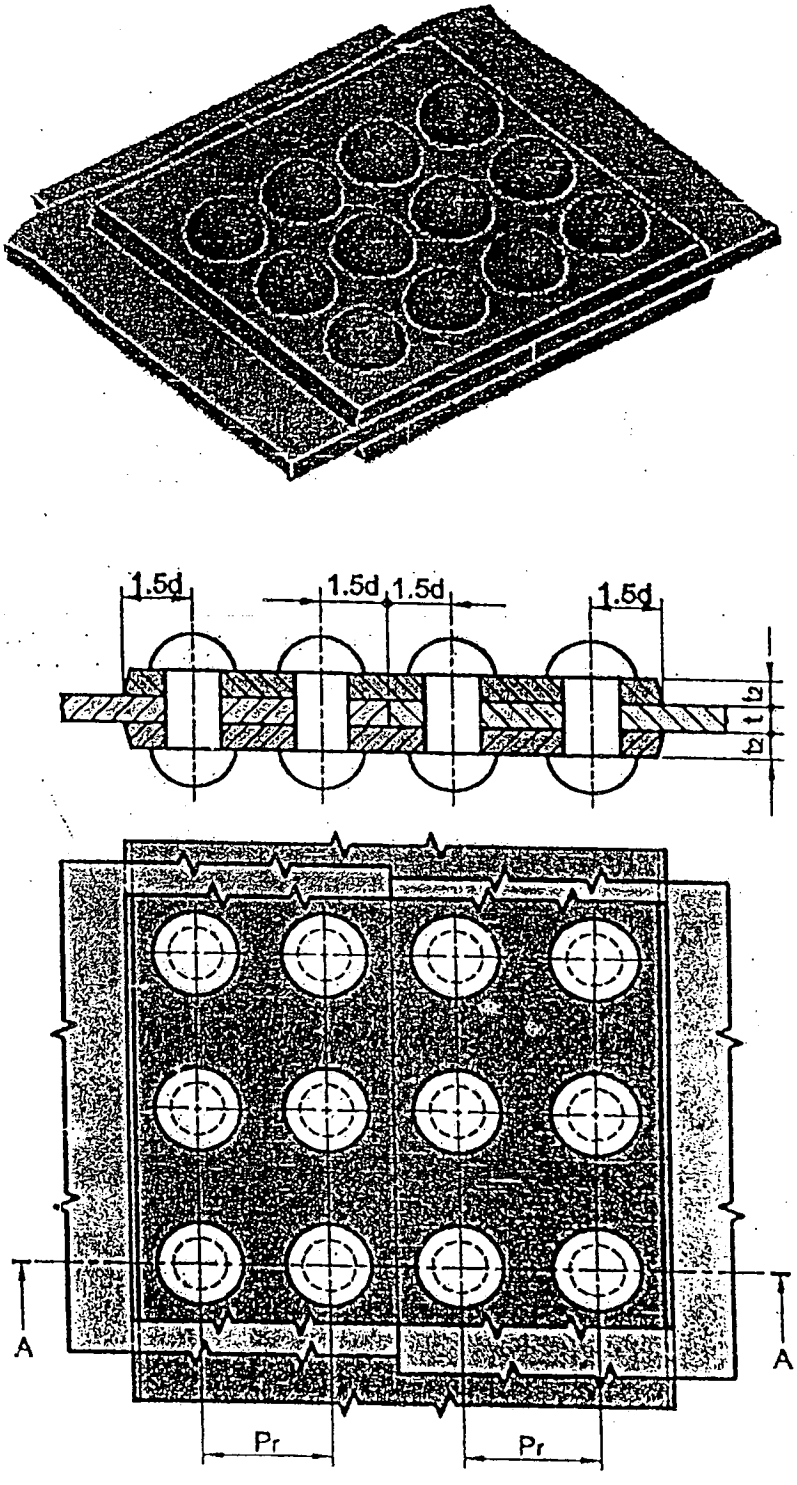
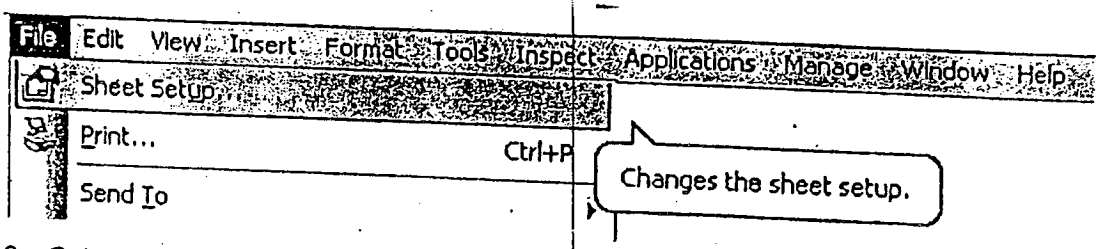


Fig. 7.10 Double Riveted Butt Joint with Double Cover Straps (Chain Riveting)

Computer Aided Drafting Procedure

1. Open the SOFTWARE. Click on the DRAWING  in the CREATE dialog box.
2. Set up the sheet of required size by clicking the SHEET SET UP in the FILE. Select A4 wide size for this problem.



3. Calculate the entitites in term of "d" (given) into numerical values.
4. Using LINE COMMAND  from DRAWING TOOL BAR draw lines to shown front view of the plates.
5. Select CURVE COMMAND  to show cut lengths of plates.
6. Using LINE COMMAND  draw the axis of rivet with appropriate line type and line thickness.
7. Select ARC COMMAND  draw the rivets as shown.
8. Using EXTEND COMMAND  , extend the axis of the rivet to the top view.
9. To get top view select LINE COMMAND  from DRAWING TOOL BAR to draw edges of the plates.
10. As per the visibility, using LINE COMMAND  and CURVE COMMAND  with appropriate line type and line thickness complete the edges of the plate in top view.
11. Select CIRCLE COMMAND  to draw the rivet.
12. Using LINE COMMAND  with appropriate line type and line thickness draw the sectional line as shown.
13. Using LEADER COMMAND  and TEXT COMMAND  annotations are made for section line as shown.
14. As per the sectional top view using FILL COMMAND  hatch the front view as shown.
15. Select TRIM COMMAND  to trim out the entities which are not necessary.
16. Finally, select the SMART DIMENSION COMMAND  from DRAWING VIEWS TOOL BAR to dimension the double riveted zigzag lap joint as shown in figure.

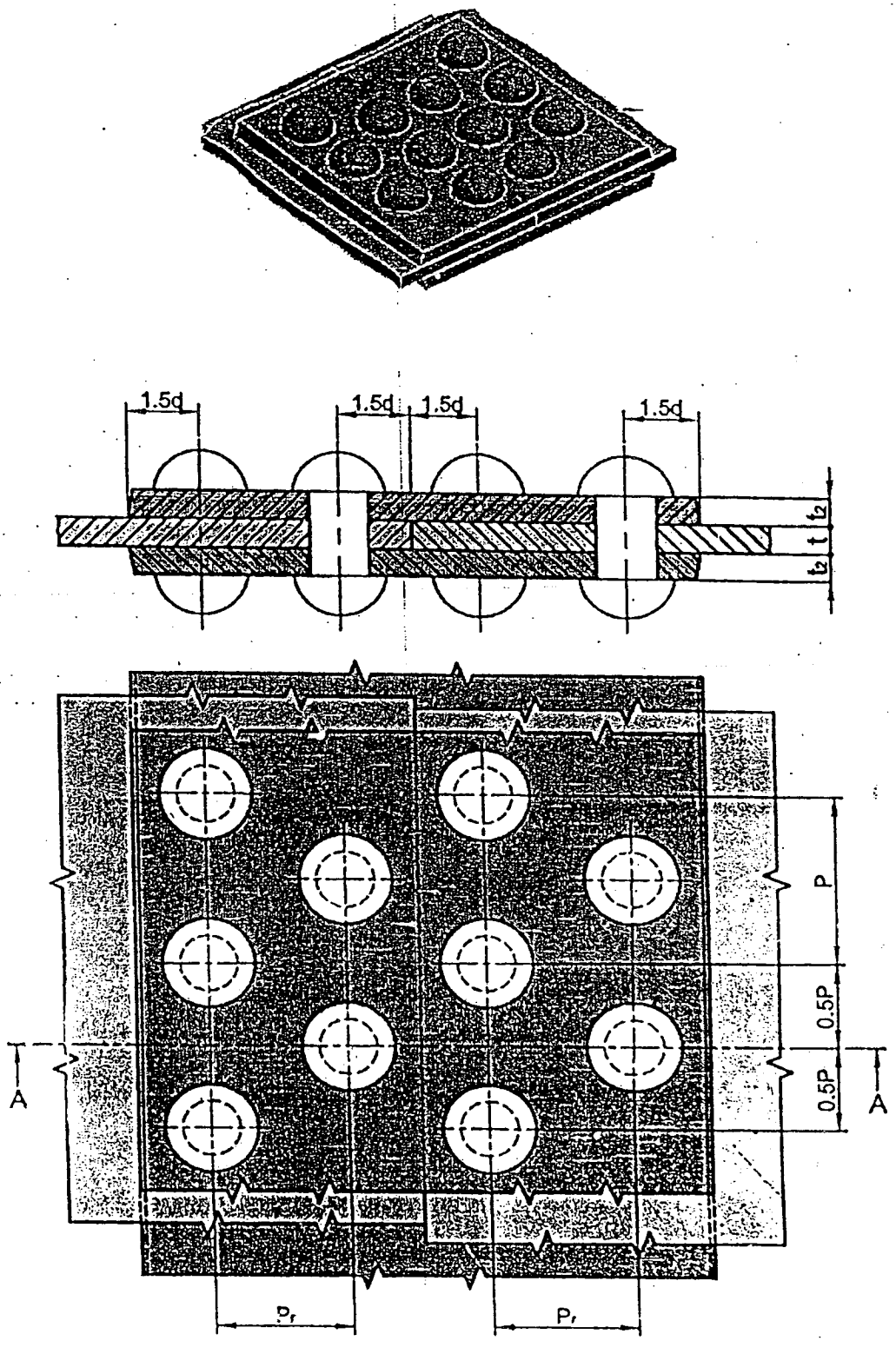


Fig. 7.11 Double Riveted Butt Joint with Double Cover Straps (Zigzag Riveting)

CHAPTER – 8

COUPLINGS

8.1 INTRODUCTION

Machine components of electrical motors, water pumps, gear boxes etc. are manufactured at different places. All such components or assemblies have to be connected to one another for power transmission. Shaft couplings are used to transmit power from a driving shaft to a driven shaft. The two shafts may have their axes collinear, inclined or intersecting, or parallel and separated by a small distance. Based on the construction, a few shaft couplings are as follows:

1. SPLIT MUFF COUPLING
2. FLANGE COUPLING
3. PROTECTED TYPE FLANGE COUPLING
4. PIN TYPE FLEXIBLE COUPLING
5. OLDHAM'S COUPLING
6. UNIVERSAL (HOOKES) COUPLING

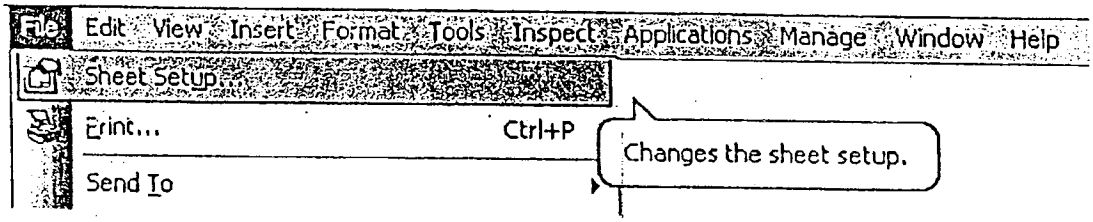
8.2 MUFF COUPLING

A muff coupling is a hollow cylindrical part fitted over a shaft with clearance is called a sleeve. When used in a coupling, the sleeve is also known as muff. The muff is generally made of cast iron. It is fitted over the ends of shafts to be connected. The keyways in the shaft and muff are aligned and a sunk key is driven-in, making the coupling. Driving a single key through out the length may pose difficulties due to the misalignment of keyways at the end of shafts. Hence, it is desirable to insert two keys from both ends of the muff. Different types of muff couplings are available.

A split muff coupling is shown in Fig.8.1. The C.I. hollow cylindrical muff is split into two halves and is recessed to accommodate bolts and nuts. A sunk key is first placed in position and then the two halves of the muff are fastened by bolts and nuts. These couplings are used for heavy duty applications. Both the key and friction grip between the shaft and muff help in transmitting large power.

Computer Aided Drafting Procedure

1. Open the **SOFTWARE**. Click on the **DRAWING**  in the **CREATE** dialog box.
2. Set up the sheet of required size by clicking the **SHEET SET UP** in the **FILE**. Select A4 wide size for this problem.



3. Draw axis line by using **LINE COMMAND**  from **DRAWING TOOL BAR**, select the appropriate line type and line thickness.
4. Calculate the entities in term of "d" (given) into numerical values.
5. Using **LINE COMMAND**  , **ARC COMMAND**  , **CURVE COMMAND**  and **FILLET COMMAND**  draw flange shown.
6. Using **LINE COMMAND**  from **DRAWING TOOL BAR** draw key as shown.
7. As per the section given using **FILL COMMAND**  hatching is done in front view as shown.

8. Select **EXTEND COMMAND**, **LINE COMMAND**, **CURVE COMMAND** **ARC COMMAND** and **CIRCLE COMMAND** by setting suitable **TYPE** and **THICKNESS** from **RIBBON BAR** to complete the side view of muff coupling as shown.
9. Select **TRIM COMMAND** to trim out the entities which are not necessary.
10. Finally, select the **SMART DIMENSION** command from **DRAWING VIEWS TOOL BAR** to dimension the muff coupling as shown in figure.

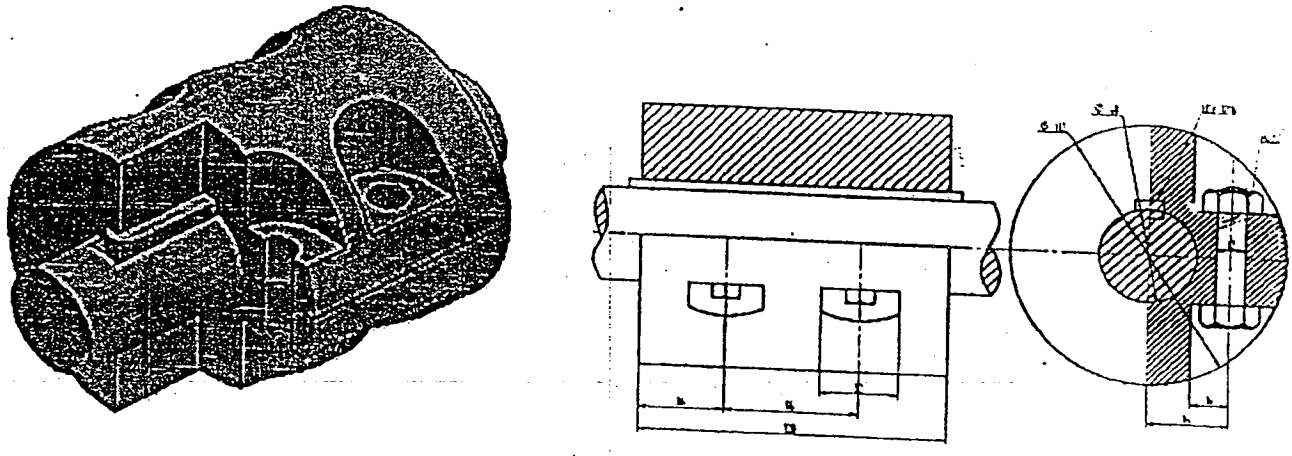


Fig. 8.1 Split Muff Coupling

8.3 PROTECTED TYPE FLANGE COUPLING

A circular disc with a hub to support a shaft, having bolt holes on its pitch circle is called a flange. Two flanges are assembled with shafts by keys. In some marine applications flanges are forged at the end of the shaft to form a shaft with integral flange. The flanges are fastened together using number of bolts and nuts. The number and size of bolts will depend on the size of shaft, which in turn will depend on the power to be transmitted.

The keys are positioned at 90° to each other. A small recess of about 1 mm is maintained between the shaft end and flange face as shown in Fig. 8.2. This ensures a gap between the two shafts and proper contact and firm tightening between the flange faces.

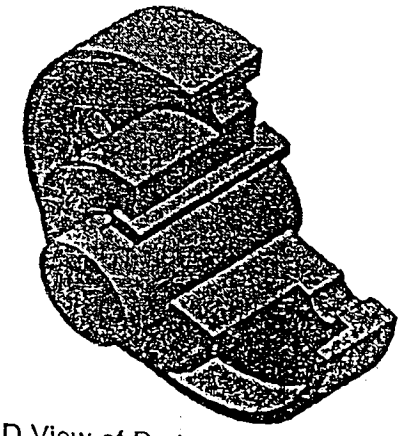


Fig. 8.2 3-D View of Protected Type Flange Coupling

Here the bolt heads and nuts are exposed and liable to cause injury to the operator. As a safety measure, the design may be modified with an annular projection called shroud to form a protection rim on both the flanges. This rim projection covers the bolt heads and nuts and provides protection. Fig.8.3 shows two views of such a coupling with the general propotions, based on shaft diameter.

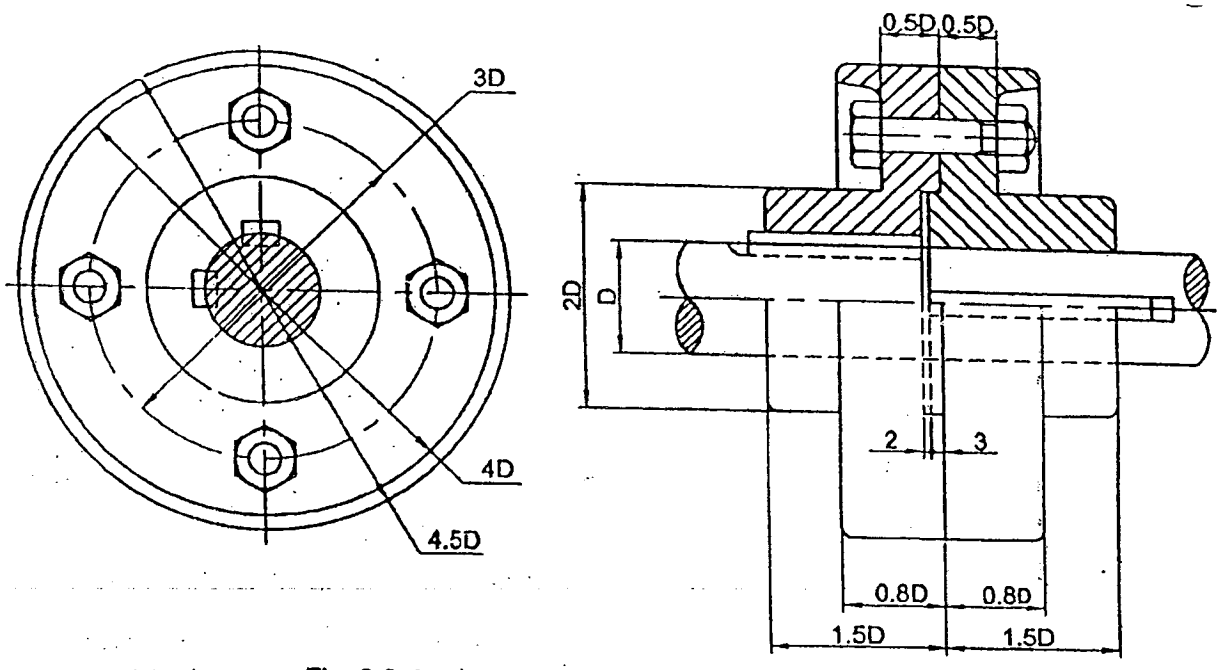
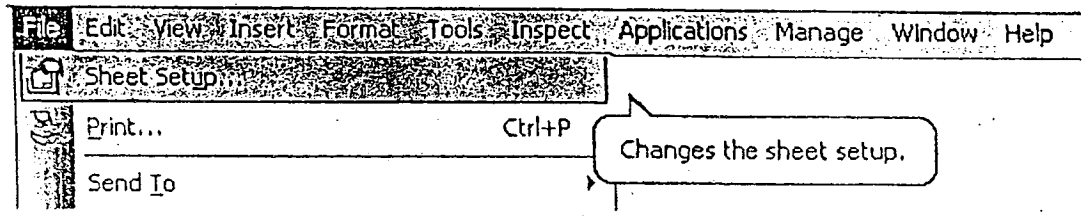


Fig. 8.3 Two Views of Protected Type Flange Coupling

Computer Aided Drafting Procedure

1. Open the **SOFTWARE**. Click on the **DRAWING** in the **CREATE** dialog box.
2. Set up the sheet of required size by clicking the **SHEET SET UP** in the **FILE**. Select **A4** wide size for this problem.



3. Draw axis line by using **LINE COMMAND** from **DRAWING TOOL BAR**, select the appropriate line type and line thickness.
4. Calculate the entities in term of "d" (given) into numerical values.
5. Calculate the entities which are in are in terms d into numerical values.
6. Actuate **LINE COMMAND** and select **LINE TYPE** and **THICKNESS** from option, draw diameter d to suitable length using **ARC COMMAND**
7. Select **RECTANGLE COMMAND** option from **DRAWING TOOL BAR** to draw flanges on either side of construction line.

8. Draw bolt, nut and key according to dimensions using **LINE COMMAND** from **DRAWING TOOL BAR.**

9. Draw all necessary CONSTRUCTION LINES using **LINE COMMAND** from **DRAWING TOOL BAR** and setting suitable **LINE TYPE** and **THICKNESS.**

10. Use **TRIM COMMAND** to trim out the entities which are not necessary.

11. Use **FILLET** option from **DRAWING TOOL BAR** to fillet the corners of flange.

12 Draw key using **LINE COMMAND** from **DRAWING TOOL BAR.**

13. Select **FILL COMMAND** option from **DRAWING TOOL BAR,** hatch the space left free after drawing all entities.

14. Dimension all parts using **SMART DIMENSION** from **DRAWING VIEWS TOOL BAR.**

8.4 PIN TYPE FLEXIBLE COUPLING

A bushed (Pin) type flanged coupling is shown in Fig.8.4. It is a modified design of protected flange coupling, where plain flanges are used and the bolts are replaced by bush and pins. The large ends of the pins are covered with bushes made by flexible materials such as rubber or leather. The smaller ends of the pins are rigidly fastened to the flanges by means of nuts. The flexible material of the bushes accommodates any small misalignments and acts as shock absorber. The extra length and diameter of the large end of the pin provides sufficient area required for the bushes. These couplings are widely used in the application such as to connect centrifugal pump to an electric motor. Figure 8.5 shows the details of Bush and Pin assembly with the general proportions and Fig. 8.6 shows two views of the coupling with the general proportions based on the shaft diameter.

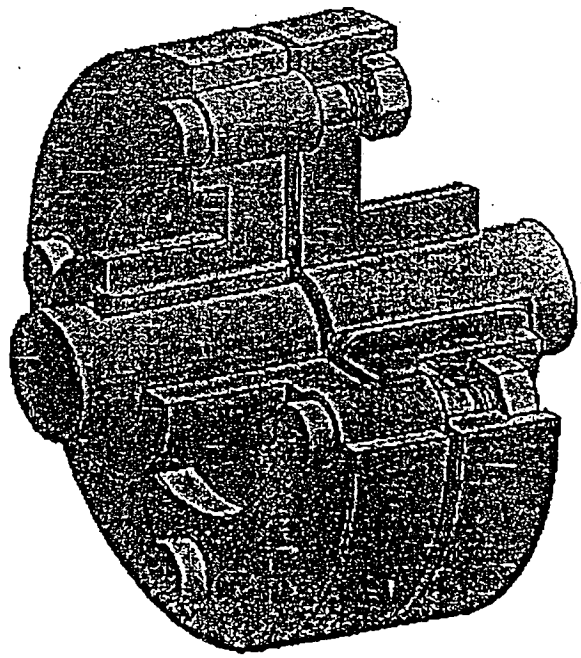


Fig. 8.4 Pin (Bush) Type Flexible Coupling

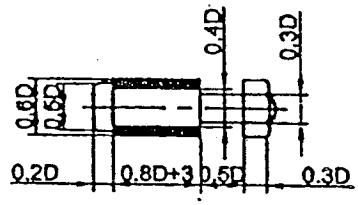


Fig. 8.5 Details of Pin and Bush

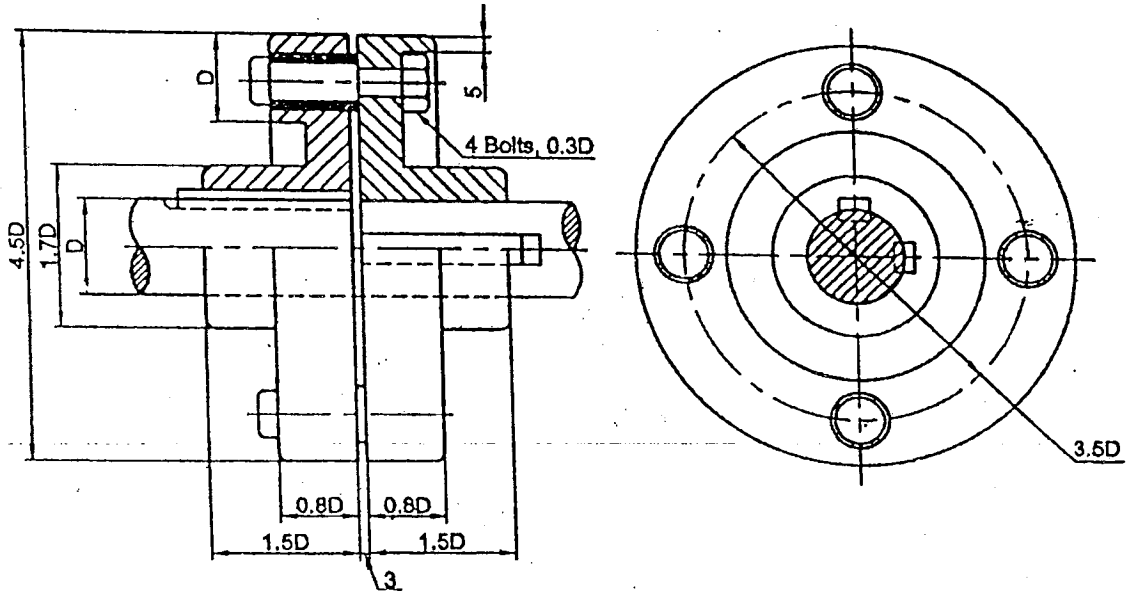


Fig. 8.6 Two Views of Pin (Bush) Type Flexible Coupling

8.5 OLDHAM'S COUPLING

An exploded view of a Oldham coupling is shown in Fig.8.7. It consists two flanges, each having a rectangular slot and a central disk with rectangular projections on either side at right angles, to fit into the slots in the flanges.

To make the coupling, the two flanges are positioned such that the slots are at right angles. The central disk is placed between the two flanges such that the rectangular projections seat in the slots. When the shafts are in rotation, the central disk also rotates and slides in the slots of the flanges. Power is transmitted between the flanges through the central disk. Fig. 8.8 shows two views of such coupling with the general proportions based on the shaft diameter.

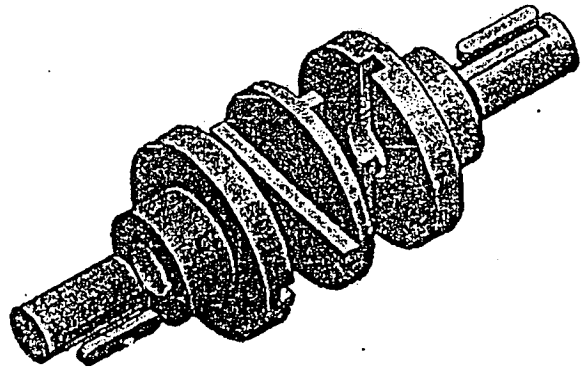


Fig. 8.7 Exploded View of a Oldham coupling

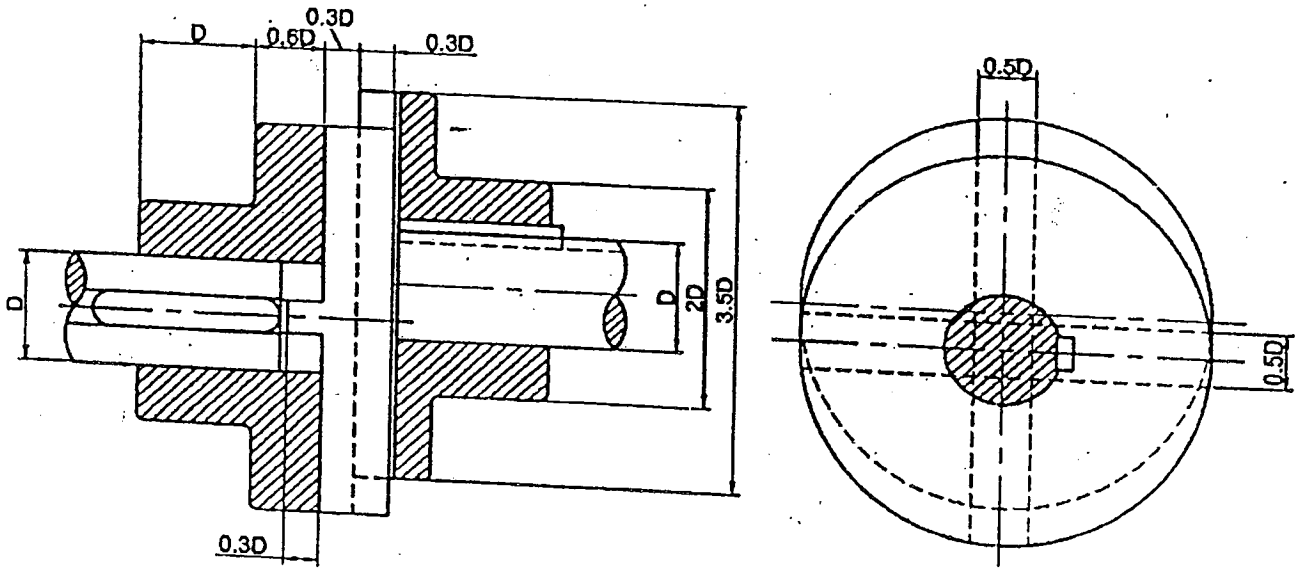


Fig. 8.8 Two views of Oldham's Coupling

8.6 UNIVERSAL COUPLING (HOOK'S COUPLING)

An universal coupling also called as Hook's joint is shown in Fig.8.9 and Fig.8.10 shows exploded view of the join. It is used to connect two shafts, whose axes intersect when extended. The main parts are two forks and a central block made of two arms at right angles to each other to form a cross. Each of the two forks are keyed to the ends of the shafts by taper sunk keys. The forks are pin joined to the central block, permitting inclination between the shafts. The angle between the shafts may vary even when the shafts are rotating. Fig. 8.11 shows two views of the coupling with the general proportions based on the shaft diameter.

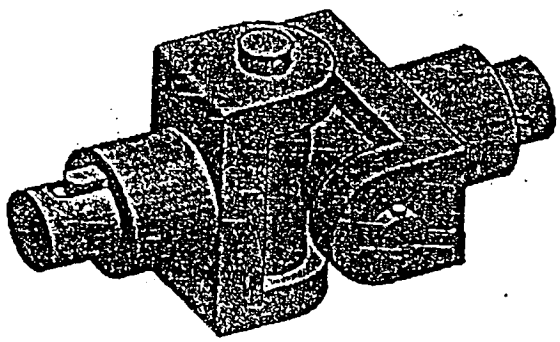


Fig. 8.9 3-D View of Universal Coupling

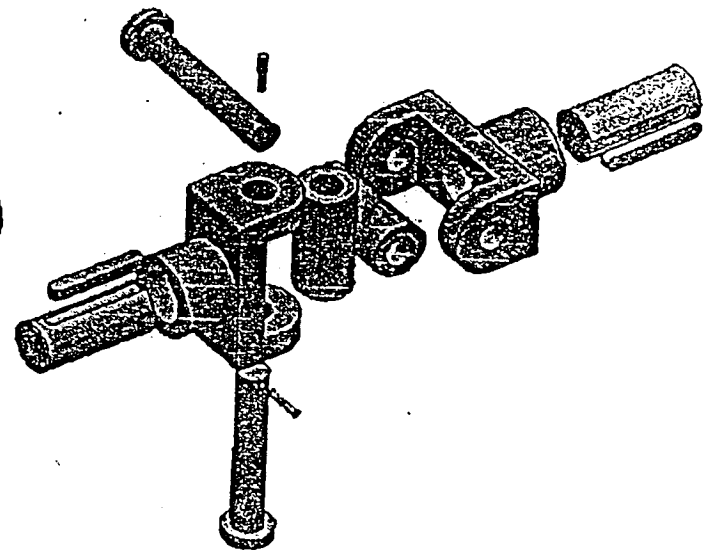


Fig. 8.10 Exploded View of the Universal Coupling

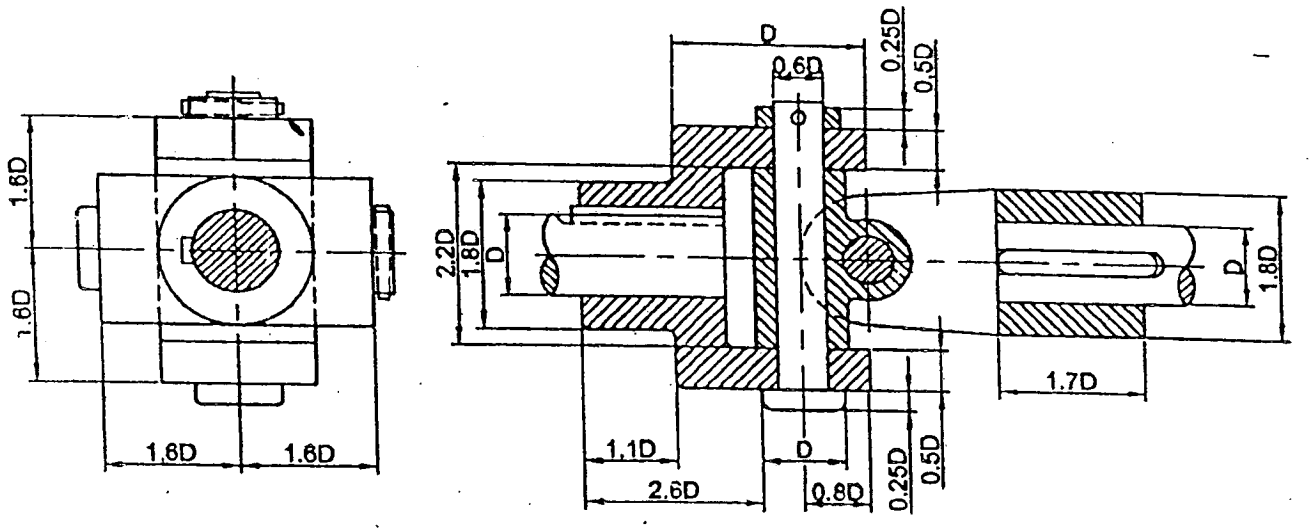


Fig. 8.11 Two Views of Universal Coupling

CHAPTER – 9
ASSEMBLY DRAWINGS

9.1 INTRODUCTION

An assembly drawing shows the assembled product or machine. The assembly drawing can have one, two, three or more views as required. Generally, a full sectional view is used to show how the parts are assembled. Assembled drawings are not dimensioned generally, except for overall dimensions. They do not contain the hidden lines unless they are absolutely necessary to show some important features which otherwise may missed out. Assembly drawings should contain part number and name and total number of parts required to make up the assembly.The following assembly drawings are covered

i. Screw jack ii. Lathe tail stock iii. Plummber block iv. Machine vice

v. Tool head of a shaping machine vi. Petrol engine piston vii. IC engine connecting rod

9.2 SCREW JACK

Figure 9.2 shows the parts of a screw jack. Screw jack is used to lift weights such as an automobile to a small height.It also serves as supporting aid in a raised position.The screw(3) is made of steel and is square threaded and the body(1) is made of cast iron. The nut(2) is made of gun metal for better wear resistance. The nut is placed in the body from the top and is tight fit in it. The cup(4) is placed over the screw such that it sits on the projected portion of the screw. The washer(5) is placed inside the cup and tightened by means of set screw(6). The Tommy bar(7) is inserted from side, in the hole provided on the head of the screw to obtain the mechanical advantage. When the screw spindle is rotated, the load bearing cup moves only up or down along with the screw spindle but will not rotate with it.

Draw the plan and elevation views of the assembly to a suitable scale. The detailed part drawings of screw jack are shown in figure 9.2

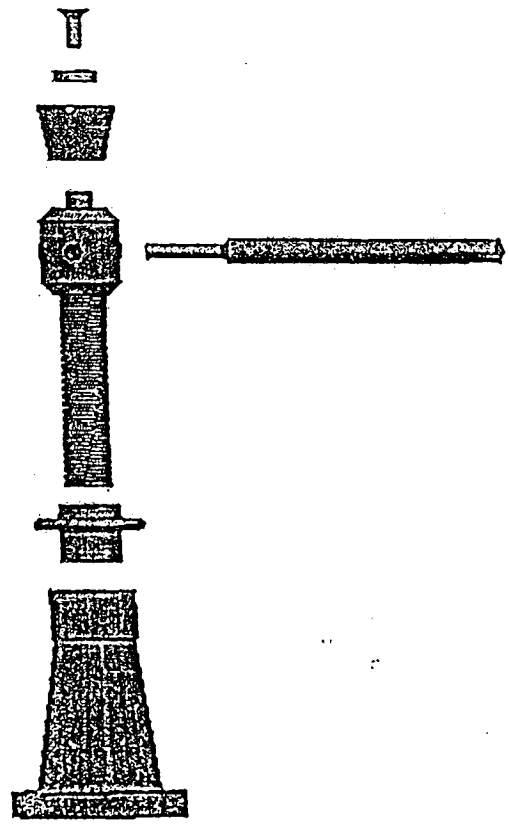
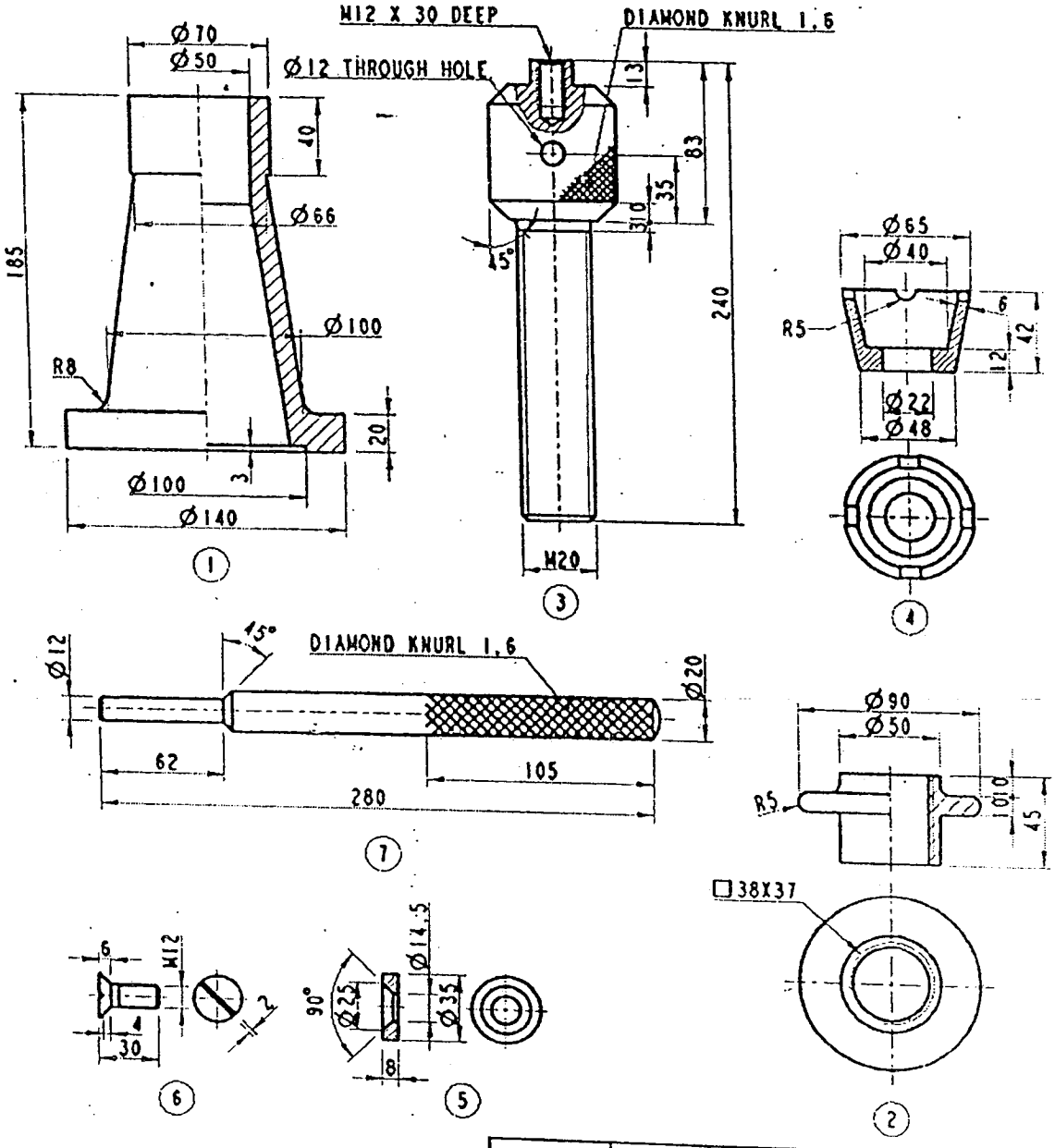


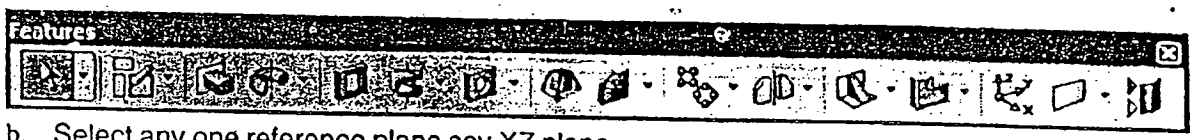
Fig. 9.1 3-D Exploded View of Screw Jack



PART No.	DESCRIPTION	MATL	No. OFF
7	TOMMY BAR	Fe 410W	1
6	CSK SCREW	Fe 410W	1
5	WASHER SPECIAL	Fe 410W	1
4	CUP	CAST STEEL	1
3	SCREW-SPINDLE	Fe 410W	1
2	NUT	GUN METAL	1
1	BODY	CAST IRON	1

Fig. 9.2 Detail of Parts View of Screw Jack

1. Open the **SOFTWARE.** Click on the **SOLID PART** in the create dialog box.
2. To construct body of screw jack.
   a. Select a **REVOLVED PROTRUSION** from **FEATURE TOOL BAR.**



   b. Select any one reference plane say XZ plane.
   c. Once the reference plane is selected, the screen changes to 2D mode.
   d. Using **LINE COMMAND** , **ARC COMMAND** and **FILLET COMMAND** draw the part. Choose the axis from **AXIS OF REVOLUTION COMMAND** .
   e. Click on **RETURN** it will return to 3D mode (part).
   f. Specify the rotation angle as 360° to get the body of the screw jack as shown in fig. 9.3.
   g. Save the part by giving the file name as BODY.

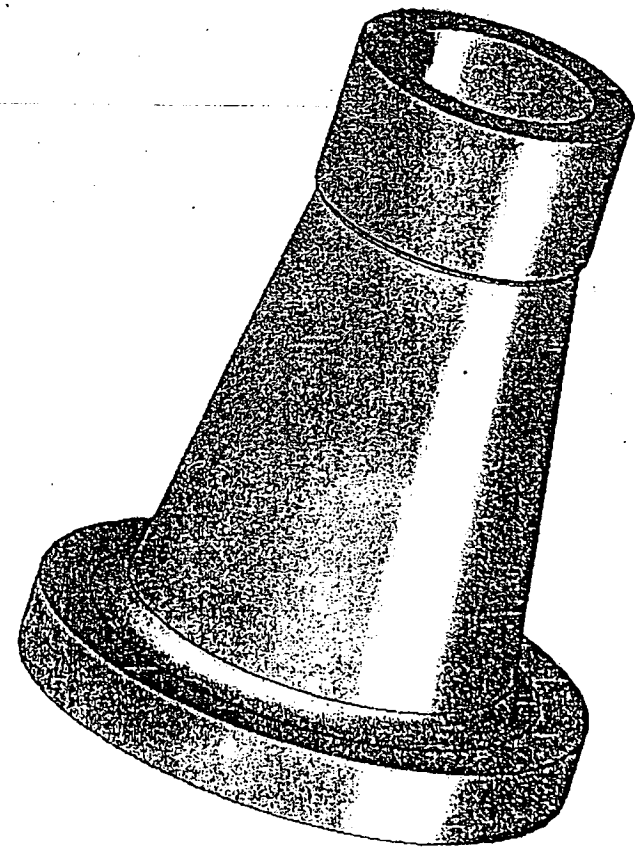
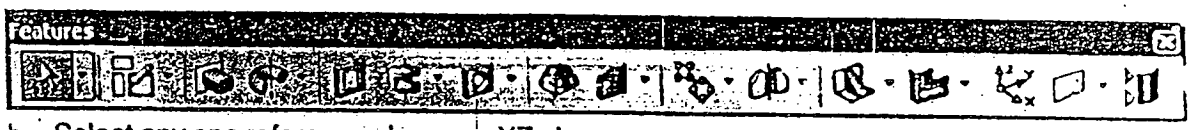


Fig. 9.3 3-D View of Body

3. To construct Nut of screw jack.

   a. Select a **REVOLVED PROTRUSION** from **FEATURE TOOL BAR.**



   b. Select any one reference plane say XZ plane.
   c. Once the reference plane is selected, the screen changes to 2D mode.
   d. Using **LINE COMMAND** , **ARC COMMAND** and **FILLET COMMAND** draw the part. Choose the axis from **AXIS OF REVOLUTION COMMAND** .
   e. Click on return it will return to 3D mode (part).
   f. Specify the rotation angle as 360° to get the nut of the screw jack as shown in Fig. 9.4.
   g. Save the part by giving the file name as NUT.

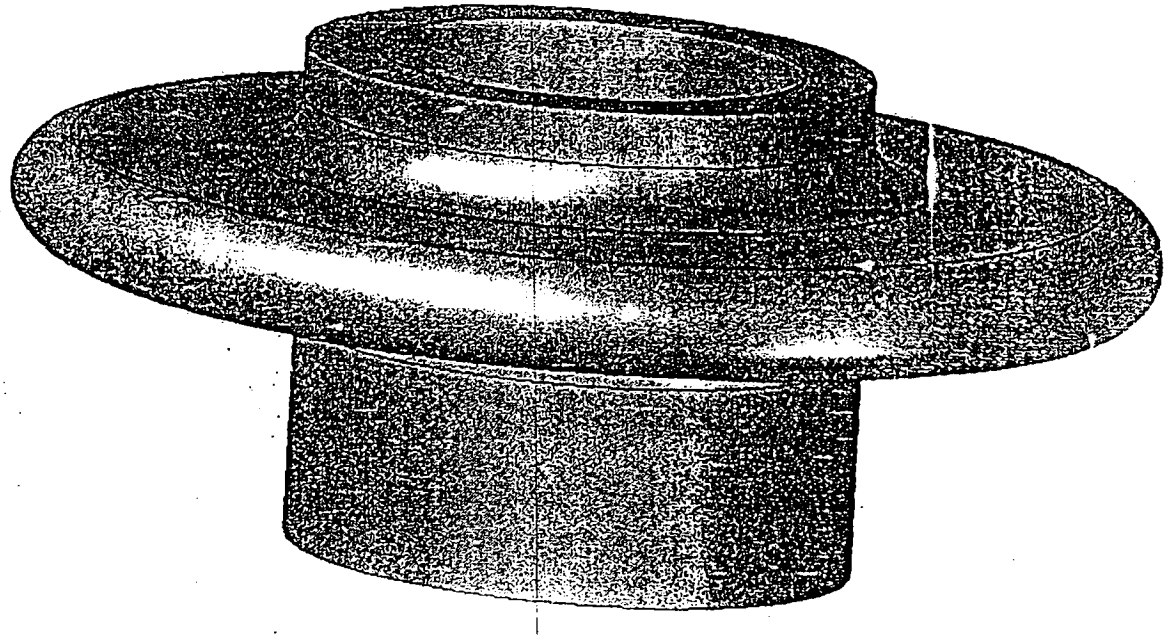
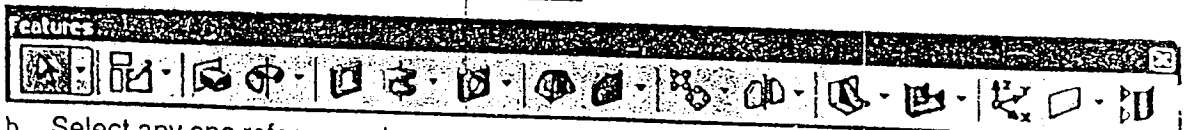


Fig. 9.4 3-D View of Nut

4. To construct SCREW SPINDLE of screw jack.

   a. Select a **REVOLVED PROTRUSION** from **FEATURE TOOL BAR.**



   b. Select any one reference plane say XZ plane.
   c. Once the reference plane is selected, the screen changes to 2D mode.
   d. Using **LINE COMMAND** draw the part. Choose the axis from **AXIS OF REVOLUTION**

COMMAND  .

e. Click on return it will return to 3D mode (part).
f. Specify the rotation angle as 360° to get the screw spindle of the screw jack.
g. Using HOLE COMMAND  and hole option the through hole is made.
h. Using THREAD COMMAND  and thread option the thread is made.
i. Save the part by giving the file name as SCREW SPINDLE.

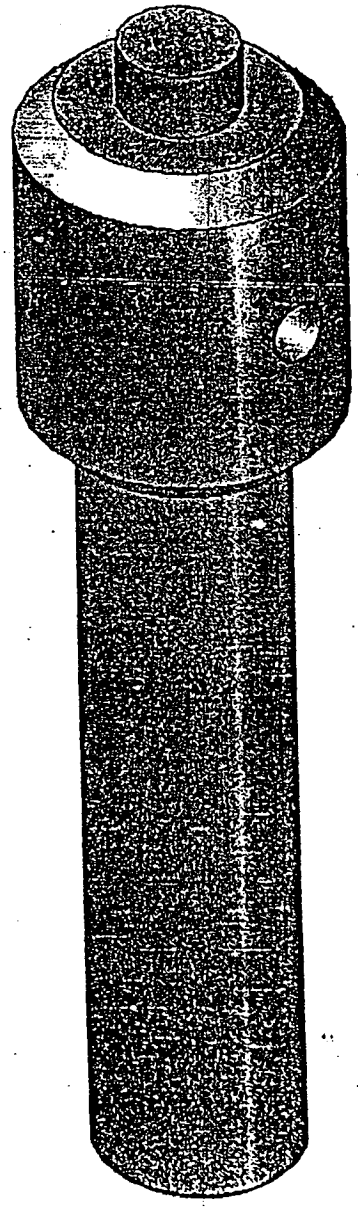
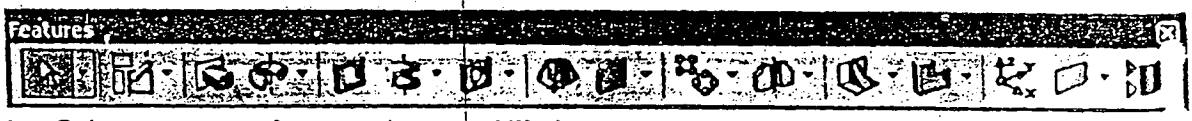


Fig. 9.5 3-D View of Screw Spindle

5. To construct CUP of screw jack.

a. Select a **REVOLVED PROTRUSION** from **FEATURE TOOL BAR.**



b. Select any one reference plane say XZ plane.
c. Once the reference plane is selected, the screen changes to 2D mode.
d. Using **LINE COMMAND** and **ARC COMMAND** draw the part. Choose the axis from **AXIS OF REVOLUTION COMMAND**.
e. Click on return it will return to 3D mode (part).
f. Specify the rotation angle as 360° to get the cup of the screw jack.
g. Using **CUTOUT COMMAND** and **ARC COMMAND** complete the cup as shown in Fig. 9.6.
h. Save the part by giving the file name as CUP.

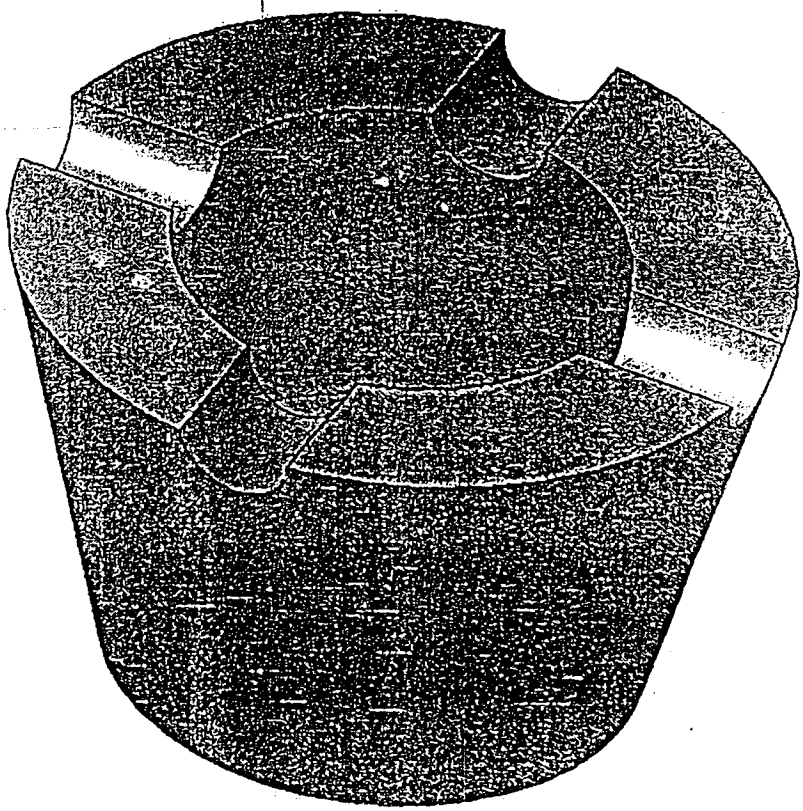
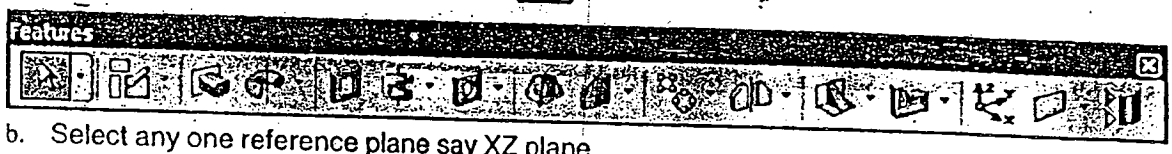


Fig. 9.6 3-D View of Cup

6. To construct WASHER SPECIAL of screw jack.

   a. Select a **REVOLVED PROTRUSION** from **FEATURE TOOL BAR.**



   b. Select any one reference plane say XZ plane.
   c. Once the reference plane is selected, the screen changes to 2D mode.
   d. Using **LINE COMMAND** draw the part. Choose the axis from **AXIS OF REVOLUTION COMMAND**.
   e. Click on return it will return to 3D mode (part).
   f. Specify the rotation angle as 360° to get the washer special of the screw jack as shown in Fig. 9.7.
   g. Save the part by giving the file name as WASHER SPECIAL.

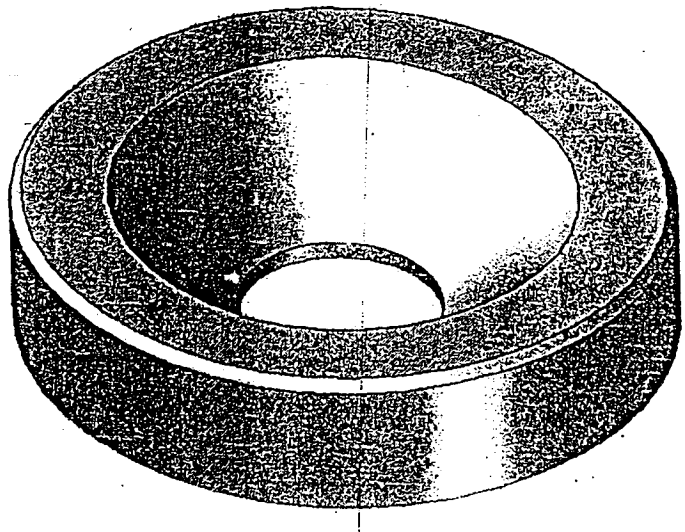
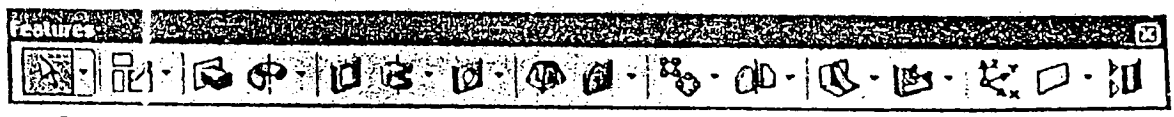


Fig. 9.7 3-D View of Special Washer

7. To construct CSK SCREW of screw jack.

   a. Select a **REVOLVED PROTRUSION** from **FEATURE TOOL BAR.**



   b. Select any one reference plane say XZ plane.
   c. Once the reference plane is selected, the screen changes to 2D mode.
   d. Using **LINE COMMAND** draw the part. Choose the axis from **AXIS OF REVOLUTION**

COMMAND  .

e. Click on return it will return to 3D mode (part).
f. Specify the rotation angle as 360° to get the csk screw of the screw jack.
g. Using **THREAD COMMAND**  and thread option complete the csk screw as shown in Fig. 9.8.
h. Save the part by giving the file name as CSK SCREW.

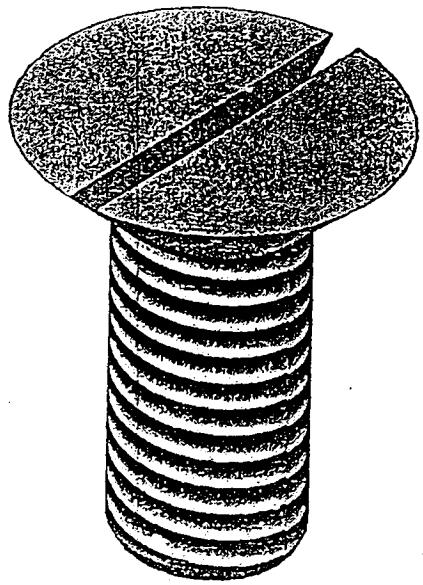
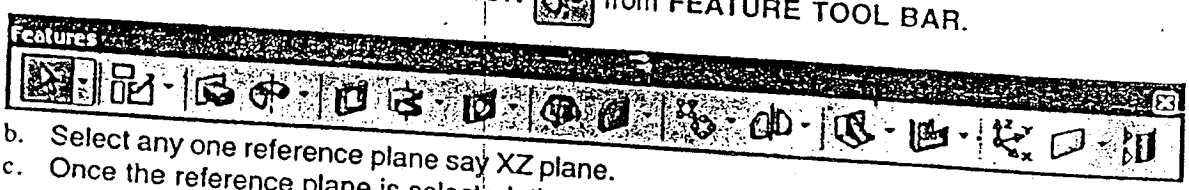


Fig. 9.8 3-D View of Screw

8. To construct TOMMY BAR of screw jack.
   a. Select a **REVOLVED PROTRUSION**  from **FEATURE TOOL BAR.**



   b. Select any one reference plane say XZ plane.
   c. Once the reference plane is selected, the screen change to 2D mode.
   d. Using **LINE COMMAND**  and **ARC COMMAND**  draw the part. Choose the axis from **AXIS OF REVOLUTION COMMAND**  .
   e. Click on return it will return to 3D mode (part).
   f. Specify the rotation angle as 360° to get the tommy bar of the screw jack as shown in Fig.9.9.
   g. Save the part by giving the file name as TOMMY BAR.

0

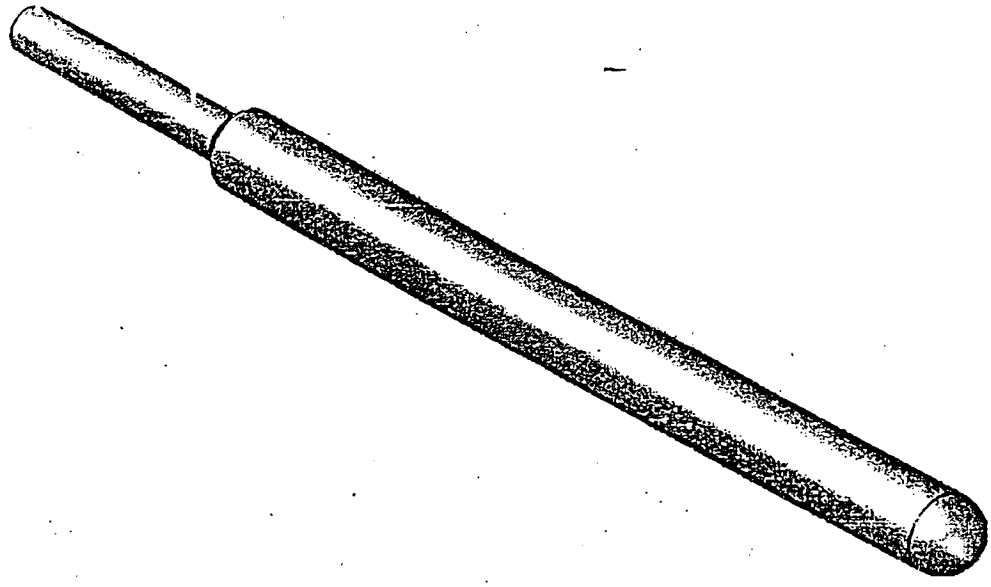


Fig. 9.9 3-D View of Tommy Bar

9. To Assemble: open the SOFTWARE click on the ASSEMBLY planes in the create dialog box.
10. Select the edge bar to view the part files which are saved.
11. As per the assembly procedure starting from body to tommy bar, drag and drop the part one by one as given below.
    a. First drag and drop the BODY part file from the parts library to assembly mode.
    b. Drag and drop the NUT part file from the parts library to assembly mode and select ASSEMBLE COMMAND. From ribbon bar, pick AXIAL ALIGN COMMAND from the relationship types. Select nut and body to assemble.
    c. Drag and drop the SCREW SPINDLE part file from the parts library to assembly mode and select ASSEMBLE COMMAND. From ribbon bar, pick AXIAL ALIGN COMMAND from the relationship types. Select screw spindle and nut to assemble.
    d. Drag and drop the CUP part file from the parts library to assembly mode and select ASSEMBLE COMMAND. From ribbon bar, pick AXIAL ALIGN COMMAND from the relationship types. Select cup and screw spindle to assemble.
    e. Drag and drop the WASHER SPECIAL part file from the parts library to assembly mode and select ASSEMBLE COMMAND. From ribbon bar, pick AXIAL ALIGN COMMAND and CONNECT COMMAND from the relationship types. Select cup and washer spe-

cial to assemble.

f. Drag and drop the CSK SCREW part file from the parts library to assembly mode and select ASSEMBLE COMMAND. From ribbon bar, pick AXIAL ALIGN COMMAND and INSERT COMMAND from the relationship types. Select csk screw and cup to assemble.

g. Drag and drop the TOMMY BAR part file from the parts library to assembly mode and select ASSEMBLE COMMAND. From ribbon bar, pick AXIAL ALIGN COMMAND and INSERT COMMAND from the relationship types. Select nut and body to assemble.

12. Save the assembly by giving the file name as SCREW JACK.

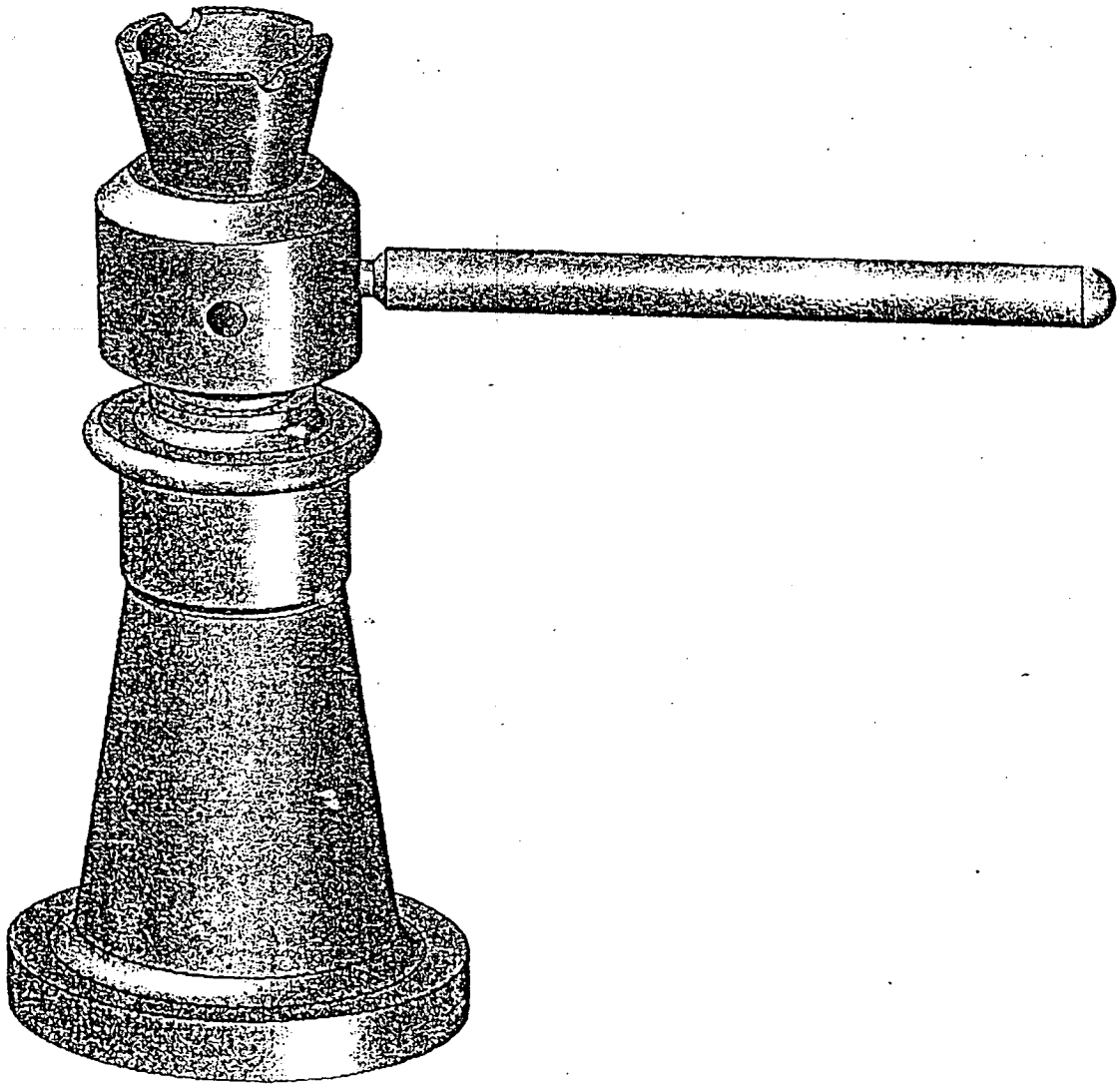


Fig. 9.10 3-D Assembled View of Screw Jack

13. To get exploded view of screw jack:

a. Select applications from the main tool bar.
b. Select exploded view, it changes to exploded view environment.
c. From **EXPLODED VIEW BAR** select **AUTOMATIC EXPLODE COMMAND** to get the exploded view of screw jack as shown in Fig. 9.11.
d. Select return, to enter into the assembly mode.

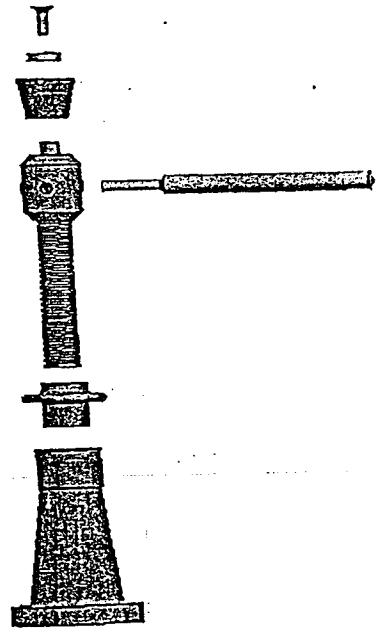


Fig. 9.11 3-D Exploded View of Screw Jack

14. .To get orthographic view of screw jack:
a. Select file SCREWJACK from the main tool bar, pick create drawing
b. Create drawing window appears, select OK.
c. From **ASSEMBLY** mode it changes to **DRAFT** mode and drawing view creation wizard window will appear. Select Next.
d. Select front from the named views and click next and finish. Front view will be generated.
e. From **DRAWING VIEWS TOOL BAR** select **PRINCIPAL VIEW COMMAND** select front view which is generated and move the cursor down to get top view and move the cursor to left or right to the respective side views.
f. Using **SMART DIMENSION COMMAND** dimension the orthographic views
g. Select **PART LIST COMMAND** from the **DRAWING VIEWS TOOL BAR** to get the parts list.
g. Save the file as SCREWJACK.

Solution :

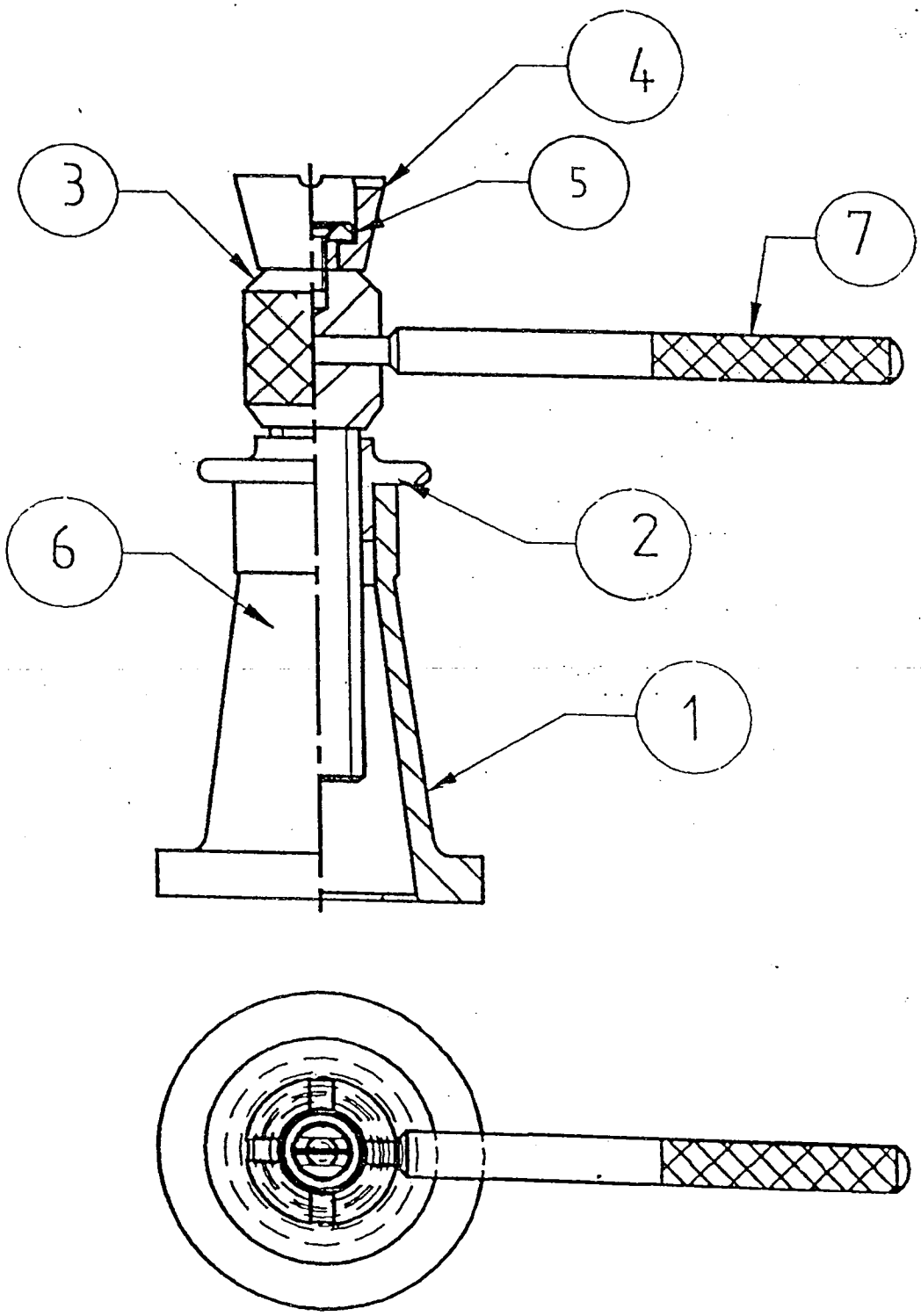


Fig. 9.12 Orthographic Views of Screw Jack

9.2 LATHE TAIL STOCK

The tail stock is mounted on the bed ways opposite to the headstock to support the workpieces or tools such as drills, remears, etc. It can be clamped anywhere on the lathe bed.

The exploded view tail stock shown in Fig. 9.13 consists of body(1) which has a through horizontal bore and four rectangular blocks at its bottom which project into the trough formed between the bedways of the lathe. A feather(2) is fitted in the hole in the front end of the bore such that its rectangular head projects into the bore. the barrel (3) fitted with the center (19) at its front end is insereted into the bore such that the projecting head of the feather passes through the logitudinal groove of the corresponding cut in the periphery of the barrel. The screw spindle (4) is screwed into the barrel. The flat face of the flange (5) is secrured to the end of the bore by screws(6). The hand wheel (8) is keyed to the screw spindle by tightening a nut with a washer. The rotation of the screw spindle impartsaxial motion for the barrel as it is constrained by the feather.

The barrel can be arrested in any position by the handle. The tailstock can be clamped on the bed in any position by the clamping arrangement consisting of a clamping plate(15) a square headed bolt(16) and nut.

Details of a lathe tail stock are shown in Fig. 9.14. Assemble the parts of the tailstock and draw the

a. Sectional front view.

b. Left side view.

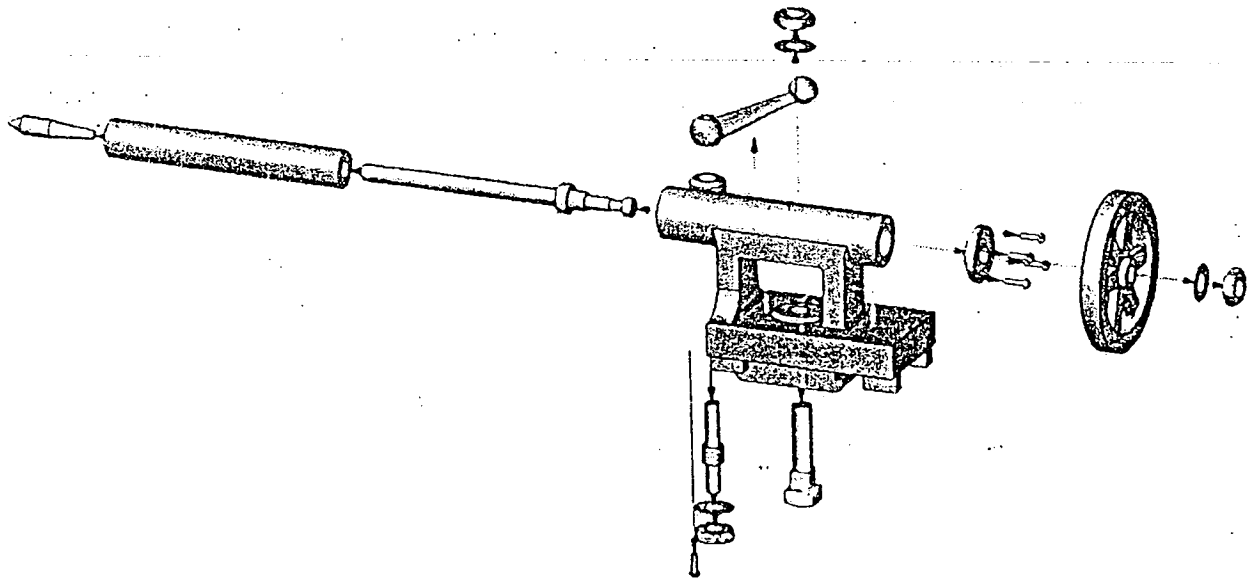


Fig. 9.13 3D Exploded View of Tailstock

The assembled drawing is shown in Fig. 9.15. The sectional front view and top view is shown in Fig. 9.16.

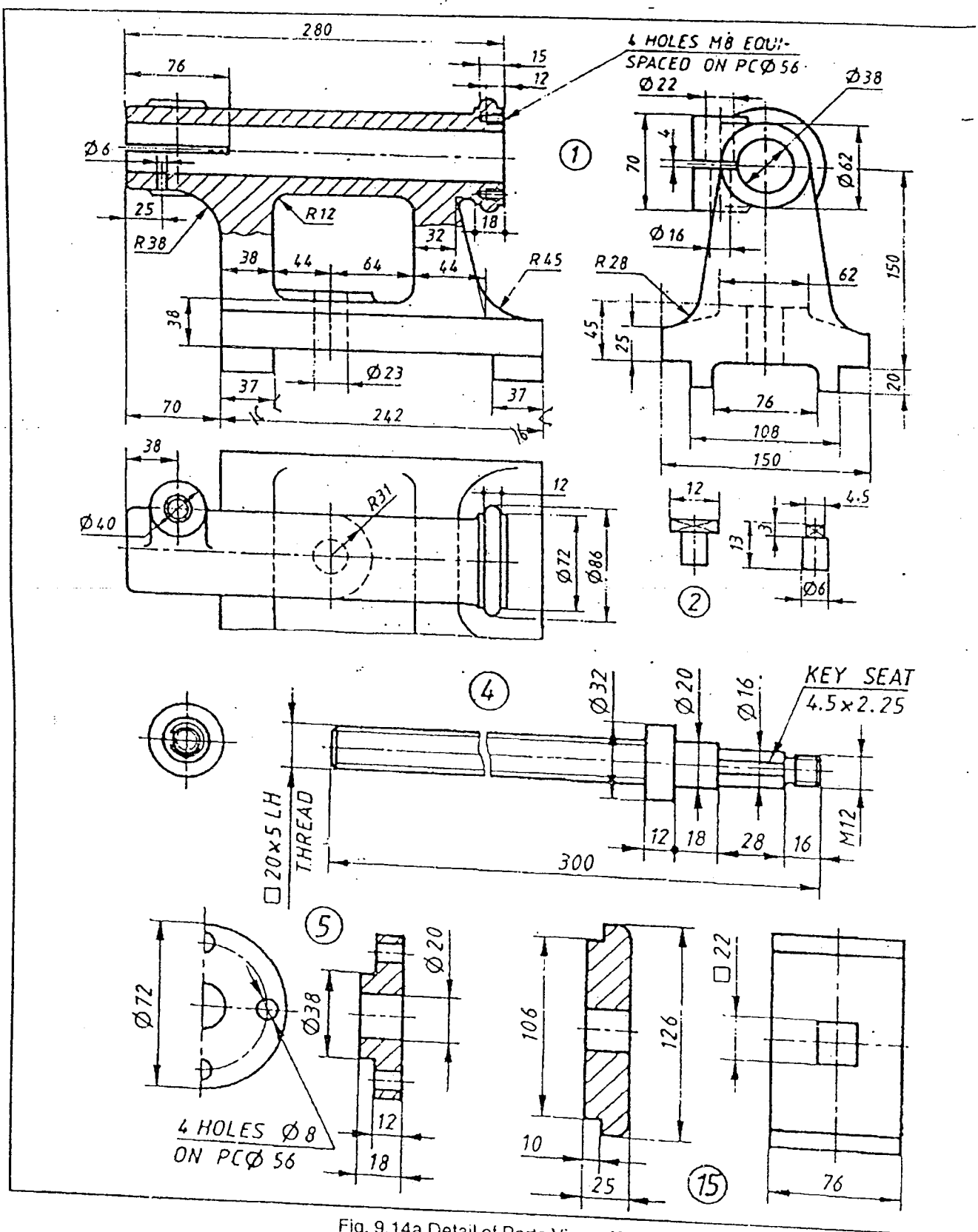
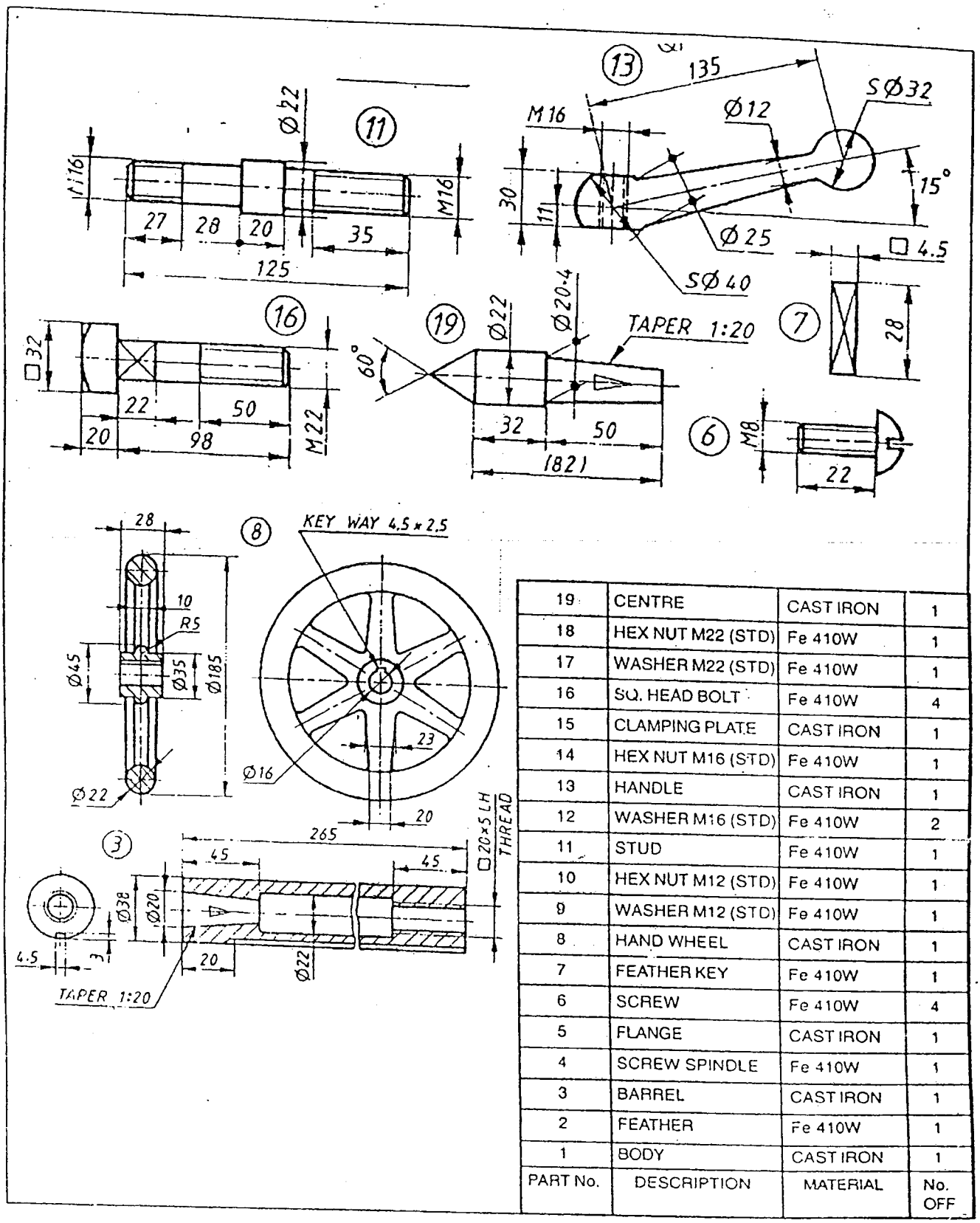


Fig. 9.14a Detail of Parts View of Tailstock



PART No.	DESCRIPTION	MATERIAL	No. OFF
19	CENTRE	CAST IRON	1
18	HEX NUT M22 (STD)	Fe 410W	1
17	WASHER M22 (STD)	Fe 410W	1
16	SQ. HEAD BOLT	Fe 410W	4
15	CLAMPING PLATE	CAST IRON	1
14	HEX NUT M16 (STD)	Fe 410W	1
13	HANDLE	CAST IRON	1
12	WASHER M16 (STD)	Fe 410W	2
11	STUD	Fe 410W	1
10	HEX NUT M12 (STD)	Fe 410W	1
9	WASHER M12 (STD)	Fe 410W	1
8	HAND WHEEL	CAST IRON	1
7	FEATHER KEY	Fe 410W	1
6	SCREW	Fe 410W	4
5	FLANGE	CAST IRON	1
4	SCREW SPINDLE	Fe 410W	1
3	BARREL	CAST IRON	1
2	FEATHER	Fe 410W	1
1	BODY	CAST IRON	1

Fig. 9.14b Detail Parts view of Tailstock

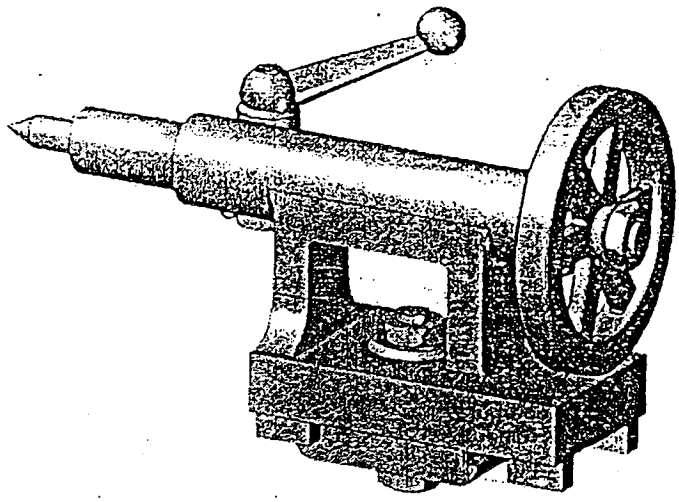


Fig. 9.15 3-D Assembled View of Tailstock

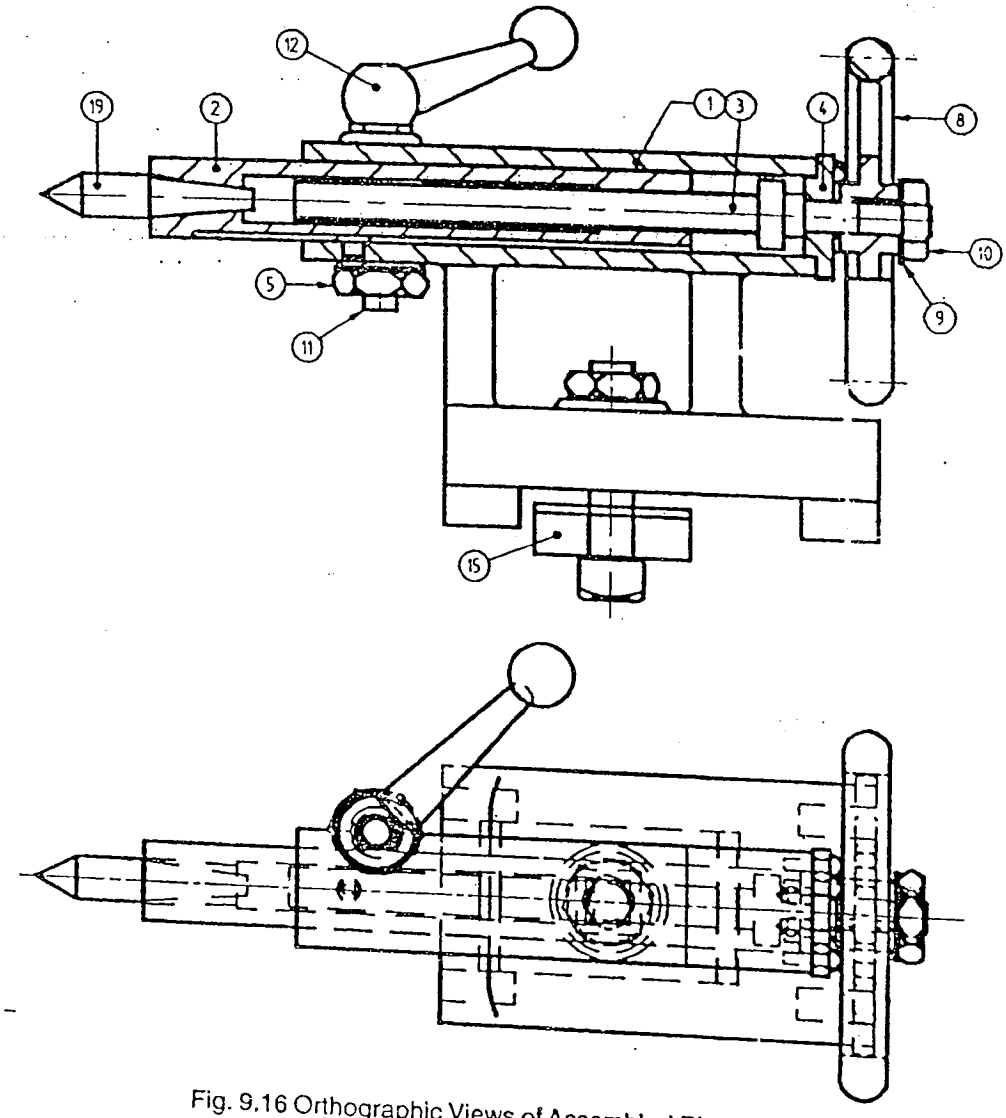


Fig. 9.16 Orthographic Views of Assembled Plummer Block

9.4 PLUMMER BLOCK (PEDASTAL BEARING)

Fig. 9.17 shows the exploded view of a plummer block. It is used to support long rotating shafts at intermediate points. It consists of a cast iron block having the base(1), bushes(3 and 4) in two halves, a cast iron cap(2) and two mild steel bolts(5). This Plummer block is made in two halves to facilitate

i. Placing and removal of the shaft in and from the bearings. ii. Adjustment for wear in the bushes and.

iii. Replacement of brasses.

The cap(2) while resting on the upper step, fits inside the block at its side but does not sit on it. The brasses(3 and 4) are prevented from moving along the length of the shaft by the two collars at the sides. A snug at the bottom, fitting inside a corresponding hole in the block, prevents their rotation. The cap and the block are fastened together by two square headed bolts(5 and 6). The square heads fit in square recesses at the bottom of the pedestal and prevents rotation of the bolts.

Figure 9.18 shows the details of the parts of a Plummer block. Fig. 9.19 shows assemble and Fig. 9.20 shows front view and top view of plummer block.

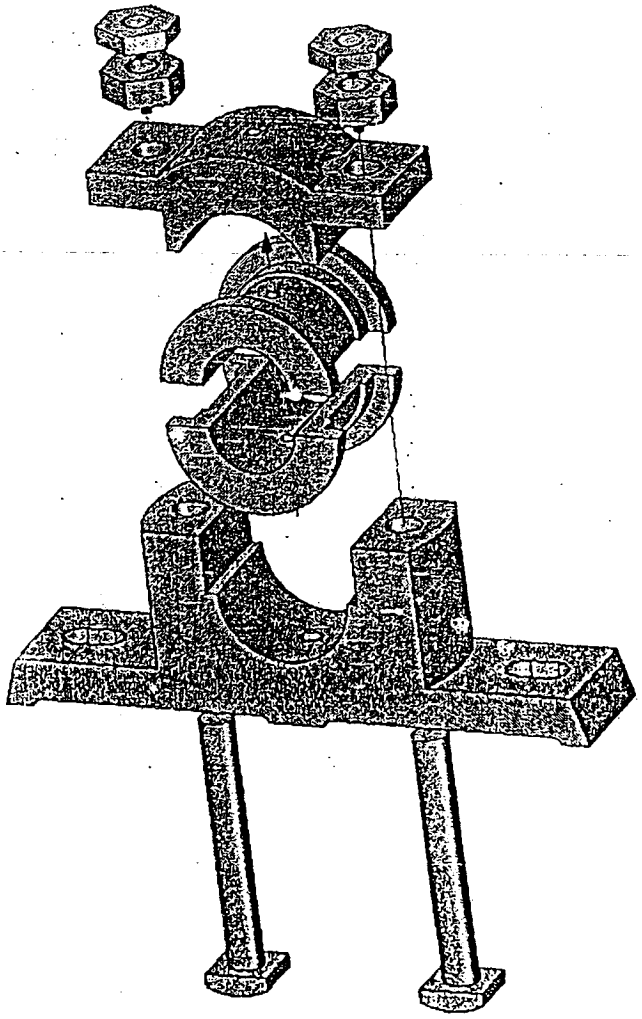
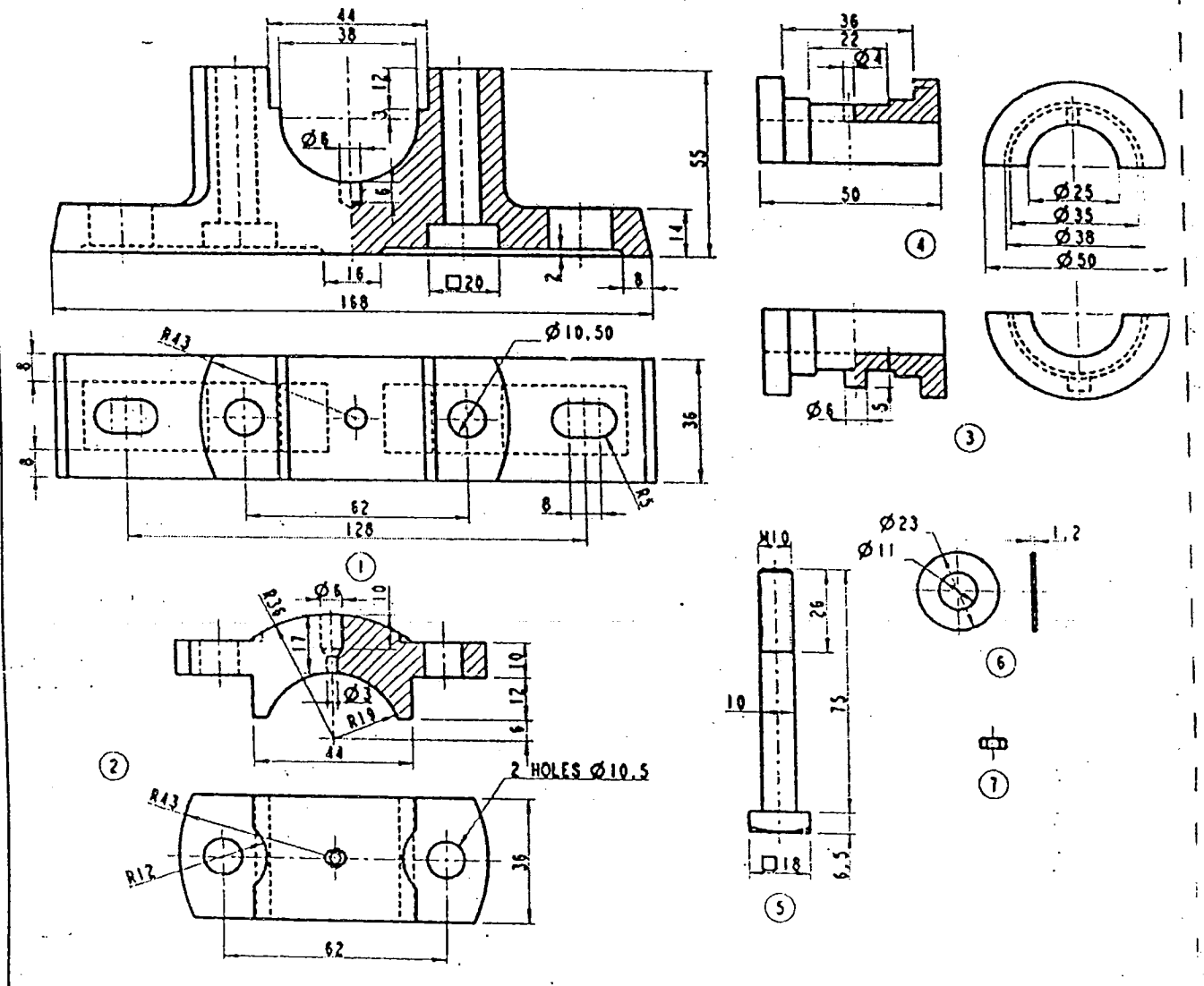


Fig. 9.17 3-D Exploded View of Plummer Block



PART No.	DESCRIPTION	MATERIAL	No. OFF
7	LOCK NUT M10	Fe 410W	1
6	NUT M10	Fe 410W	4
5	BOLT M10	CAST IRON	1
4	BEARING TOP	Fe 410W	1
3	BEARING BOTTOM	CAST IRON	1
2	CAP	Fe 410W	1
1	BODY	CAST IRON	1

Fig. 9.18 Detail of Parts View of Plummer Block

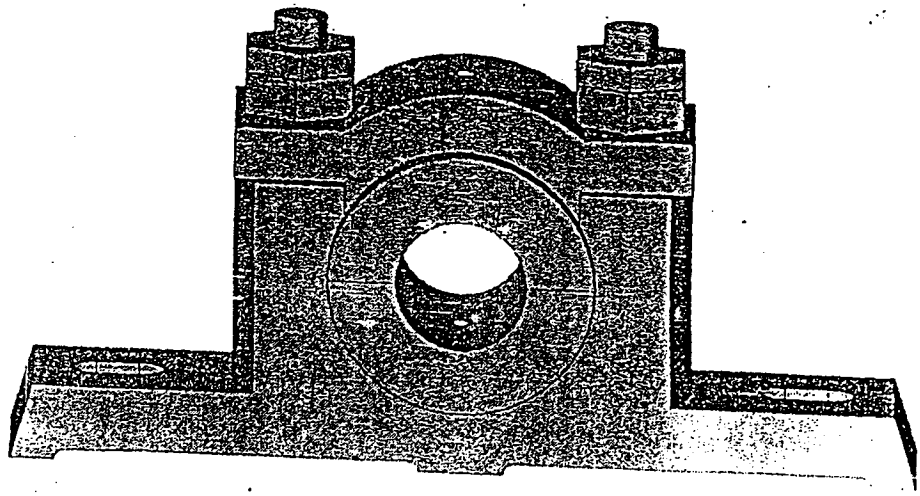


Fig. 9.19 3-D Assembled View of Plummer Block

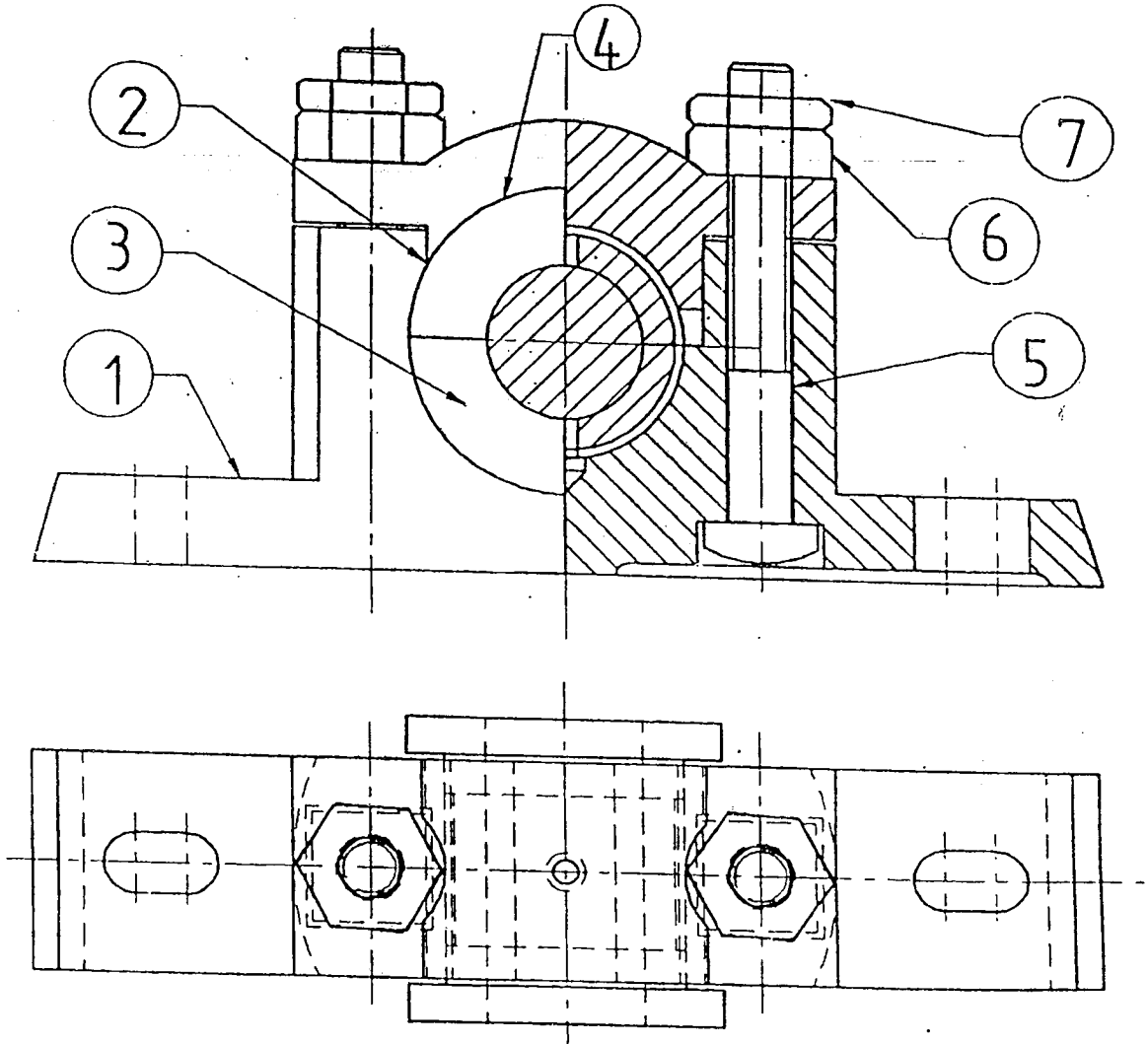


Fig. 9.20 Orthographic Views of Plummer Block

9.5 MACHINE VICE .

A machine vice is used for holding or gripping the workpieces firmly while working. Machine vices are fixed to the work tables of planing, shaping, drilling machines, etc. Fig. 9.21 shows 3-D exploded view of a Machine Vice

The fixed jaw (1) is an integral part of the body. The movable jaw (2) is mounted on guideways of the body and secured to it by a clamping plate (9) by two screws (4). A screw (5) passes through the threaded hole in the movable jaw which moves over the bed ways when the screw is rotated. Two jaw grips (3) are fixed one on each of the jaws by screws (4).

The part details of machine vice are shown in Fig. 9.22. Assembly is shown in Fig. 9.23. Fig. 9.24 shows the sectional front view and top view.

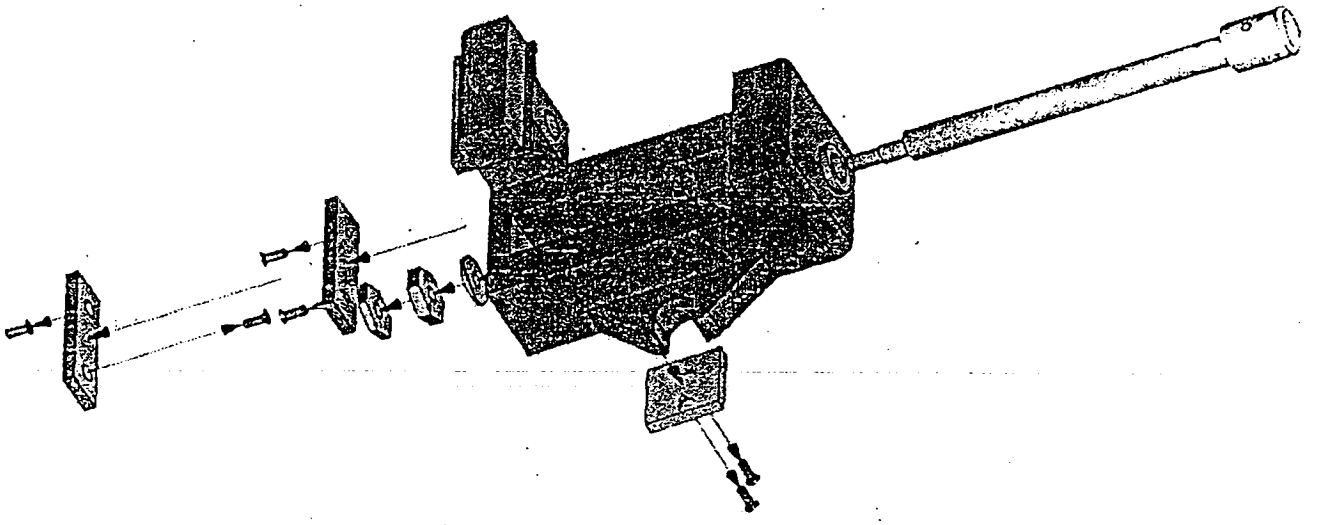
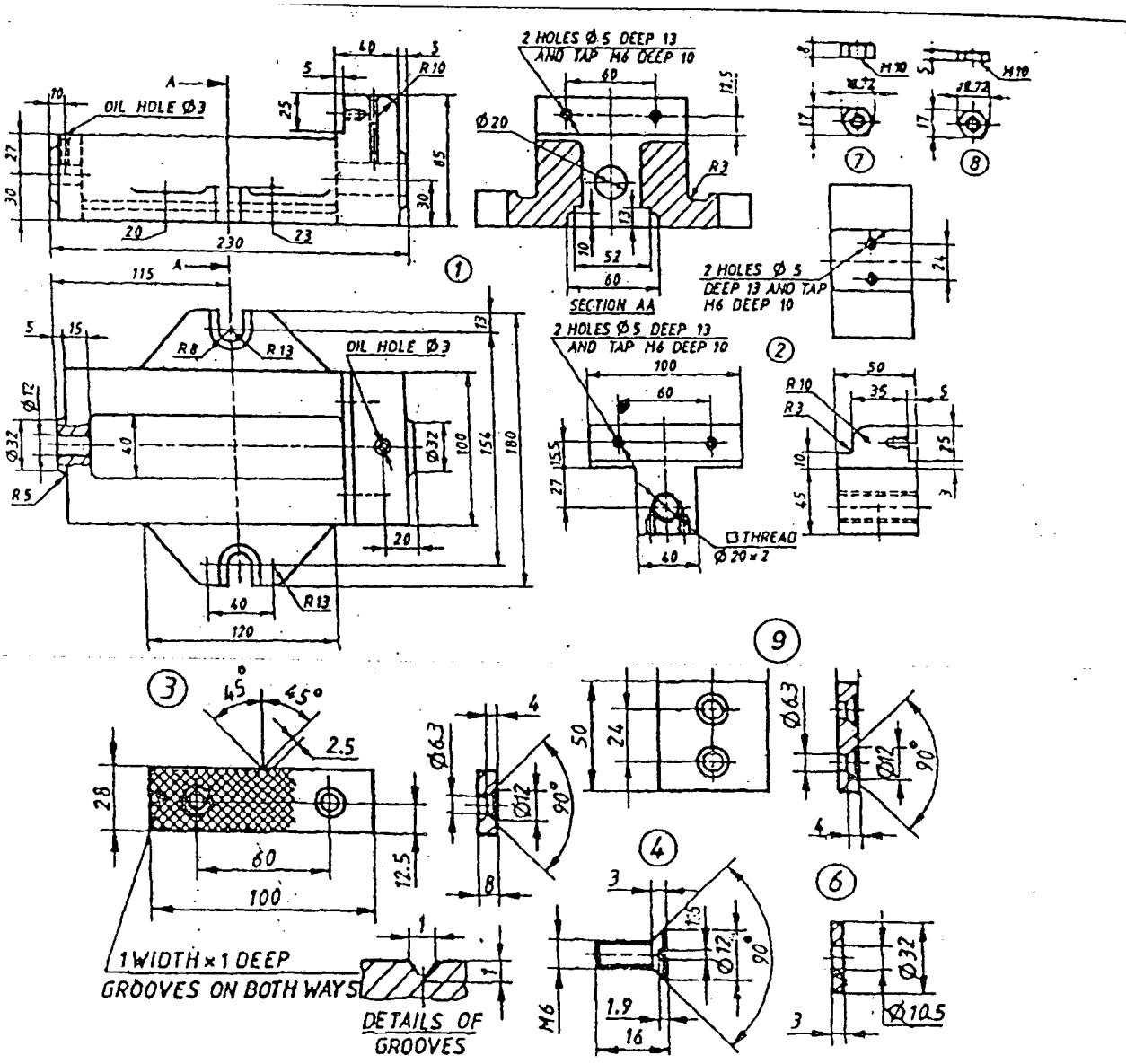


Fig. 9.21 3-D Exploded View of Machine Vice



PART No.	DESCRIPTION	MATERIAL	No. OFF
9	CLAMPING PLATE	Fe 410W	1
8	LOCK NUT	Fe 410W	1
7	NUT	Fe 410W	1
6	WASHER	Fe 410W	4
5	SCREW ROD	Fe 410W	1
4	SCREW M 6	Fe 410W	6
3	JAW GRIP	CAST STEEL	2
2	MOVABLE JAW	CAST IRON	1
1	BODY	CAST IRON	1

Fig. 9.22 Detail Parts View of Machine Vice

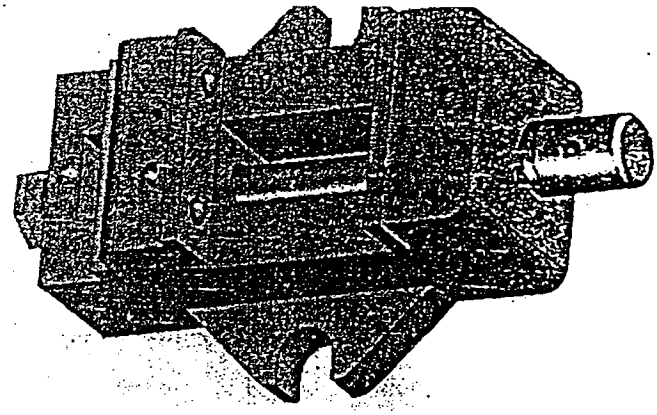
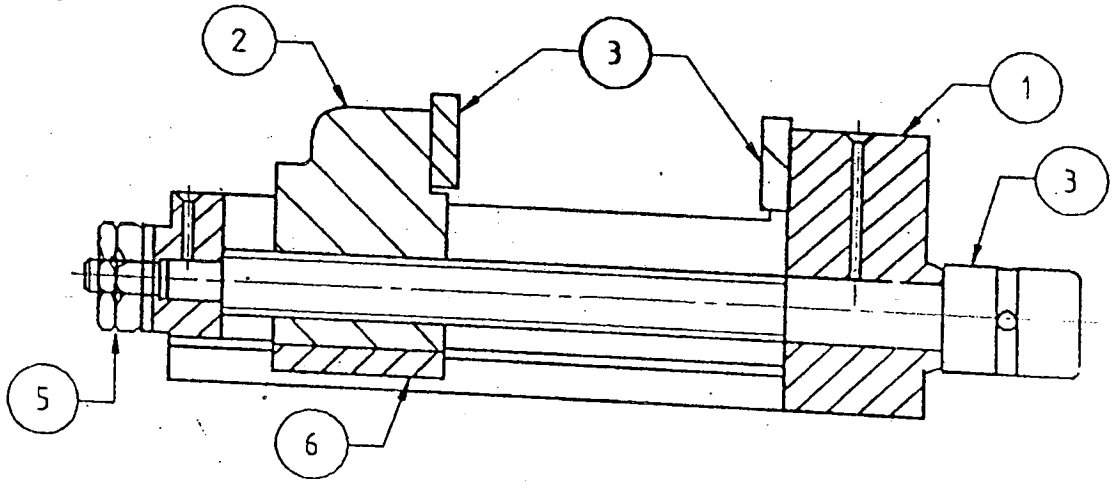


Fig. 9.23 3-D Assembled View of Machine Vice

Solution :



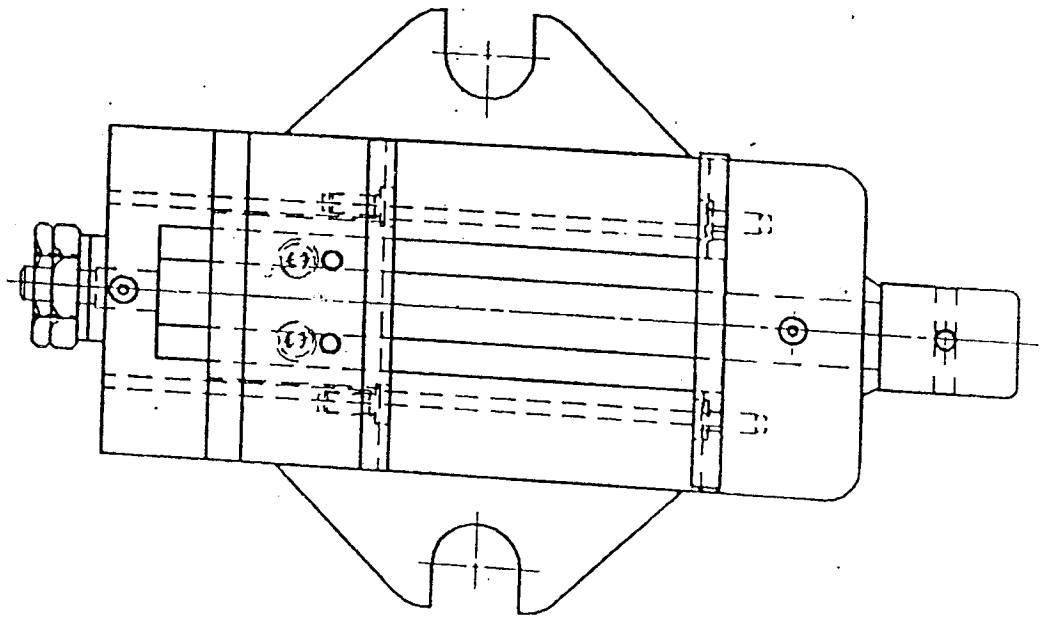


Fig. 9.24 Orthographic Views of Machine Vice

9.6 TOOL HEAD OF SHAPING MACHINE

The tool head of a shaping machine comprises of the tool holdig and the feeding devices with additional arrangements to set them inclined to the vertical. Fig. 9.25 shows the exploded view.

The clapper block is used for holding the shaper cutting toll. It rellieves the tool during the return stroke. The clapper block consists of a swivel plate(1) attached to the vertical slide of the toool head. The drag release plate(2) relieves the tool during the return stroke. The drag release plate carries the tool holder(4) and the toool is fixed in it by means of the tool clamping screw(5). The washer (6) is used over the drag release plate for providing even bering surface to the tool.

The shaper tool head slide consists of the lack plate (2) which is attached to the front face of the reciprocating ram of the shaper. The vertical slide (1) is fitted to the back plate through the guide ways and it is positioned on the screw(3) by means of sleeve (5) and handle(4). When the screw is operated, the vertical slide moves along with the screw. By rotating back plate about the horizantal axis the slide can be made to traverse at any desired angle to the vertical, shaping inclined surfaces. The swivel plate is pivoted to the slide by the seivel pin(6) and clamped at the desired postion by the clamping screw (7).

The details of the clapper block and the shaper tool head slide are shown in Fig. 9.26a and 9.26b, and bill of material are shown in fig. 9.27.

The assembly is shown in Fig. 9.28 and Fig. 9.19 shows sectional front view and top view.

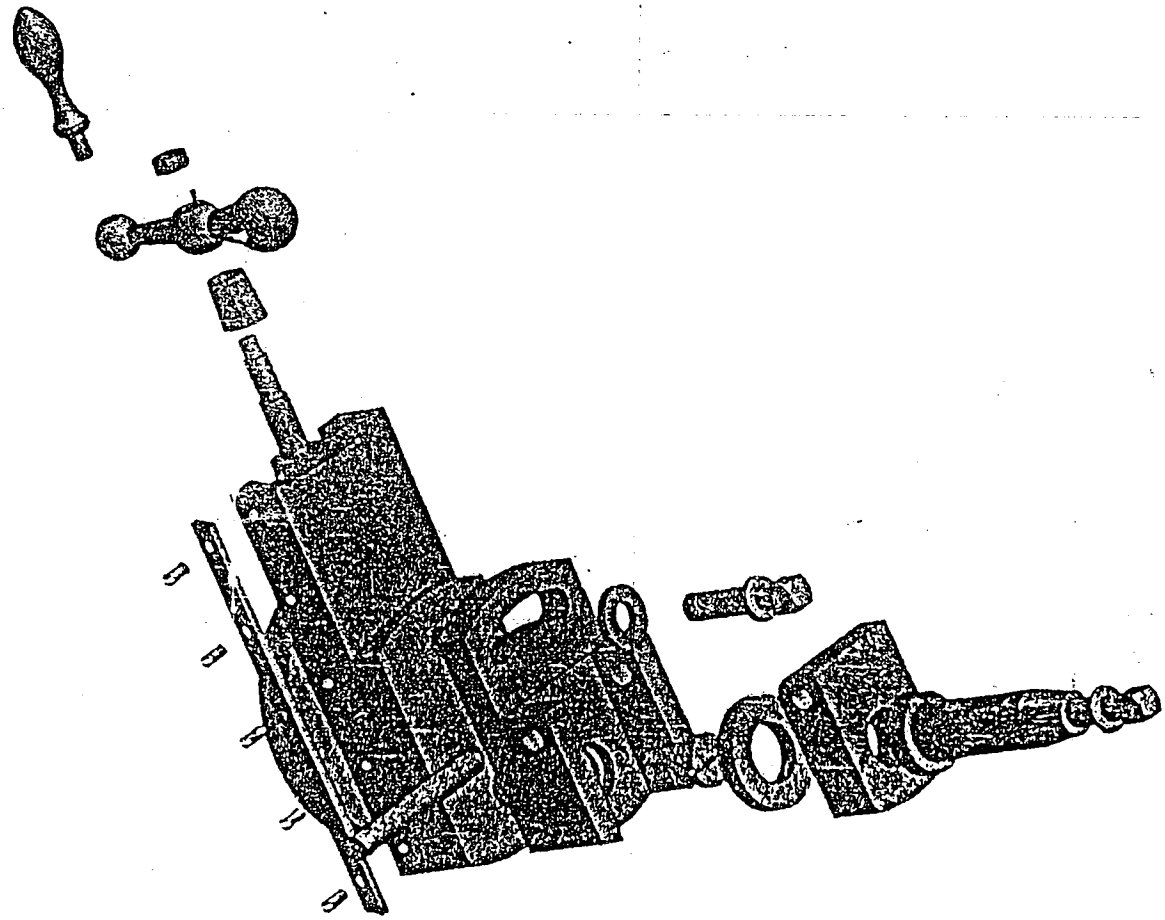


Fig. 9.25 3-D Exploded View of a Tool Head of Shaping Machine

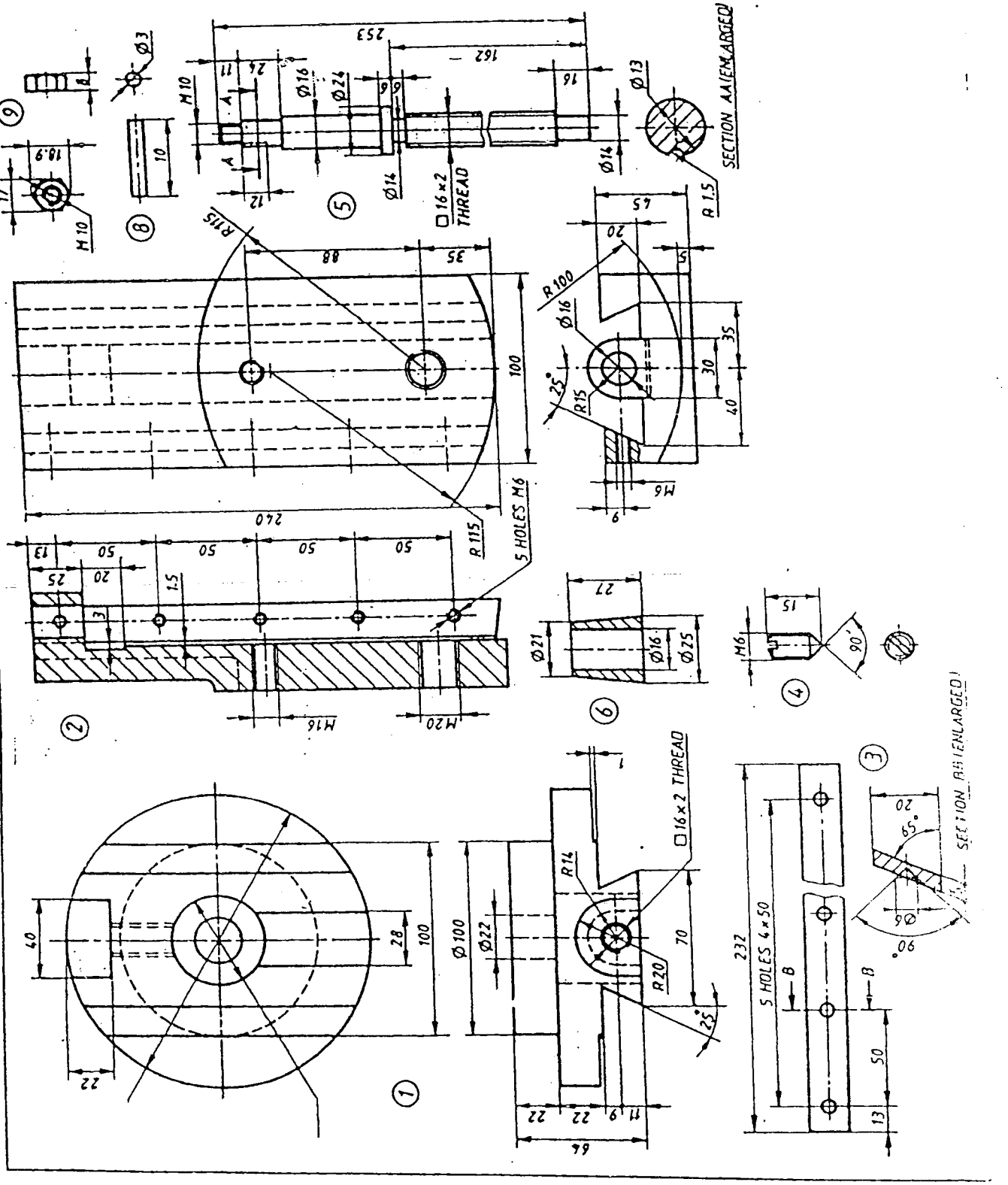


Fig. 9.26a Detail Parts Tool Head of Shaping Machine

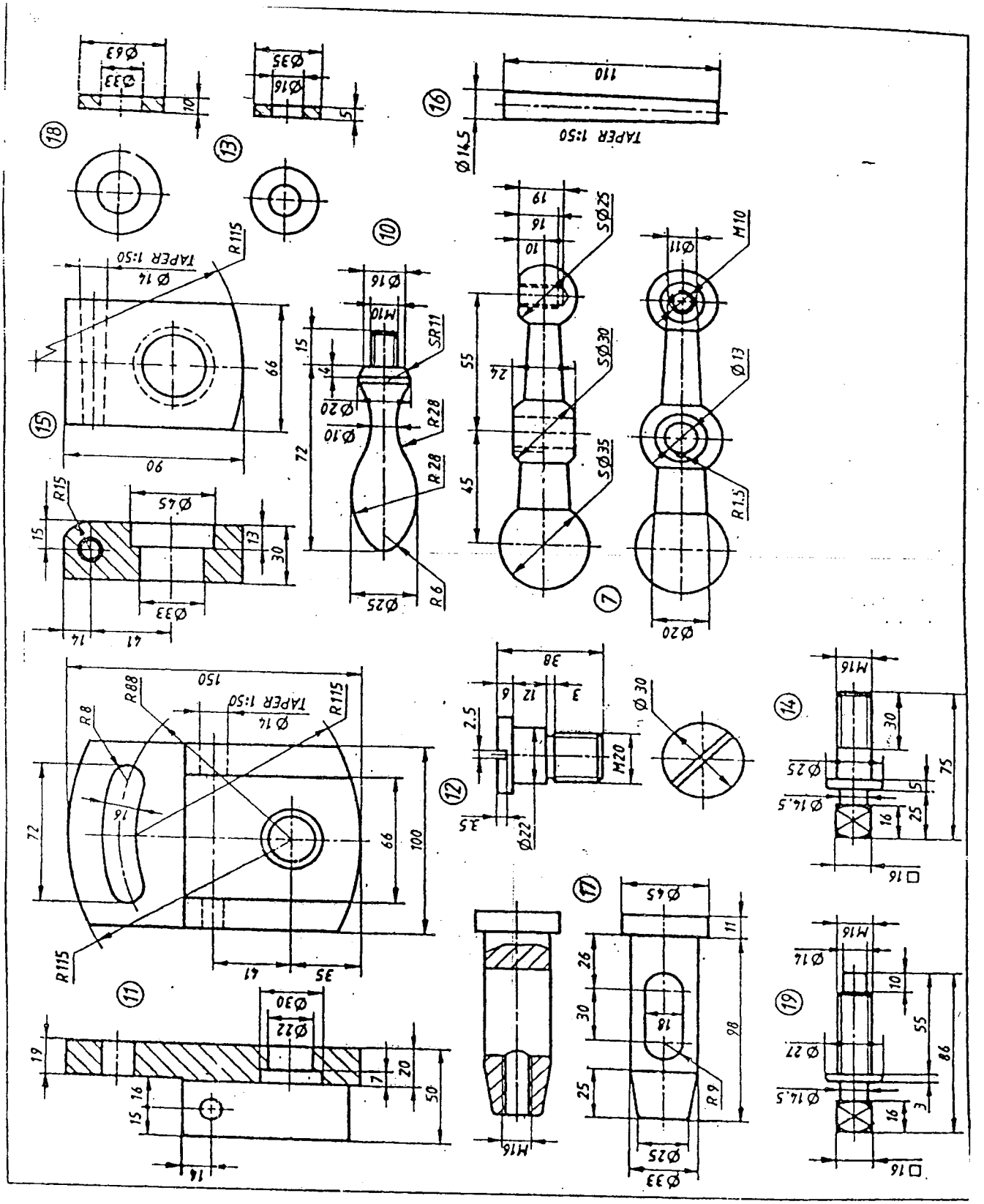


Fig. 9.26b Detail Parts Tool Head of Shaping Machine

19	TOOL FIXING SCREW	STEEL	1
18	WASHER	Fe 410W	1
17	TOOL HOLDER _	Fe 410W	1
16	PIVOT PIN	Fe 410W	1
15	DRAG PLATE	Fe 410W	1
14	CLAMPING SCREW	Fe 410W	1
13	WASHER	Fe 410W	1
12	SWIVEL SCREW PIN	Fe 410W	1
11	SWIVEL PLATE	CAST STEEL	1
PART No.	DESCRIPTION	MATERIAL	No. OFF

10	HANDLE	Fe 410W	1
9	NUT M10 (STD)	Fe 410W	1
8	ROUND KEY	Fe 410W	1
7	HANDLE BAR	Fe 410W	1
6	SPACER BUSH	Fe 410W	1
5	SCREW ROD	Fe 410W	1
4	GRUB SCREW	Fe 410W	5
3	ADJUSTABLE STRIP	Fe 410W	1
2	VERTICAL SLIDE	CAST STEEL	1
1	BACK PLATE	CAST STEEL	1
PART No.	DESCRIPTION	MATERIAL	No. OFF

Fig. 9.27 Bill of Materials of Tool Head of Shaping Machine

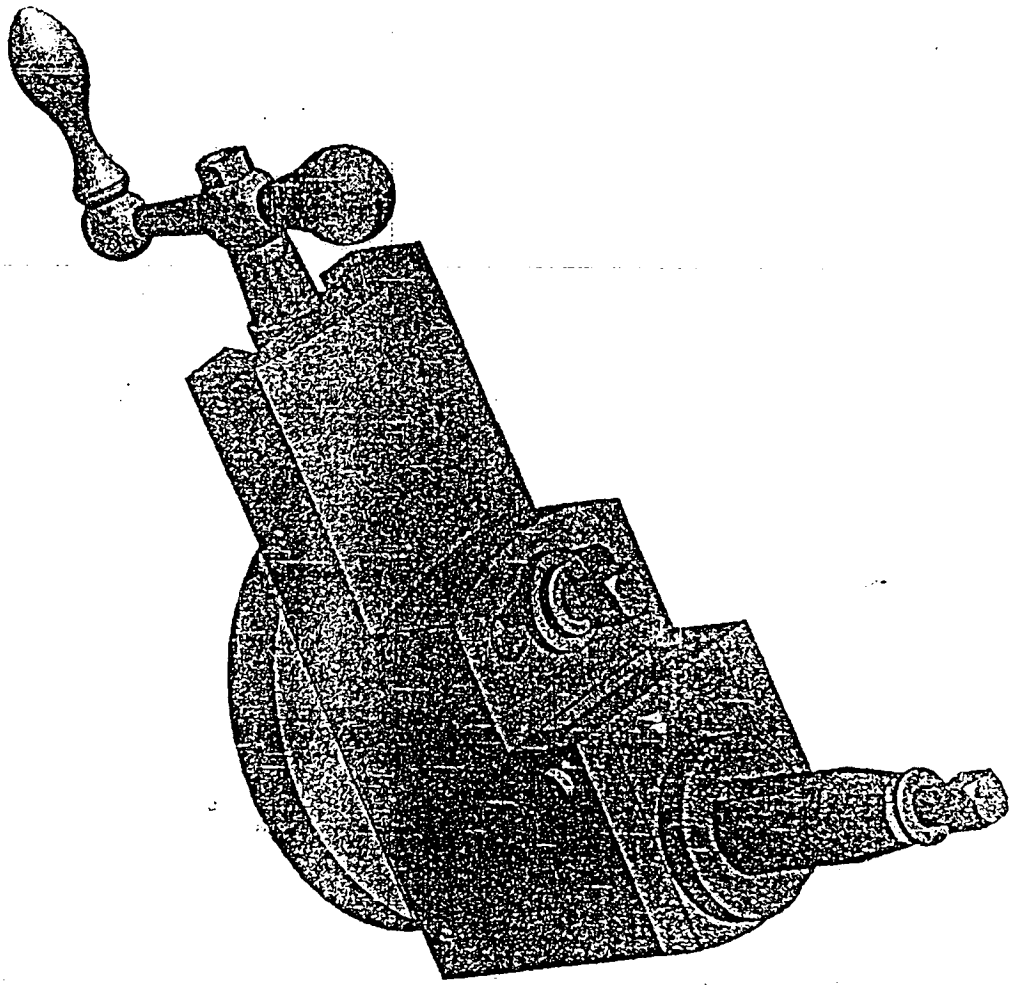


Fig. 9.28 3-D Assembled Tool Head of Shaping Machine

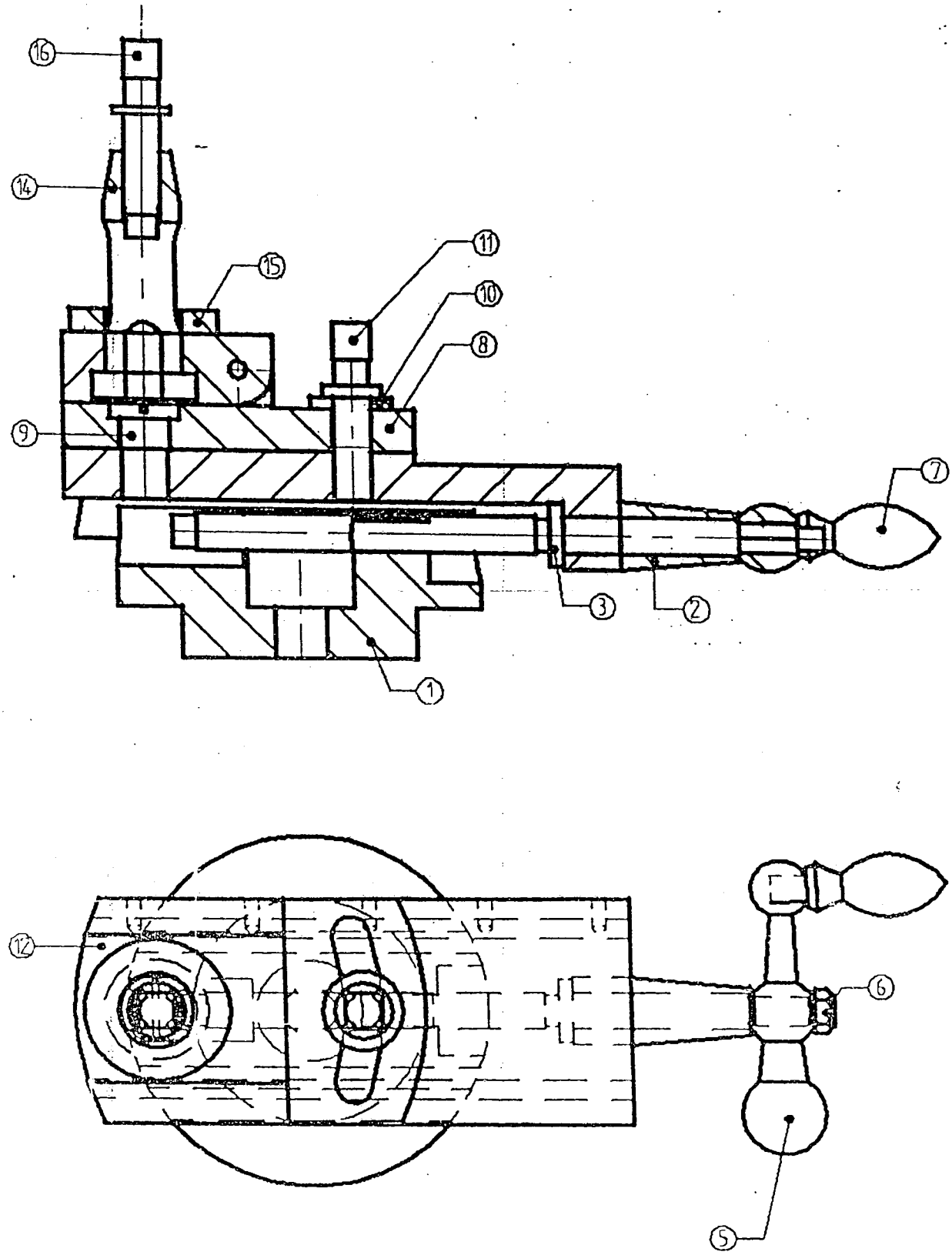


Fig. 9.29 Orthographic Views of Tool Head of Shaping Machine

9.7 PETROL ENGINE PISTON

The piston is assembled from parts as shown in the Fig. 9.31. Fig. 9.30 shows the exploded view of petrol piston. It consists of a piston(1), gudgeon pin(2), two plugs for the gudgeon pin(3) and two piston rings(4). The gudgeon pin or piston pin is driven with the push fit into the piston and has running fit in the connecting rod. The piston ring a pressure tight, leak proof running fit in the piston cylinder assembly. Fig. 9.32 shows the 3-D view of the piston.

Fig. 9.33 shows the half sectional front and side views of piston.

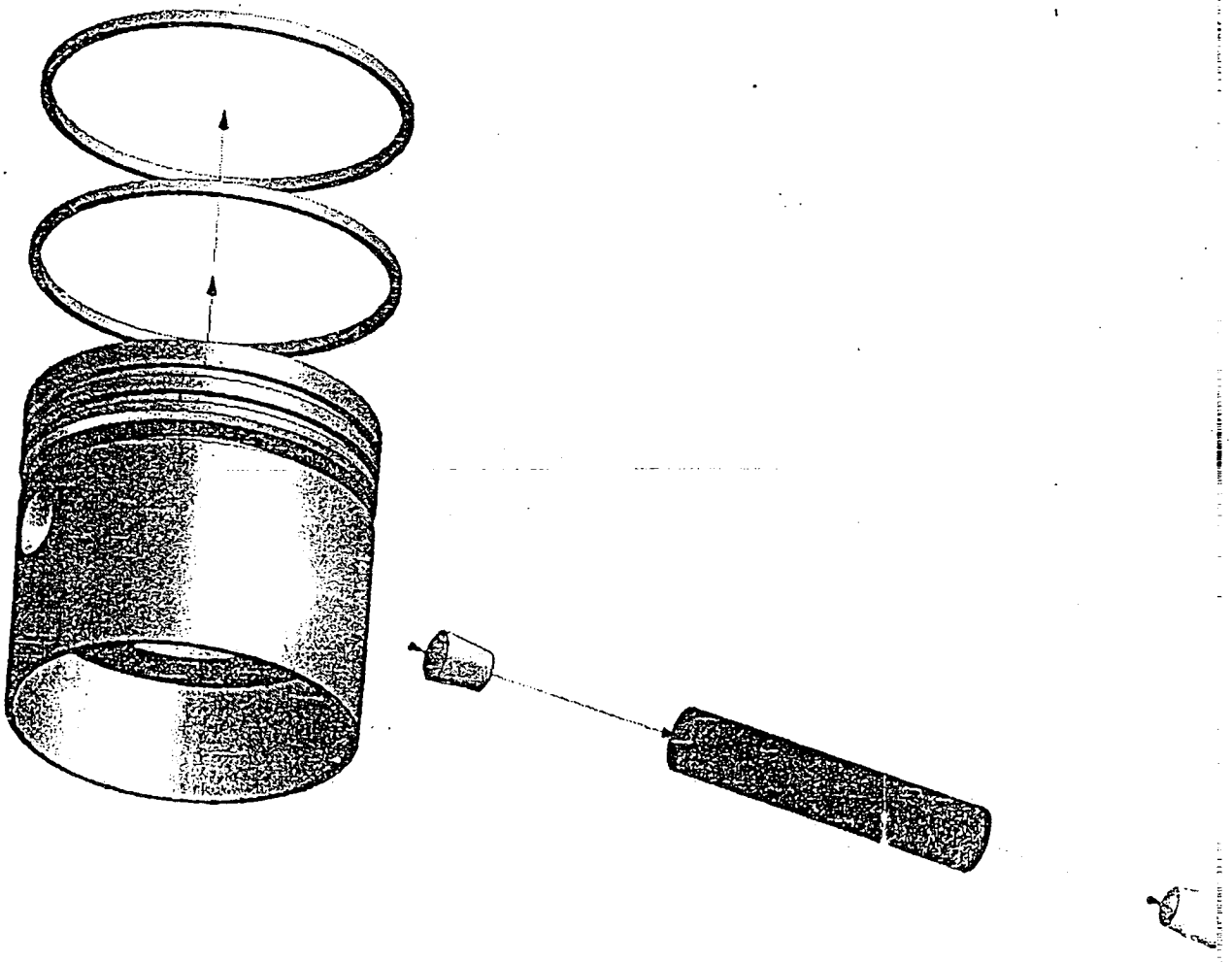
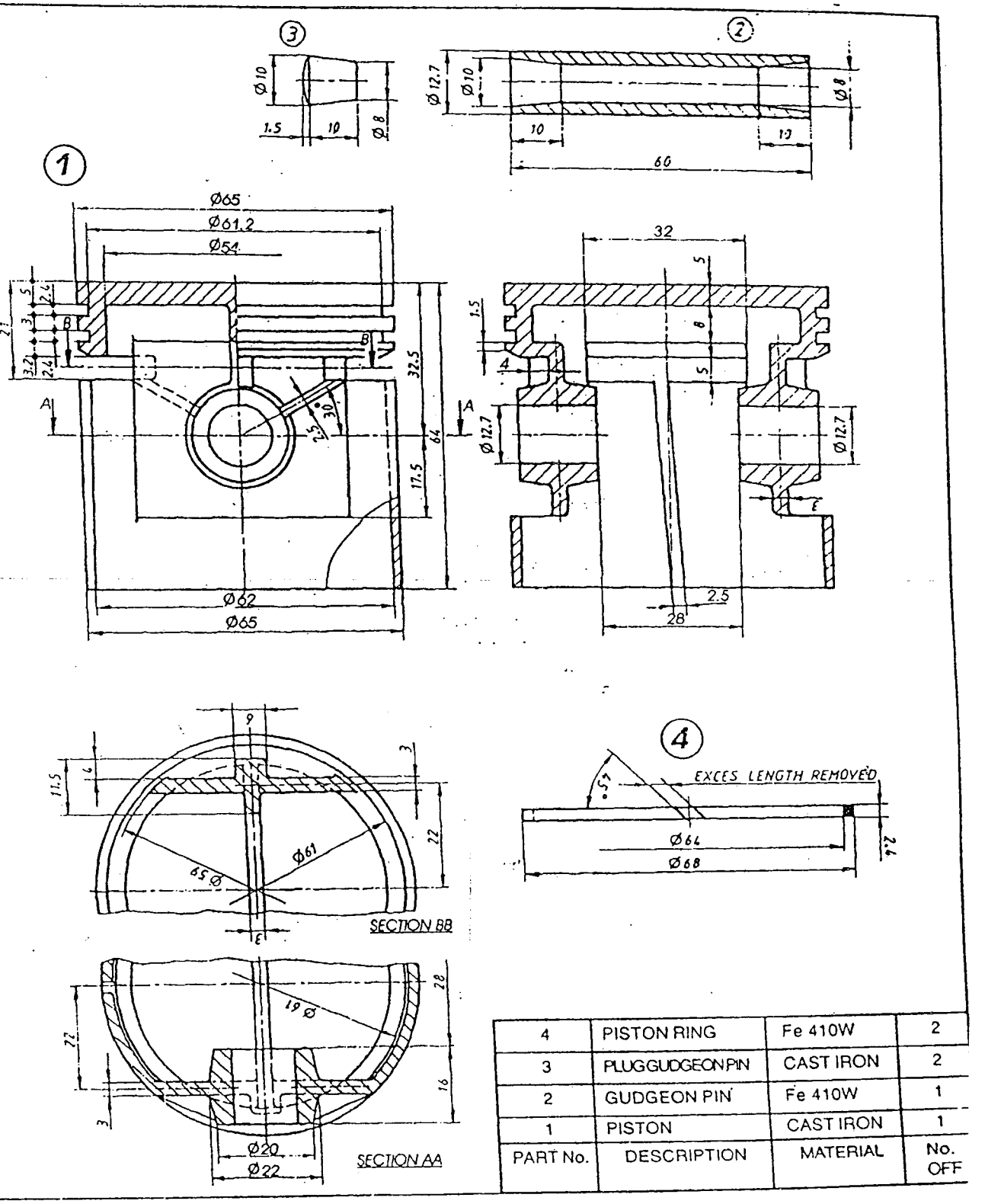


Fig. 9.30 3-D Exploded View of Piston



PART No.	DESCRIPTION	MATERIAL	No. OFF
4	PISTON RING	Fe 410W	2
3	PLUGGUDGEONPIN	CAST IRON	2
2	GUDGEON PIN	Fe 410W	1
1	PISTON	CAST IRON	1

Fig. 9.31 Detail Parts of Piston

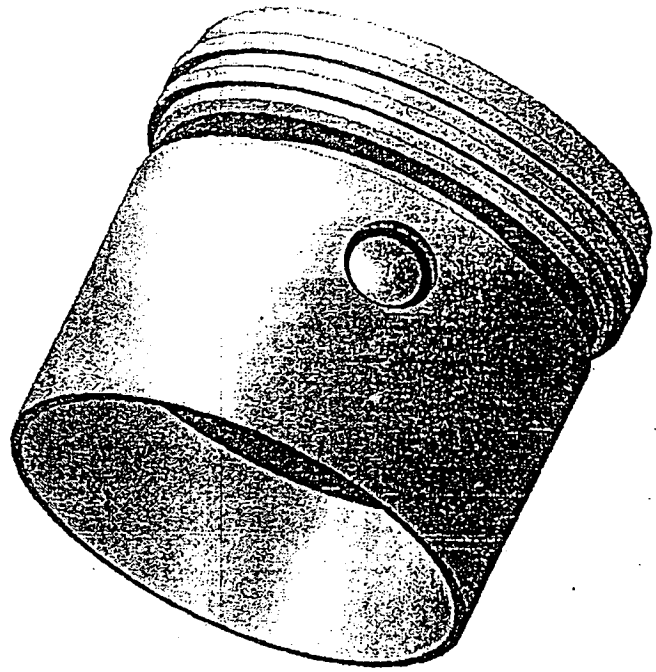


Fig. 9.32 3-D Assembled Piston

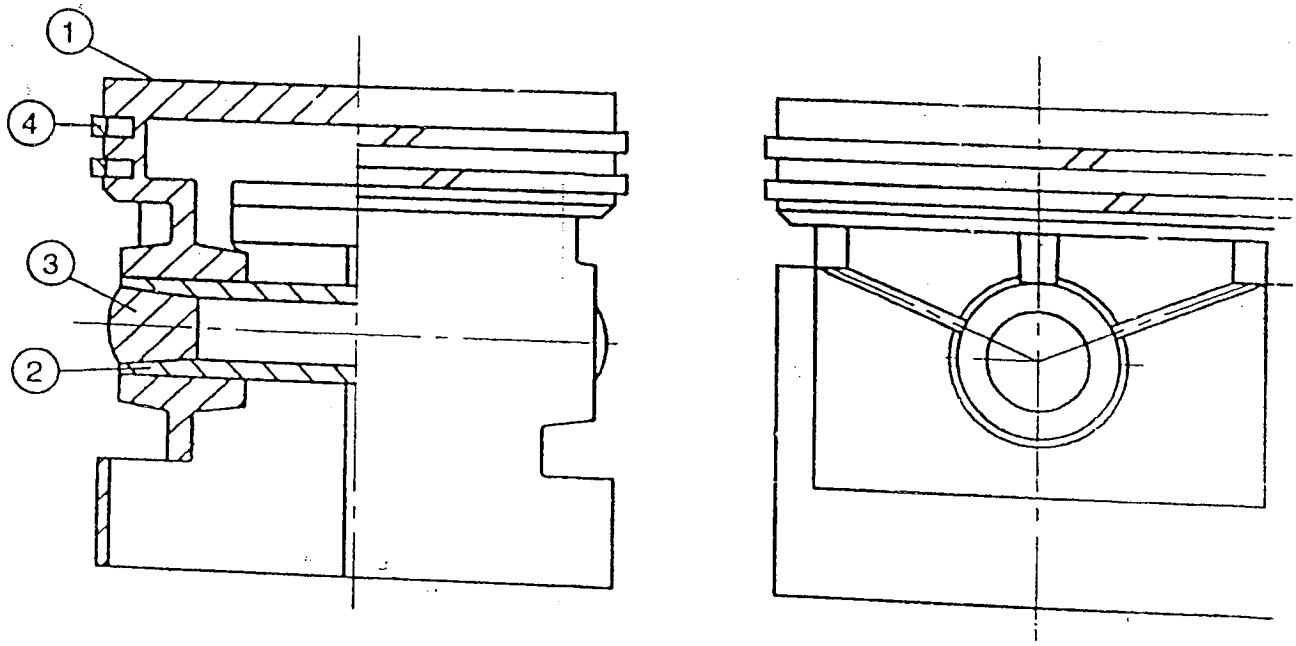


Fig. 9.33 Orthographic Views of Piston

9.8 IC ENGINE CONNECTING ROD

The connecting rod of an IC engine transforms the rectilinear motion of the piston to which it is directly connected into the rotary motion of the crank. the connecting rods are made of "I" section to enable them to withstand crushing and bending forces while being as light as possible. One end of the connecting rod is smaller in size known as the small end which is secured to the pistion. The other end is known as the big end which is secrued to the crank using the crankpin. Fig. 9.36 shows 3-D view of the connecting rod and Fig. 9.34 shows the exploded view of the connecting rod.

The bearing bush(4) which is in one piece is fitted at the small end of the connecting rod(1). The main bearing bush, which is split into two halves is placed at the big end of the connecting rod. First the split bearing brasses (3) are placed on the crank pin, then the big end of th connecting rod and the cap(2) are clamped onto these, by means of two bolts(5) and nuts (6)

The bearing brasses are made of gun metal as it has good resistance to corrosion. Oil groove is provided at the center of the bearing. The bearing bush is made of phosphor bronze to provided low coefficient of friction. Oil groove is provided in this bush for lubrication between the pin and bearing.

The details of parts of the connecting rod are as shown in the Fig. 9.35. Fig. 9.36 shows assemble view and Fig. 9.37 half sectional front and top views

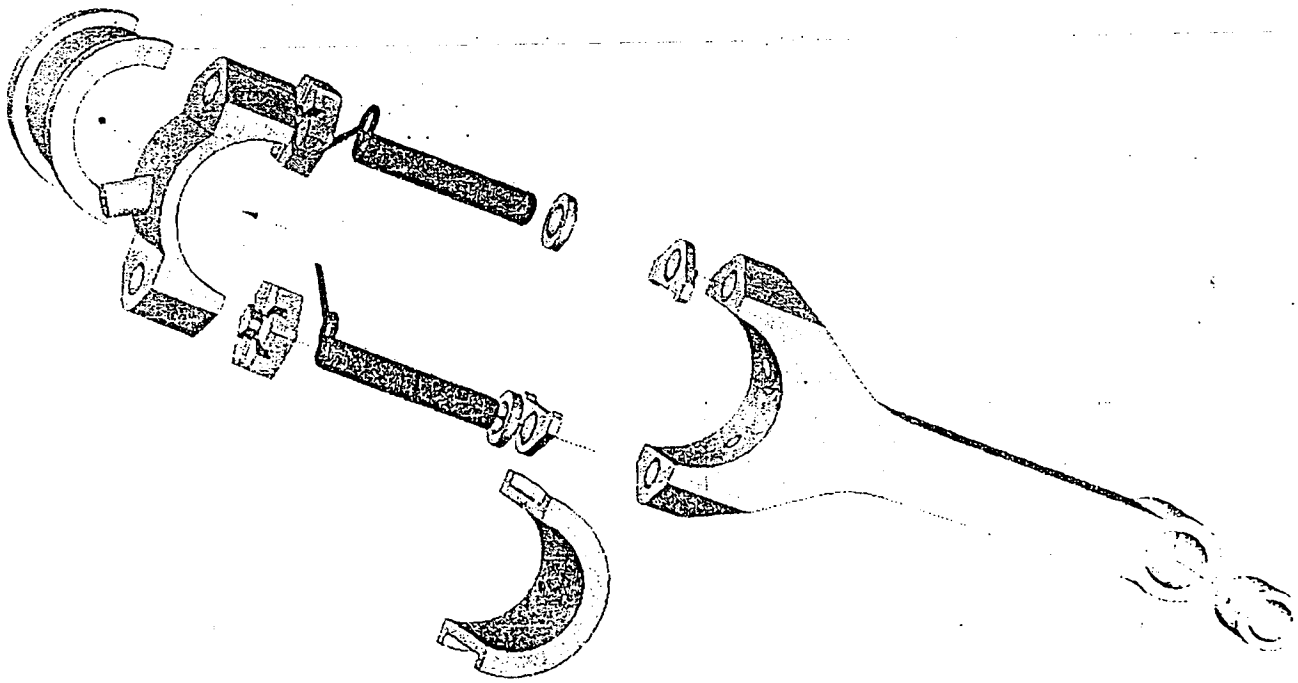
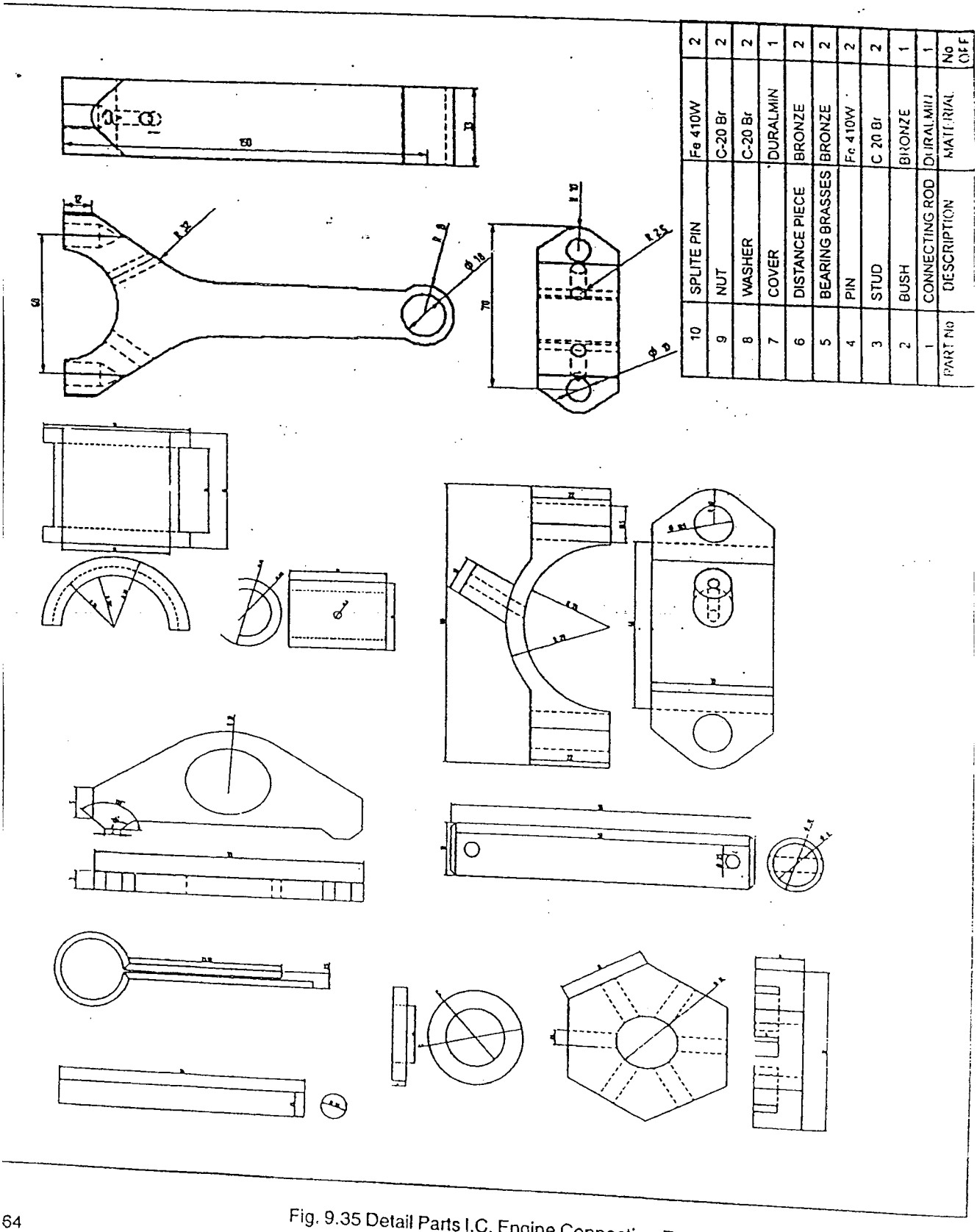


Fig. 9.34 3-D Exploded View of I.C. Engine Connecting Rod



PART No	DESCRIPTION	MATERIAL	No OFF
10	SPLITE PIN	Fe 410W	2
9	NUT	C-20 Br	2
8	WASHER	C-20 Br	2
7	COVER	DURALMIN	1
6	DISTANCE PIECE	BRONZE	2
5	BEARING BRASSES	BRONZE	2
4	PIN	Fe 410W	2
3	STUD	C 20 Br	2
2	BUSH	BRONZE	1
1	CONNECTING ROD	DURALMIN	1

Fig. 9.35 Detail Parts I.C. Engine Connecting Rod

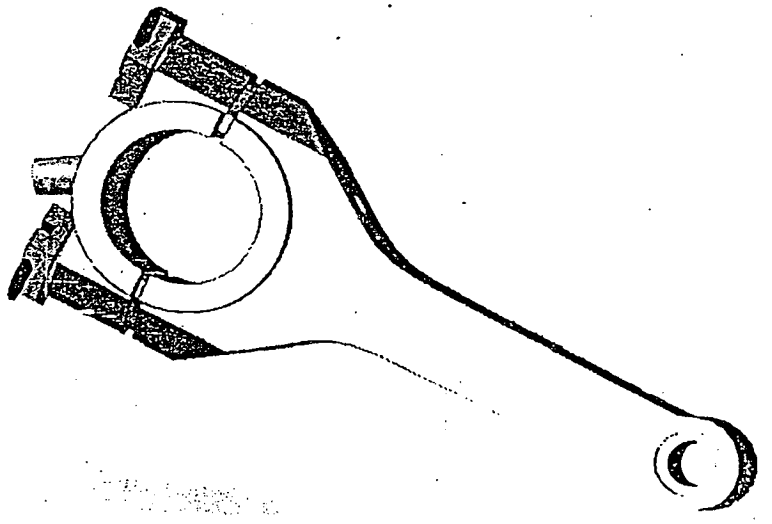


Fig. 9.36 3-D Assembled I.C. Engine Connecting Rod

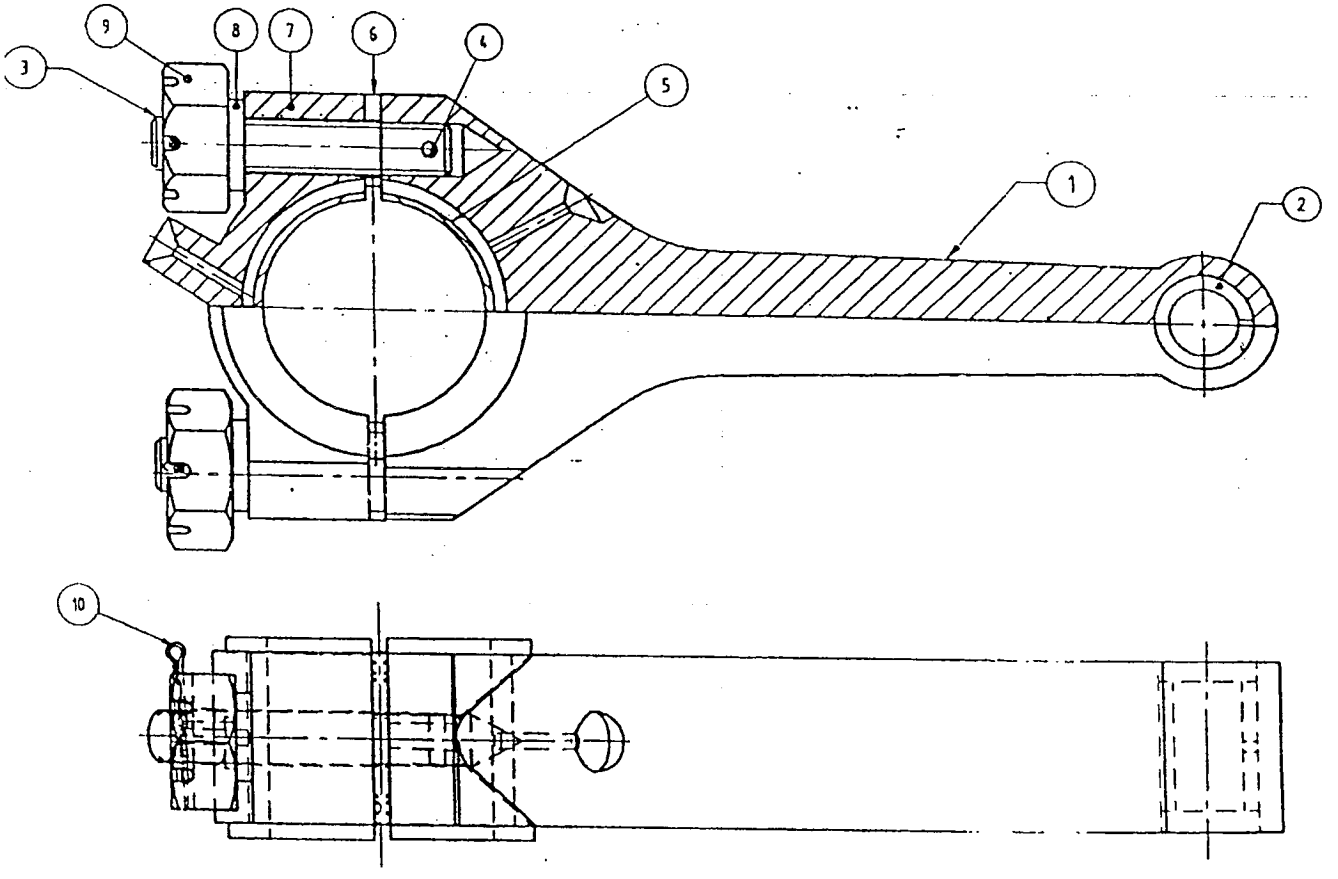
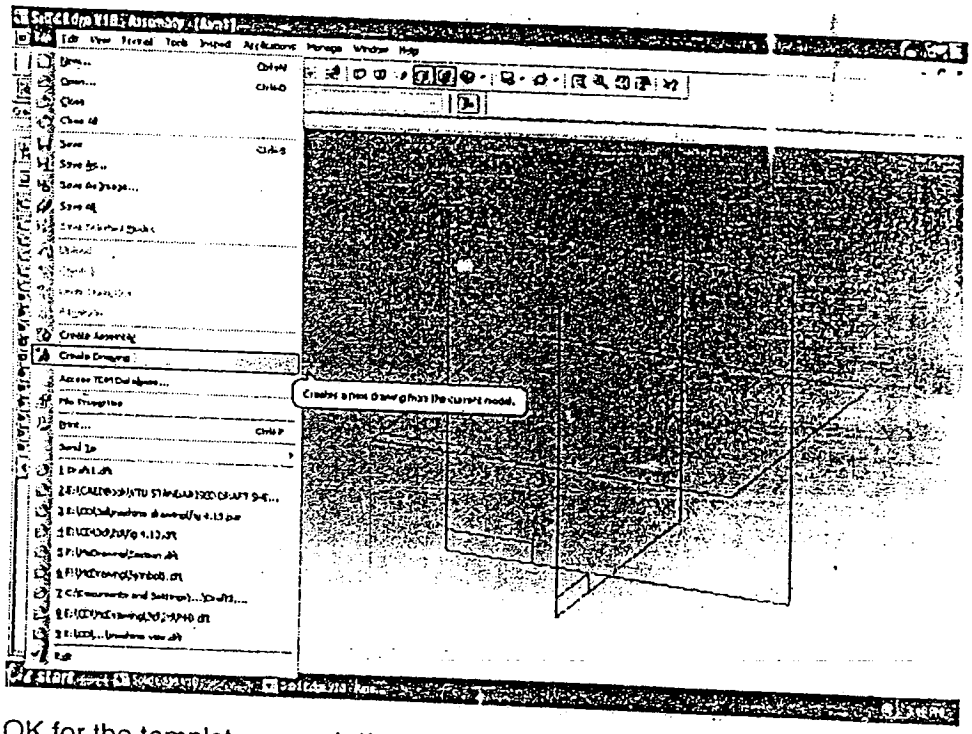


Fig. 9.37 Orthographic I.C. Engine Connecting Rod

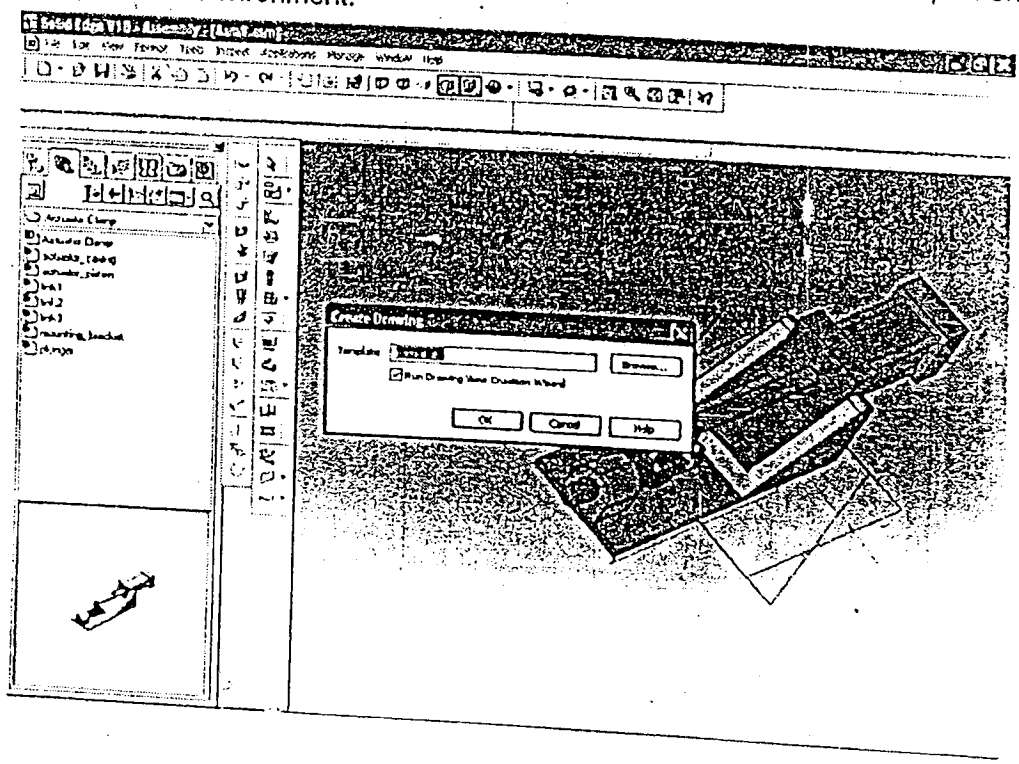
9.9 PROCEDURE FOR CONVERTING 3D TO 2D

Following are the steps to convert 3D assembly view to 2D orthographic views.

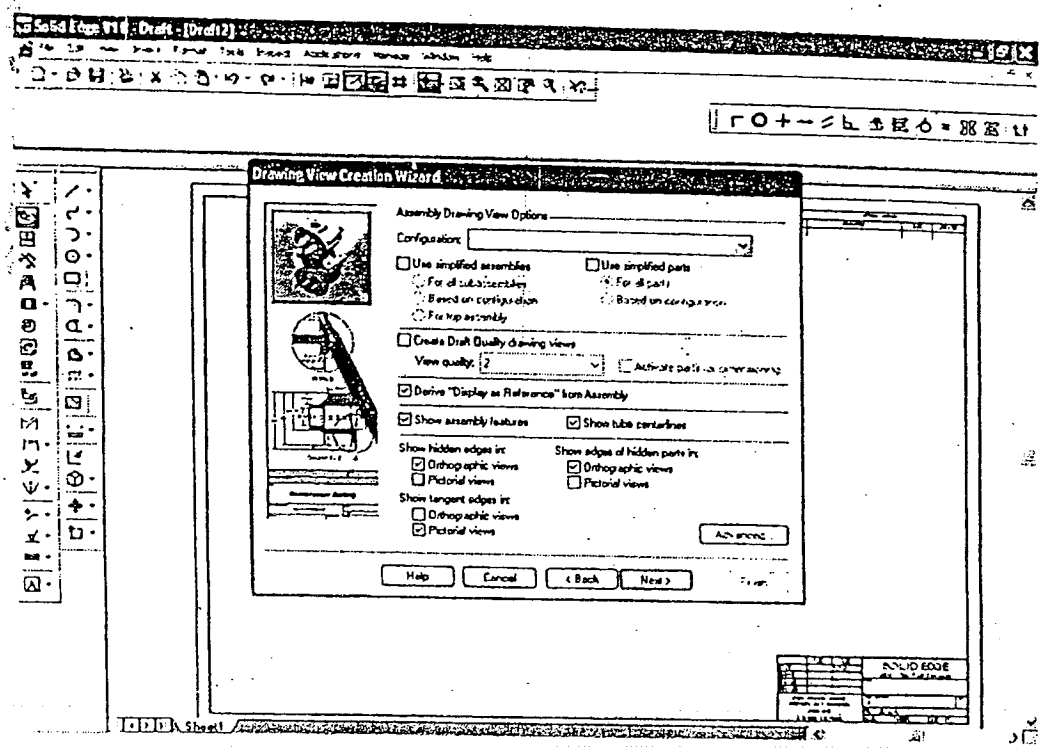
1. Save the model or assembly for which 2D has to be generated
2. Select CREAT DRAWING from FILE in MENU BAR.



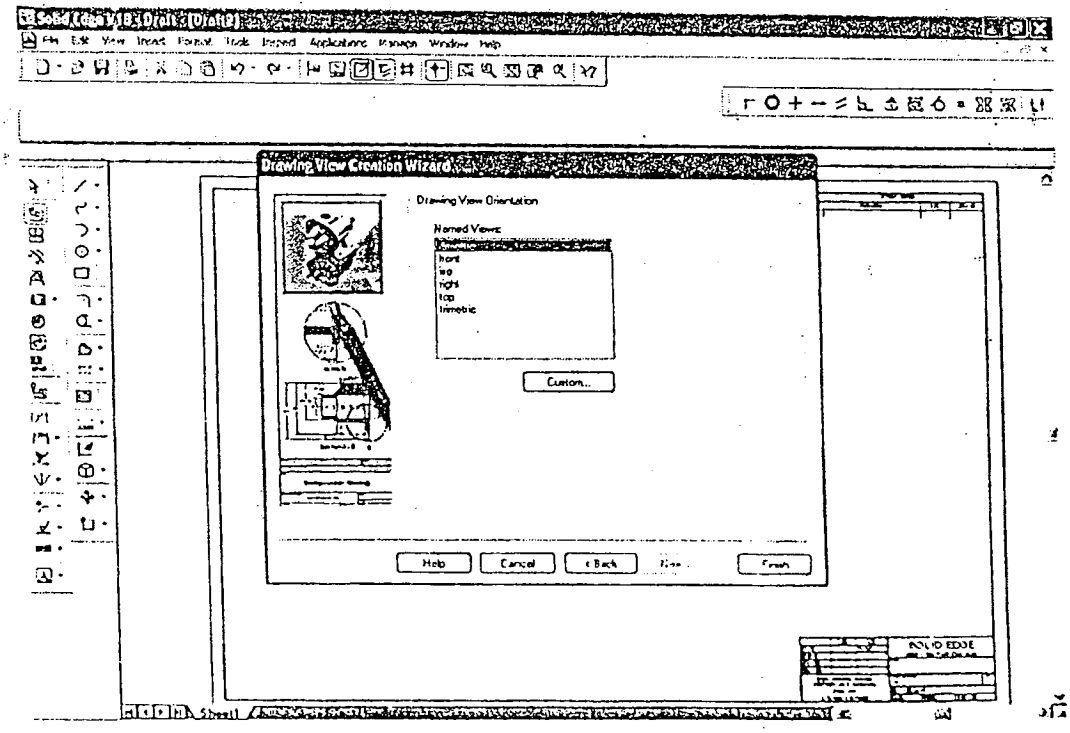
3. Select OK for the template normal.dft in create drawing window and now from part environmen will change to draft environment.



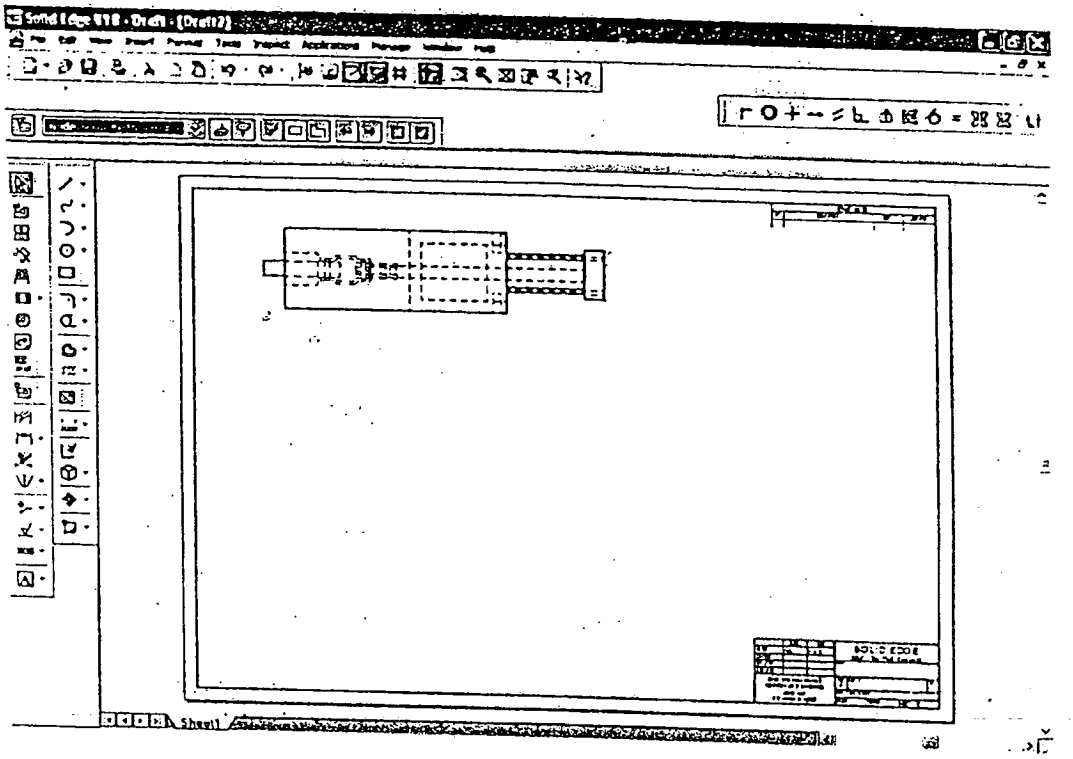
4. Drawing view creation wizard will appear select NEXT.

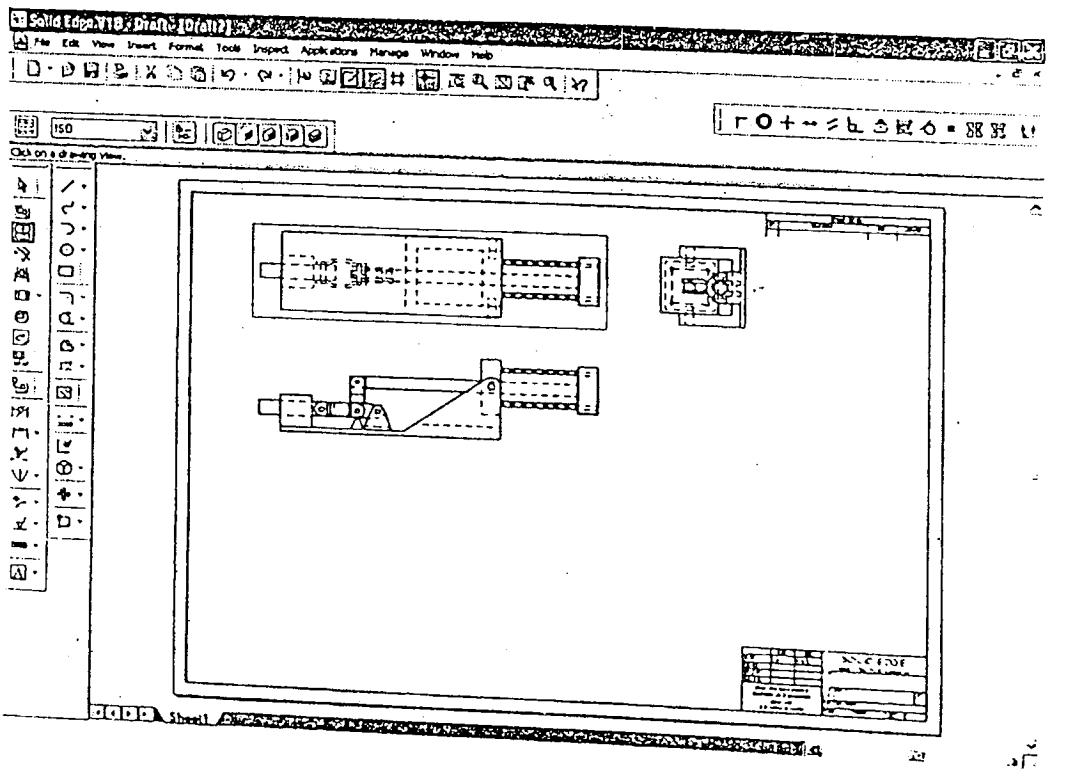


5. Select the revelant NAMED VIEWS or CUSTOM as per requirement, then select NEXT.

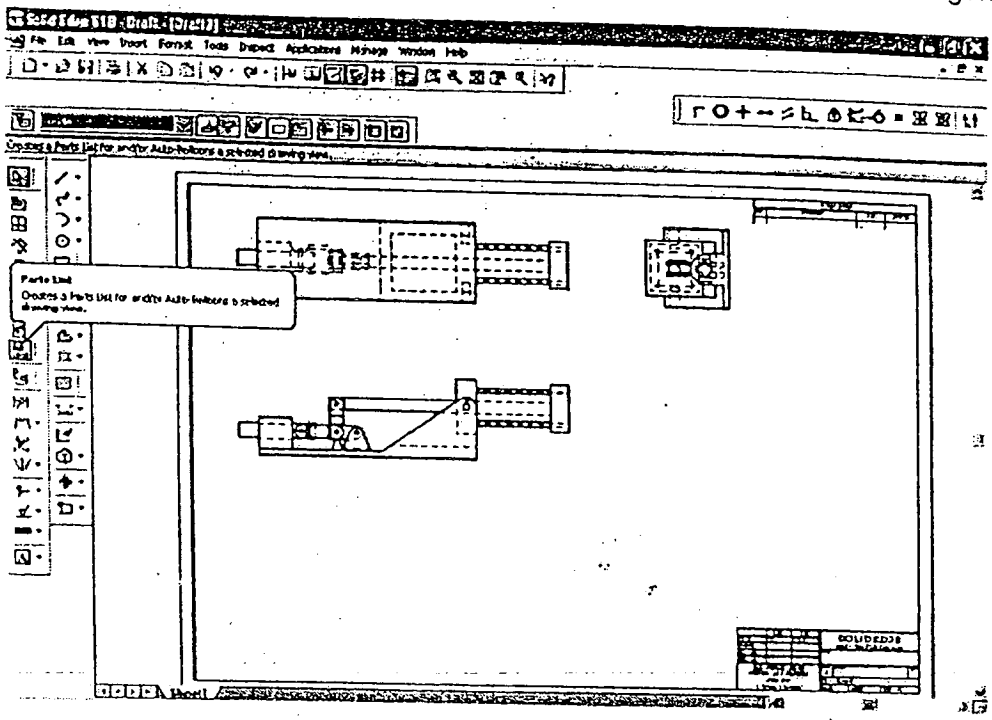


6. Now select the relevant views from drawing view layout, then select FINISH.
7. Respective views can be placed on the suitable drawing sheet.





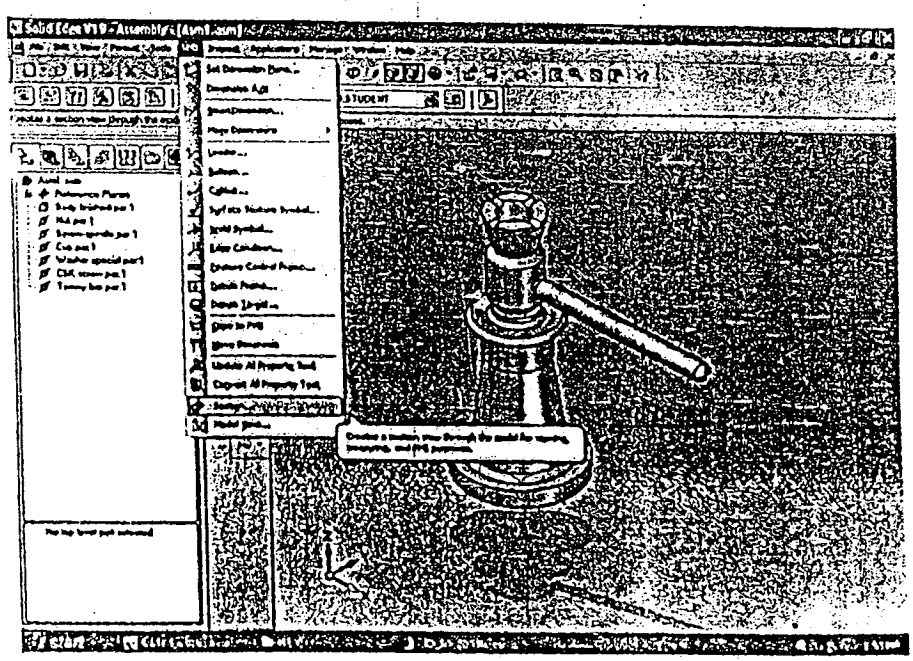
6. Select the PARTS LIST from DRAWING VIEW TOOL BAR automatically part list is generated.



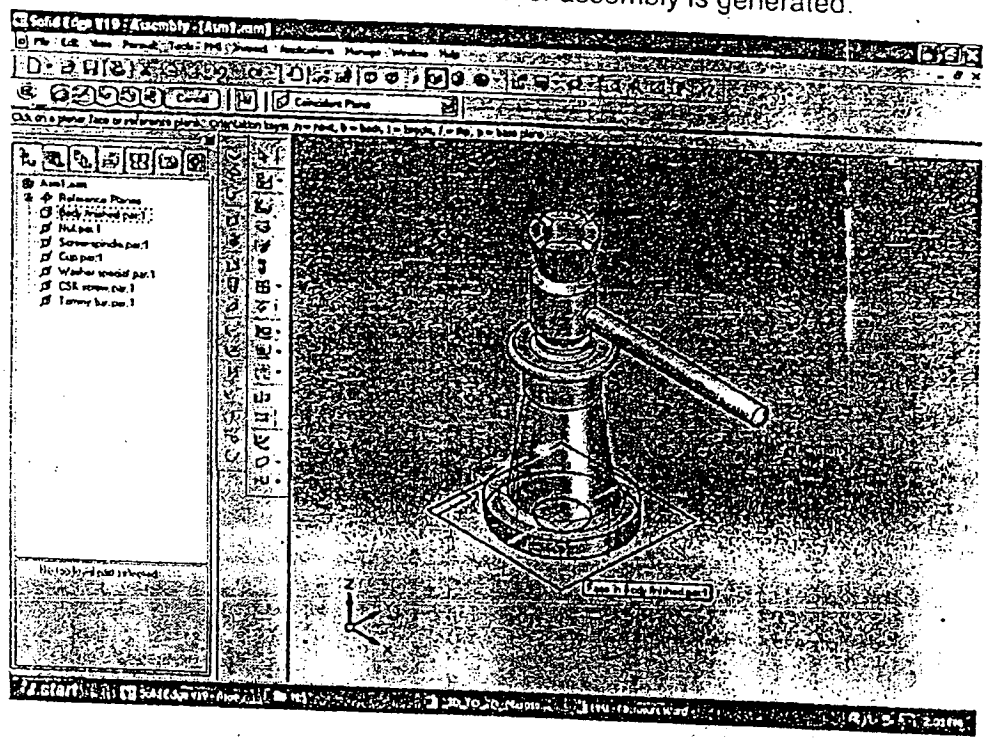
9.10 PROCEDURE FOR PMI SECTION

Following are the steps to make section in 3D assembly and convert 3D sectional assembly view to 2D orthographic views.

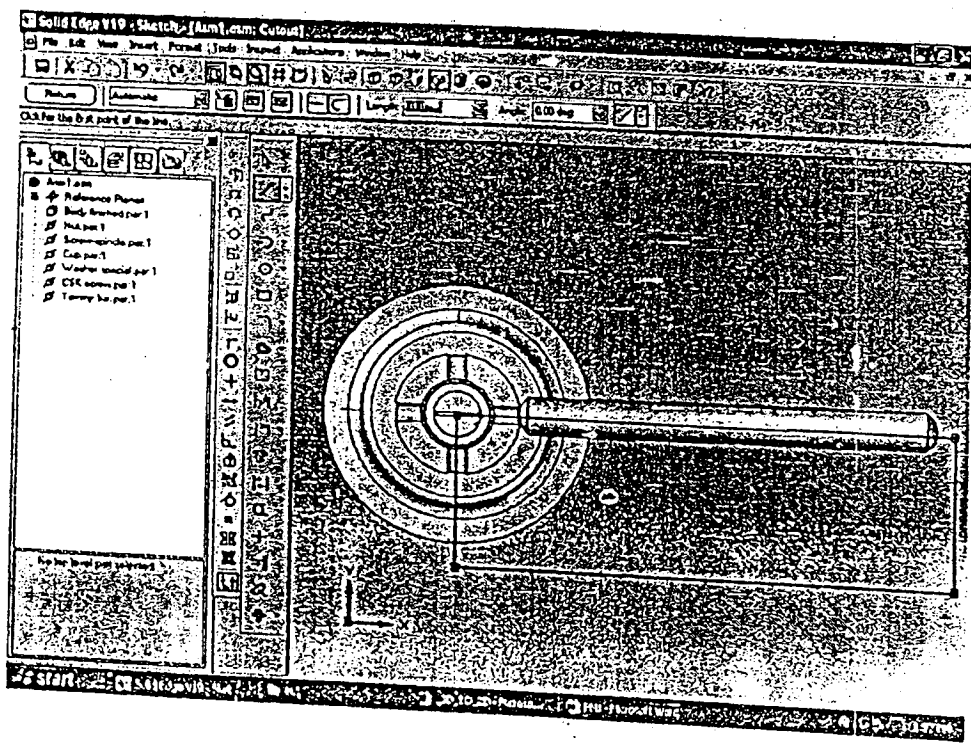
1. Save the model or assembly for which sectioning has to be made.
2. Select SECTION from PMI in MENU BAR.



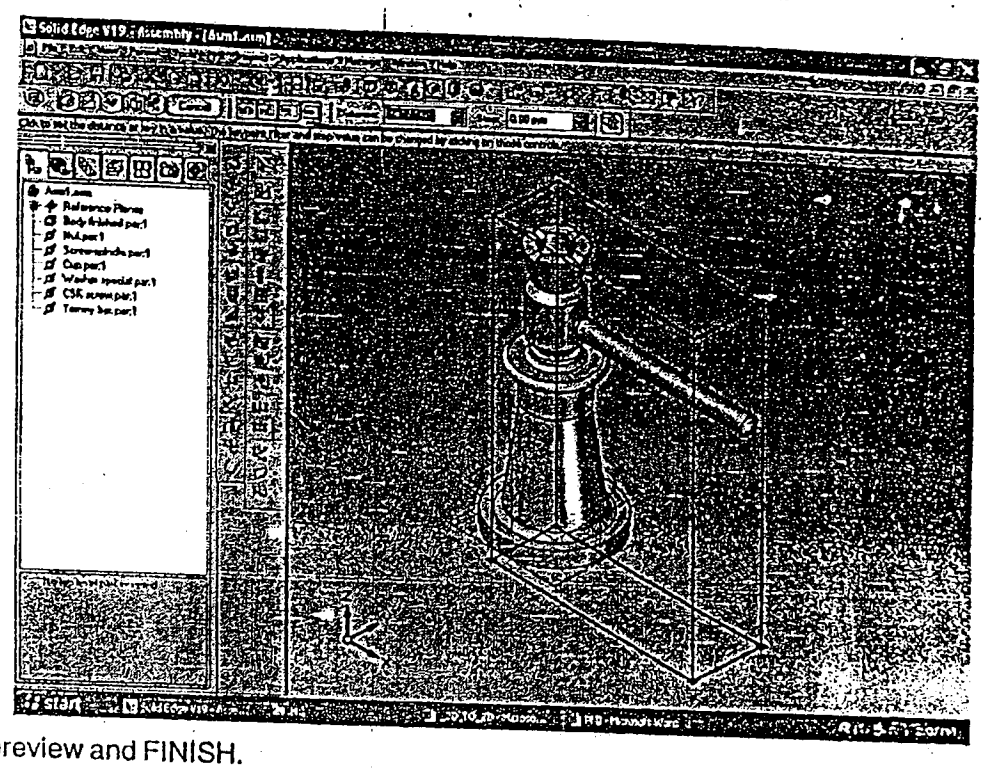
3. Select the relevant reference plane where model or assembly is generated.



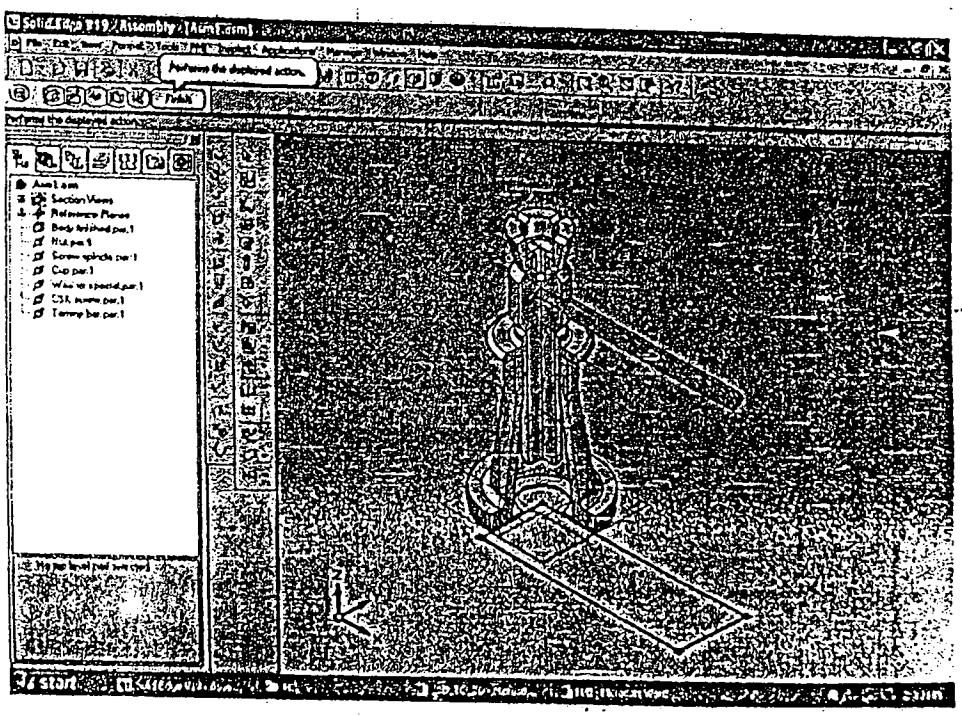
4. Using LINE, ARC and other relevant command from DRAWING MENU TOOL BAR draw the section and select RETURN.



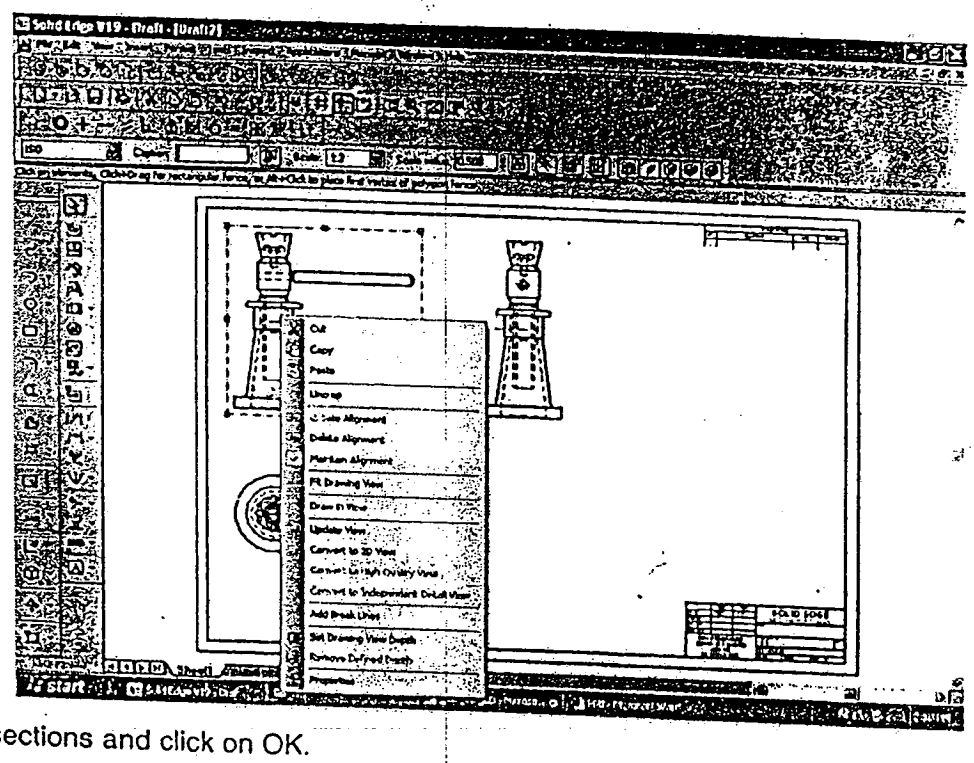
5. Now give the direction and distance for the section from RIBBON BAR.



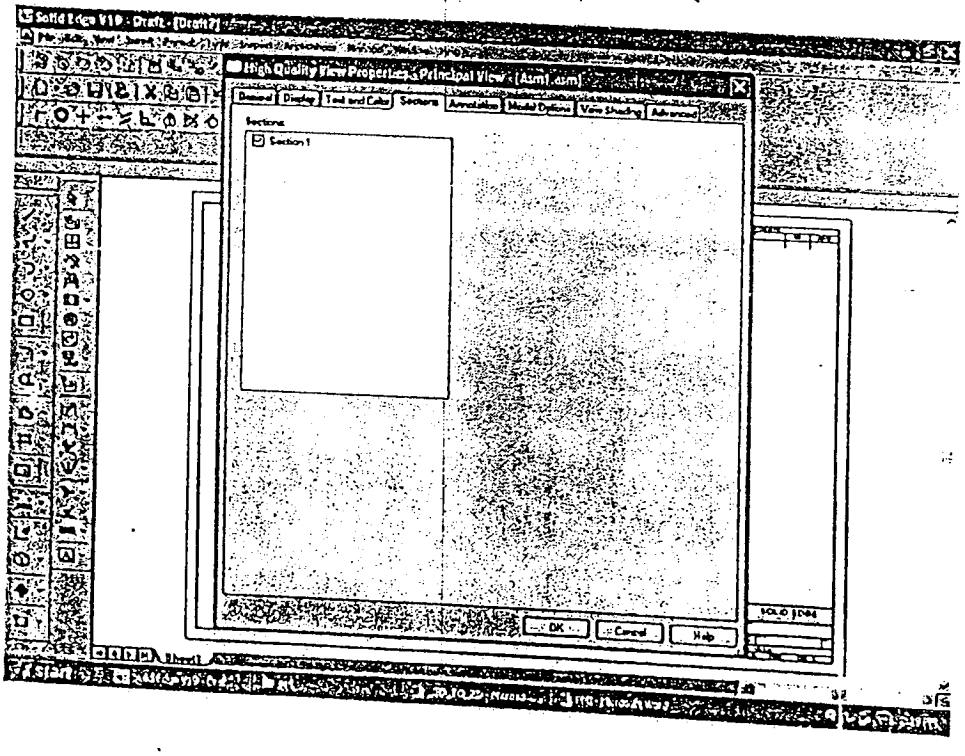
6. Select preview and FINISH.



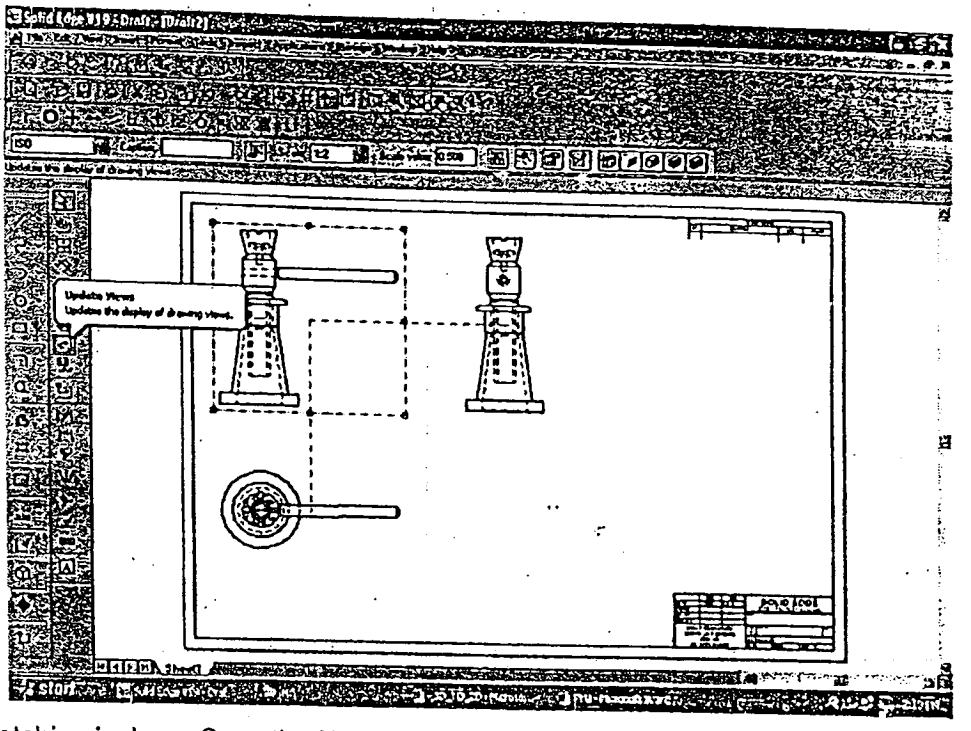
7. Follow the procedure for converting 3D to 2D (refer 9.9)
8. To get automatic hatching right click on the view, select PROPERTIES.



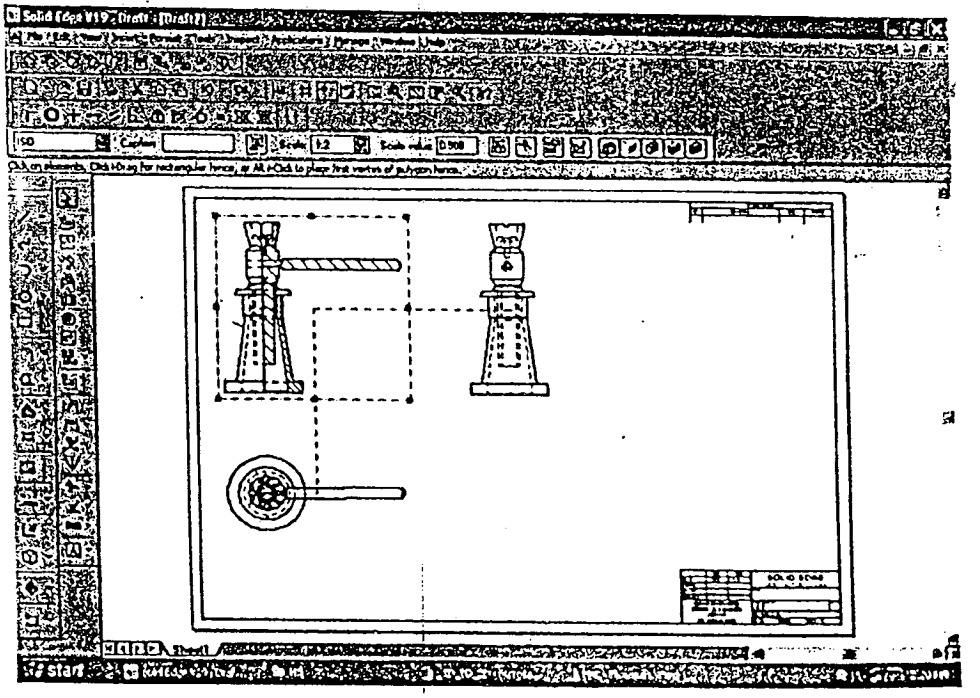
9. Select sections and click on OK.



10. Select UPDATE VIEWS from the DRAWING VIEW TOOL BAR.



11. Finally hatching is done. Save the file.



QUESTION BANK

PART B

1. Draw the top view and sectional front view of double rivetes butt joint with cover plates with zig-zag riveting. The thickness of plate is 14 mm. Show at least three rivets in one row and two rivets in the adjoining rows. Indicate all the dimensions. Use snap head rivets and show all calculation on the drawing sheet.

2. Draw i) half sectional front view with top half in section and
   ii) Side view of a protected type flange coupling to connect two shafts of diameter 25mm each.

3. Draw free hand proportionate skecth of a double riveted butt joint with double cover plates and zigzag riveting as indicated below.
   i) Sectional front-view ii) Top-view.
   Take a plate thickness =10 mm and indicate clearly all dimensions on the drawing. Use a scale of full size.

4. Prepare free hand sketches of a protected type flange coupling as per instructions given below:
   i) Sectional elevation with top half in section. ii) Right view.
   Take diameter of shaft D = 30 mm and a scale of 1:1
   Indicate important dimensions on the sketches.

5. Prepare a free hand sketch of two views of adouble riveted butt joint with single cover plate to connect two plates of 9mm thick. Adopt chain riveting. Use snap head rivets. Show three rivets in a row. Mark all proportions on the views.

6. Prepare a free hand sketch (half sectional front view-top halp) of a protected type flange coupling for a shaft of 30mm dia. Adopt. Standard proportions. Add side view. Amrk important dimensions/proportions on the views.

7. Draw to 1:1 scale, top and sectional front views of a double riveted chain lap joint. The thickness of the plate is 9 mm. Show atleast three rivets. Use snap rivets. Indicate all the dimensions.

8. Draw to 1:1 scale, the following views of a protected type flange coupling (diameter of shaft = 20 mm)
   a. Front view with top half section.
   b. Left view looking from the nut end.
   Indicate important dimensions, add parts list.

9. Draw the following views of a SOCKET and SPIGOT COTTER JOINT used for joining two rods of diameter 20 mm:
   a) Sectional front view
   b) A view looking from socket end

10. Draw the following views of a 'universal coupling' used to connect two 20 mm diameter shafts.
    a) Sectional front view
    b) Profile view.

11. a) Draw a neat sketch of a double riveted butt joint with single strap. The rivets are to be arranged in a Zig-zag fashion. Assume and indicate the dimensions and show the calculations.

b) Draw a free hand sketch of a flanged nut assuming the nominal diameter to be 20 mm.

12. a) Draw a neat and proportionate sketch of a protected type of flanged compling to connect two shafts of 25 mm showing the follwing views.
    i) Front view with top halp in section.
    ii) Simple top view.
    iii) Right side view.

13. Draw the sectional front view and top view of a double riveted lap joint with zig-zag riveting to connect two plates of 12 mm thickness.

14. Draw i) Half sectional front view, with top half in section ii) side view of a bushed pin type flange coupling to connect two shafts, each of diameter 30 mm.

15. Make a neat and proportionate free hand sketch of a socket and spigot type cotter joint showing sectional front view and side view from socket end. When the diameter of the rods is to be 20 mm.

16. Prepare a neat and proportionate free hand sketch of a bushed-pin type of flexible coupling to connect two shafts of 20 mm diameter for the following views:
    i) Front view with top half in section.
    ii) Side view from pin-head end.

17. a. Draw neat sketches to indicate conventional representation of the following:
        i) BSW thread having pitch 50mm
        ii) Acme thread pitch 60mm.
    Show atleast 3 threads in section.
    b i) Draw proportionate sketch of the locking device for a nut, use 20 mm diameter bolt using split pin.
    ii) Sketch any one type of Grub screw.

18. Sketch proportionately the half sectional front view of socket and spiogot cotter joint assuming diameter of rods = 20 mm. Indicate all proportions with dimensions. Prepare parts list.

19. Sketch neat proportinal half sectional front view of protected type flanged coupling to connect two shafts of 20 mm diameter. Indicate all proportions with dimensions. Prepare parts list.

20. Draw neat and proportionate sketches of the following.
    a) ISO screw thread profile of pitch 50 mm Indicate all proportions and dimensions.
    b) Two views of hexagonal headed bolt with nut for a 30 mm diameter bolt. Take length of bolt equal to 125 mm.
    c) Castle nut.

21. Sketch neat proportioned sectional front view of Kunckle joint to connect two round rods of 25 mm diameter. Indicate all proportions with dimensions. Show the parts list.

22. Sketch the following view of a Flanged coupling (Protected type) to connect two shafts of 20 mm diameter.
    a) Front view with top half in section
    b) Left side view.

23. Sktech the sectional front view of a cotter joint with sleeve to connect two rods of diameter 25 mm. Indicate all proportions with diamensions. Add a parts list.

24. Sketch half sectional front view of a flange coupling unprotected type to connnect two shafts 20 mm diameter. Indiacte all proportions . Add parts list.

25. Sketch sectional front view of a universal coupling to connect two rods of diameter 30mm. Indicate all dimensions add a parts list.

26. Make neat and proportionate sketches of the following.
    a) Acme thread
    b) Two view of M20 hexagonal bolt with flanged nut. Consider length of the shank as 150 mm.
    c) Counter sunk head screw.

27. Sketch neat and prorpotionate figure of knuckle joint shopwing sectional front view and top view. Take dia of rods as 25 mm.

28. Draw the following, views of pin type flexible coupling, to connect to shafts of 30 mm diameter.
    a) Front view with top half in section,
    b) Side view from the pin end

29. Draw two views of (a) hexagonal bolt and (b) square headed bolt of size 25 mm dia and 100 mm long. Indicate all the dimensions.

30. Sketch a neat proportional front view of a socket and spigot cotter joint indicating all proportions to connect rods of 25 mm.

31. Sketch the sectional front view of a flexible coupling to connect two shafts of 25 mm dia with all dimensions.

32. Draw a proportional neat sketch of a knuckle joint to connect two rods of 20 mm dia. Indicate all the proportions with dimenstions.

33. Draw the three views of an ISO-threaded hexagonal bolt 140 mm long, 24 mm diameter and a thread length of 60 mm, with a hexagonal nut. Indicate all the proportions and actual dimensions.

34. Sketch a proportionate sectional front view of aknuckle joint to connect two rods of diameter 20 mm. Indicate a few important dimensions in items of diameter d.

35. Draw a neat proportionate front view with top half in section of a protected type flanged coupling to connect two shafts of diameter 30 mm. Indicate a few important dimensions in terms of shaft diameter d.

36. Draw two views of (a) hexagonal deaded bolt and (b) square headed bolt of size 25 mm dia and 100 mm long. Indicate all the dimensions.

37. Sketch a neat proportional front view of a socket and spigot and cotter joint indicating all proportions to connect rods of 25 mm.

38. Sketch the sectional front view of a flexible coupling to connect two shafts of 25 mm dia with all dimensions.

39. Draw a proportional neat sketch of a knuckle joint to connect two rods of 20 mm dia. Indicate alll the proportions with dimensions.

PART C

1. Following figure shows the details of a Tail-stock of a lathe. Assemble the parts and draw.
   a. Sectional front view.
   b. Top View.
   c. Left side view.

2. Details of a " PLUMMER BLOCK" are shown in following figure. Assemble the parts and draw the following views of the assembly:
   i. Front view showing right half in section.
   ii. Side view with left half in section.
   Take a scale of 1:1 , and indicate the important dimensions of the views.

3. Part drawings of a plummer block are shown in following figure. Assemble the parts and draw the following views to scale 1:1
   i) Front view showing right half in section
   ii) Top view
   Mark important dimensions.

4. Part drawings of tail stock of a lathe are shown in following figure. Assemble the parts and draw the following views to 1:2 scale.
   i) Sectional front view
   ii) Top view
   Mark important dimensions.

5. The details of a tail stock of lathe are shown in following figure. Assemble the parts and draw the following views of the assembly to 1:2 scale.
   a. Sectional front view
   b. Top view
   Parts list for this:

PART NO	DESCRIPTION	MATERIAL	NO OFF
1	BODY	CAST IRON	1
2	FEATHER	Fe 410 W	1
3	BARREL	CAST IRON	1
4	SCREW SPINDLE	Fe 410 W	1
5	FLANGE	CAST IRON	1
6	SCREW	Fe 410 W	4
7	FEATHER KEY	Fe 410 W	1
8	HAND WHEEL	CAST IRON	1
9	WASHER M12STD	Fe 410 W	1
10	HEX NUT M12	Fe410 W	1
11	STUD	Fe 41 W	1

12	WASHER STD	FE 410W	2
13	HANDLE	CAST IRON	1
14	HEX.NUT M16	F 410 W	1
15	CLAMPING PLATE	CAST IRON	1
16	SQ.HEAD BOLT	Fe 410 W	4
17	WASHER M22 STD	Fe 410 W	1
18	HEX. M22	Fe 410 W	1
19	CETRE	CAST IRON	

6. The details of a machine vice are given in following figure. Assemble the parts and draw the following views of the assembly to 1:2 scale
   a. Sectional front view.
   b. Top view.
   Indicate the important dimensions of the view.

7. The part drawings of a machine vice are given in following figure. Assemble the parts and draw the following views of the machine vice;
   a) Sectional front view.
   b) Top view.

8. Following figure shows the details of a screw jack. Assemble the parts of the screw jack and show the following views.
   i) Half sec ional front view showing the right half in section.
   ii) Simple top view.
   iii) Right profile view.

9. Following figure shows the part drawing of a tail stock. Assemble the tailstock and show the following views.
   i) Sectional front view showing the top spinder portiona in section
   ii) Simple top view.
   iii) Left profile view.

10. Following figure shows the details of a machine vice. Assemble the parts and draw
    i) Sectional front view.
    ii) Top view.
    iii) Left side view.

11. Assemble all the parts of the screw jack shown in following figure and draw
    i) Half sectional front view with right half in section.
    ii) Top view.

12. Following figure shows the details of a screw jack. Assemble the parts of the jack and draw the following views:
    i) Front view with right half in each section.
    ii) Top view.
    Indicate the scale.

13. Sketch neat proportional half sectional front view of a plummer block. Prepare parts list. Assume suitable diameter for the shaft. Show right half in section.

14. Following figure shows the details of a petrol engine connecting rod. Assemble the parts and draw the following views. Dimension the drawings.
    a. Front view with top half in section.
    b. Top view.

15. Following figure shows the details of screw jacks. Assemble the parts of and draw the following views.

    i) Sectional front view and ii) Top view.

16. Details of a plummer block is shown in following figure. Assemble the parts and draw the following views with all important dimensions.
    i) Left half sectional front view
    ii) Top view

NEW SCHEME

06ME36A

Third Semester B.E. Degree Examination, Jan 2008
(ME/IP/AU/IM/MA/AE/MI)
COMPUTER AIDED MACHINE DRAWING
MODEL QUESTION PAPER -2

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any ONE question from each of the parts A, B and C.
2. Use FIRST ANGLE projections only.
3. Missing data if any may suitably be assumed.
4. All the calculations should be on answer sheet supplied.
5. All the dimensions are in mm.
6. Drawing instruments may or may not be used for sketching

PART – A

1. An equilateral triangular pyramid of 30mm side of base and axis 60mm long rests with its base on HP such that one of the base edges is inclined at 45° to the VP and nearer to it. It is cut by a section plane inclined at 60° to the HP and perpendicular to the VP, intersecting the axis at 40mm from the vertex. Draw the front view, sectional views looking from the top and right side along with the cut solid. Also project the true shape of section. **(20 marks)**

2. The pictorial view of a machine part is shown in figure1.Draw the following views:
   i) Front View and ii) Side View **(20 marks)**

PART – B

3. Draw top and sectional front views of a double riveted chain lap joint. The thickness of the plate is 9mm. Show at least three rivets. Use snap head rivets. Indicate all the dimensions. **(20 marks)**

4. Draw the following views of protected type flange coupling to connect two shafts of diameter 25mm
   i) Front view with top half in section.
   ii) Side view. **(20 marks)**

PART – C

5. Figure 2 shows the details of a Tail-stock of a lathe. Assemble the parts and Draw. (i) Sectional front view and (ii) Top View **(60 marks)**

6. Details of a " PLUMMER BLOCK" are shown in figure3. Assemble the parts and draw the following views of the assembly:
   a. Front view showing right half in section.
   b. Side view with left half in section. **(60 marks)**

06ME3

NEW SCHEME

Third Semester B.E. Degree Examination, Jan 2008

(ME/IP/AU/IM/MA/AE/MI)

COMPUTER AIDED MACHINE DRAWING

MODEL QUESTION PAPER -1

Time: 3 hrs. **Max. Marks:**

Note: 1. Answer any **ONE** question from each of the parts **A, B** and **C.**
2. Use **FIRST ANGLE** projections only
3. Missing data if any may suitably be assumed.
4. All the calculations should be on answer sheet supplied.
5. All the dimensions are in mm.
6. Drawing instruments may or may not be used for sketching

PART – A

1. A cone of base diameter 50mm and height 60mm stands with its base on the HP. It is cut b a VT inclined at 70° to the reference line XY and is passing through the apex of the cc Draw its front view, sectional top view and true shape of the section. **(20 marks**

2. Draw the following.
   a) ISO screw thread profile of pitch 50mm Indicate all proportions and dimensions.
   b) Two views of hexagonal headed bolt with nut for a 30mm diameter bolt. Take length of bolt equal to 125mm. **(20 mark**

PART – B

3. Draw the following views of a double riveted butt joint with double cover plates and zig: riveting.
   i) Sectional front-view
   ii) Top- view. Take a plate thickness = 10mm. **(20 marks**

4. Draw the following views of pin type flexible coupling to connect two shafts of 30mm diameter.
   (i) Front view with top half in section and
   (ii) Side view from the pin end **(20 mark**

PART – C

5. Details of a plummer block is shown in Figure1. Assemble the parts and draw the following views with all important dimensions.
   i. Left half sectional front view
   ii. Top view **(60 marks**

6. Figure2 shows the details of screw jack. Assemble the parts and draw the following views.
   i) Sectional front view and ii) Top view. **(60 mark**