

view of this section is shown in Fig. 21.42. The shaft is shown in the round as per normal convention. The retaining screw is drawn as shown. The sectional view, Fig. 21.42, gives a clear view of the inside of the object and is easy to draw. The parts are balloon-referenced.

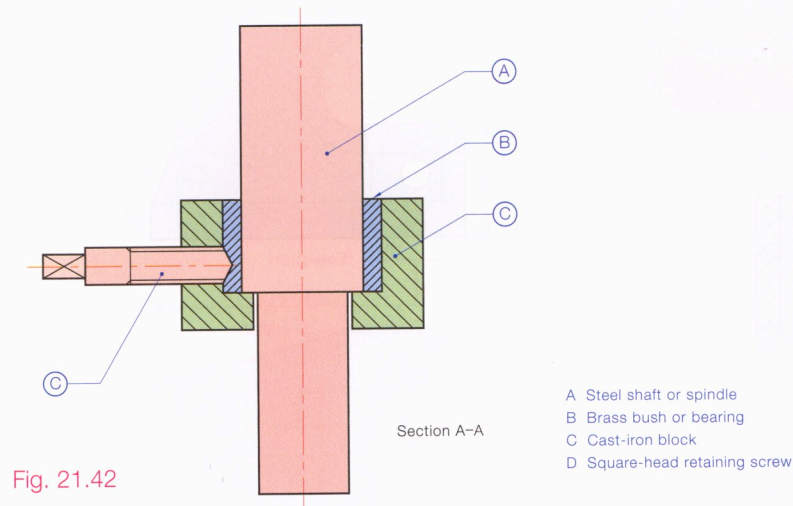


Fig. 21.42

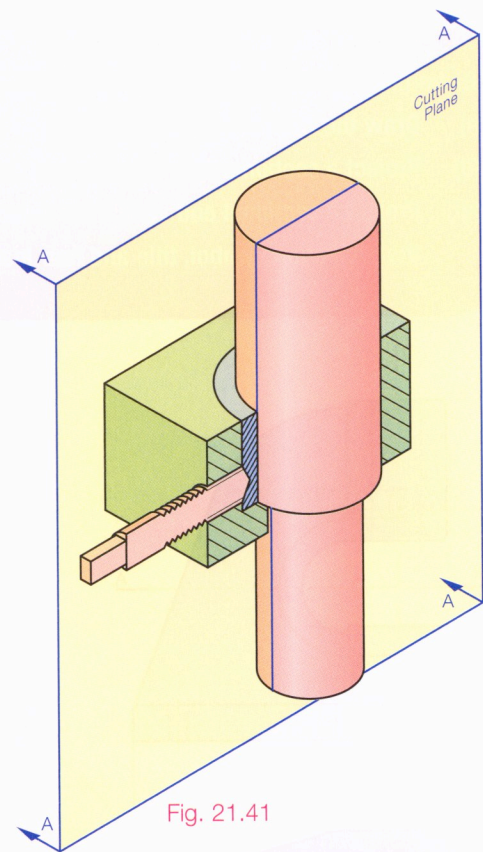


Fig. 21.41

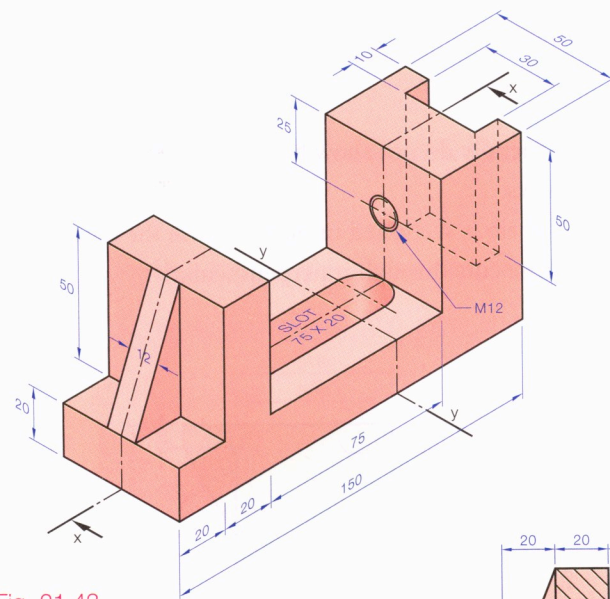
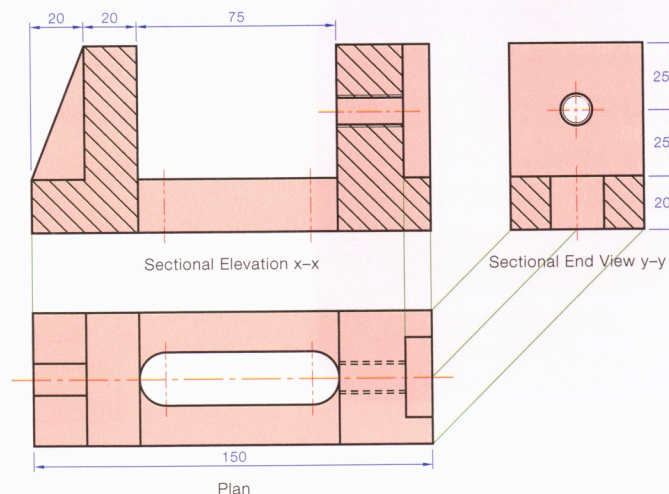


Fig. 21.43

There are several things to note from the solution in Fig. 21.44.

- (1) The rib is not hatched in the sectional elevation X-X even though the plane passes through it.
- (2) The hatch lines in the sectional elevation X-X continue through the threads for the threaded hole.
- (3) The projection symbol is shown.



MACHINE VICE BODY

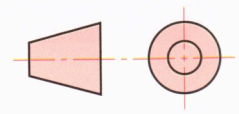


Fig. 21.44

Given the isometric projection of a machine vice body in Fig. 21.43. Draw to full-size using first-angle projection.

- (i) A sectional front elevation on X-X.
- (ii) A sectional end elevation on Y-Y.
- (iii) A full plan.
- (iv) Insert seven leading dimensions.



Given the plan and elevation of a machined casting in Fig. 21.45.

- Draw the front elevation as shown.
- Project a sectional plan from cutting plane A-A.
- Project a sectional end view from cutting plane B-B. Insert the projection symbol, title and four leading dimensions.

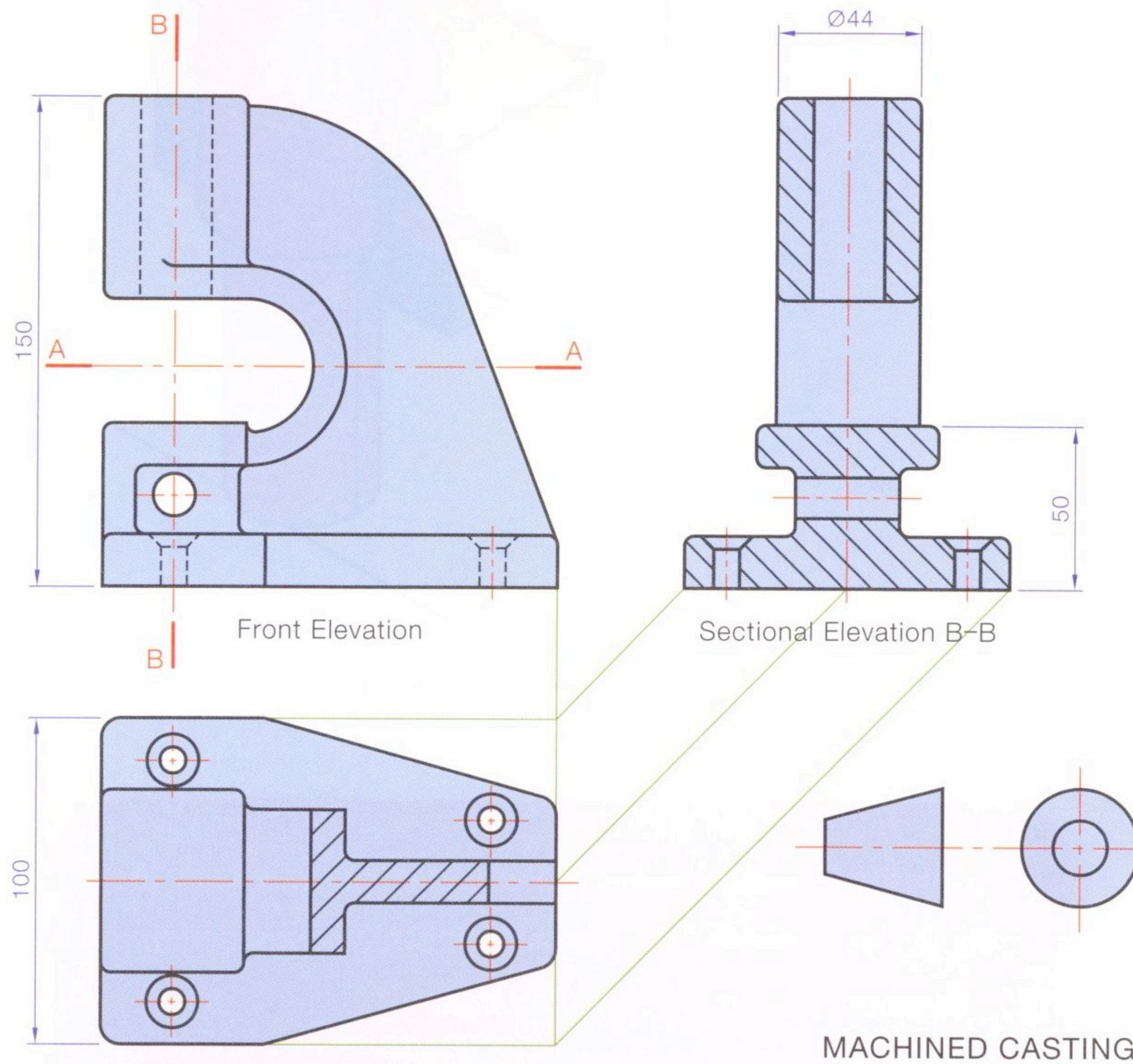


Fig. 21.46

Fig. 21.47 shows the plan and elevation of a vertical support bracket.

- Draw the given plan.
- Project a sectional elevation on X-X.
- Project an end view looking in the direction of arrow A.
- Insert four leading dimensions and the first-angle projection symbol.

**Note:** No hidden detail to be shown on the end view and all undimensioned radii are 5 mm.

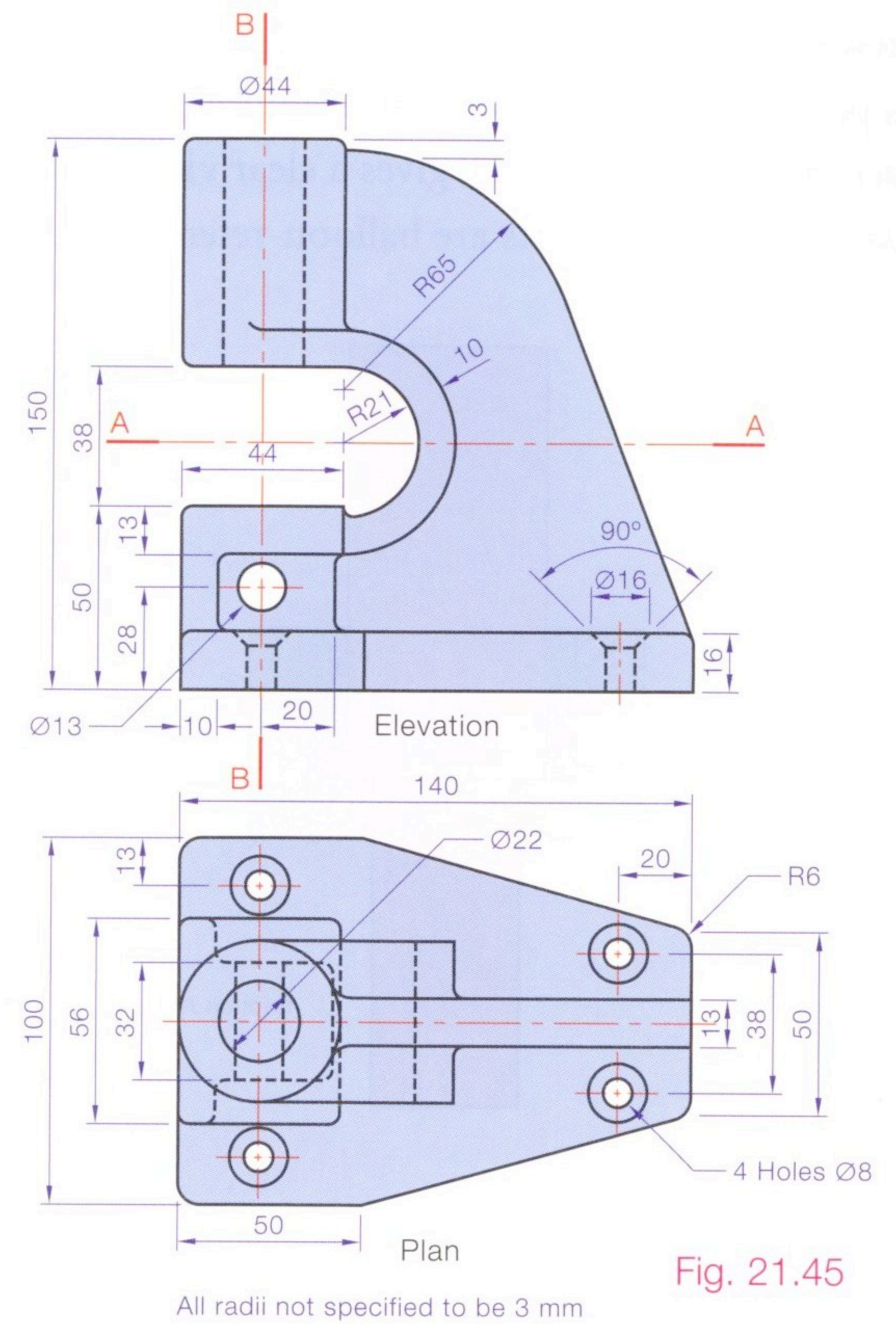


Fig. 21.45

Generally do not show hidden detail in sectional views.

The rib is sectioned in plan because the cutting plane cuts through it perpendicularly.

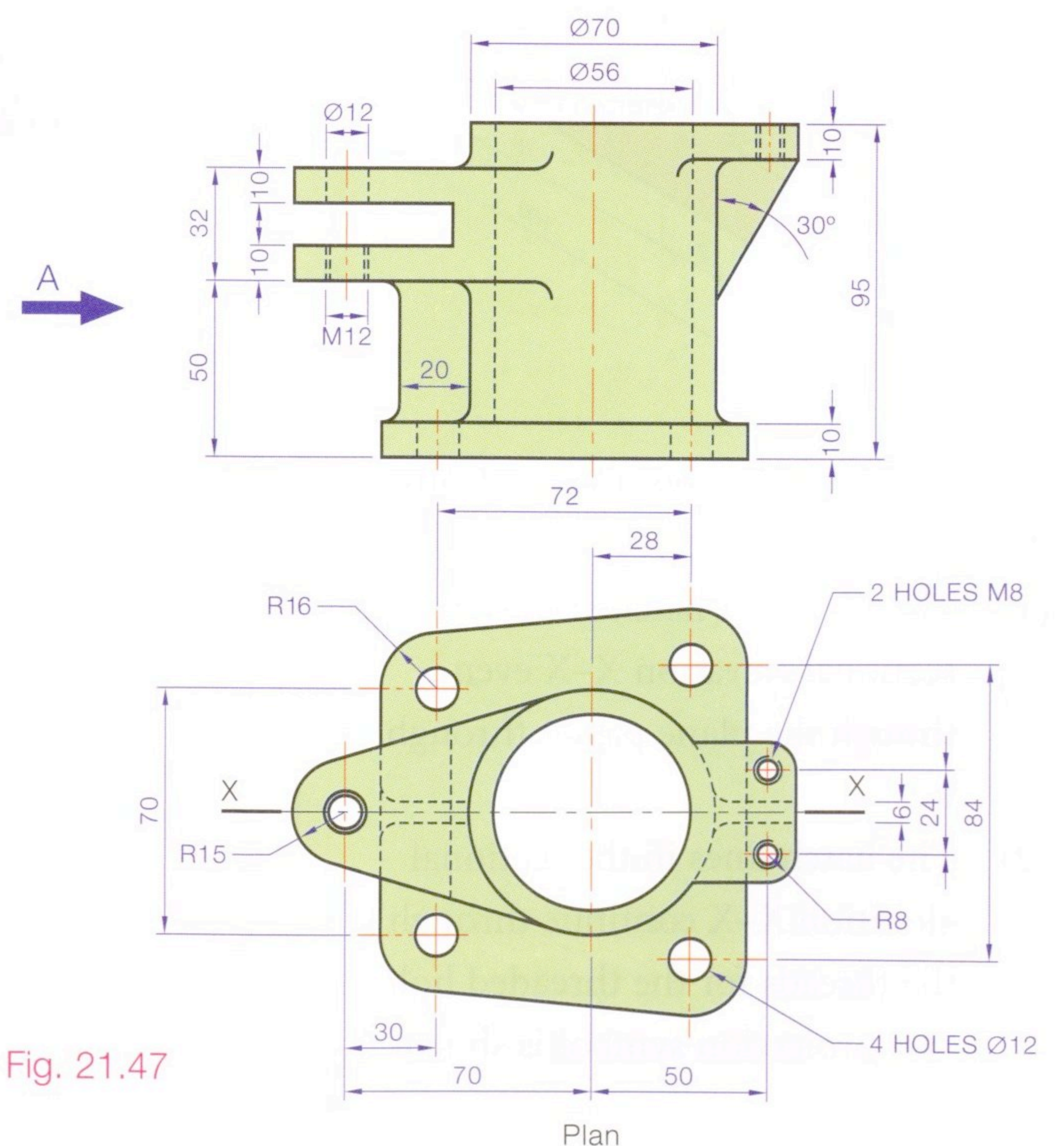


Fig. 21.47



4	NUT	MS	1
3	WASHER	MS	1
2	PIN	MS	1
1	CRANK	CI	1
REF	DESCRIPTION	MATL	QTY

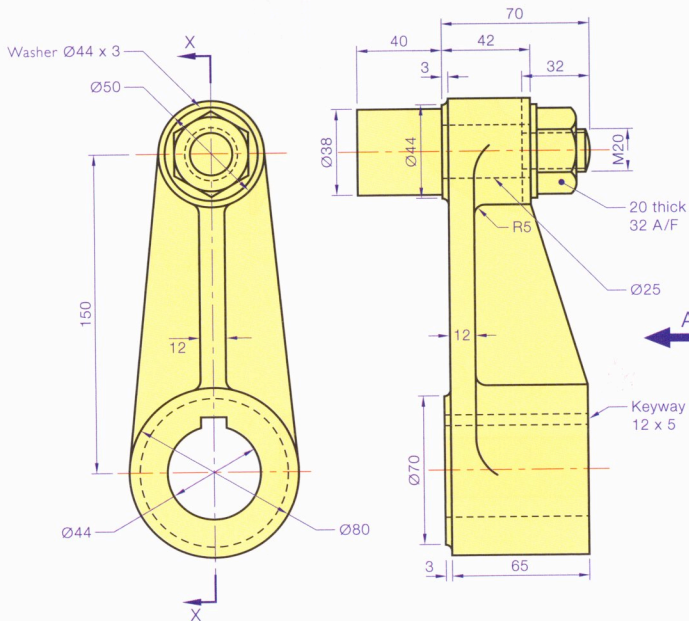


Fig. 21.49

- (1) The section X–X is to be viewed from the right, so therefore the sectional view is drawn on the left.
- (2) In the sectional view the rib, pin, washer and nut are not sectioned.
- (3) Hidden detail is generally not necessary.
- (4) The keyway is not sectioned.
- (5) Try to keep the leaders for the balloon references parallel and keep the balloon circles in line vertically or horizontally.
- (6) The projection symbol must be drawn.
- (7) The parts list is numbered from bottom to top.

4	NUT	MS	1
3	WASHER	MS	1
2	PIN	MS	1
1	CRANK	CI	1
REF	DESCRIPTION	MATL	QTY
CRANK AND PIN			

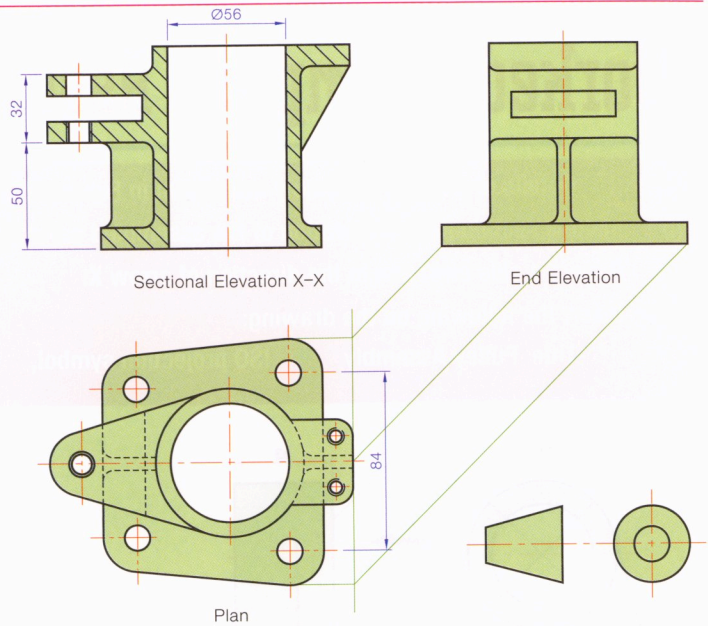


Fig. 21.48

## VERTICAL SUPPORT BRACKET

- (i) Draw an elevation looking in the direction of arrow A.
- (ii) Draw a sectional end view on X-X.
- (iii) Add the parts list, balloon reference the parts and include four main dimensions.

**Use first-angle projection.**

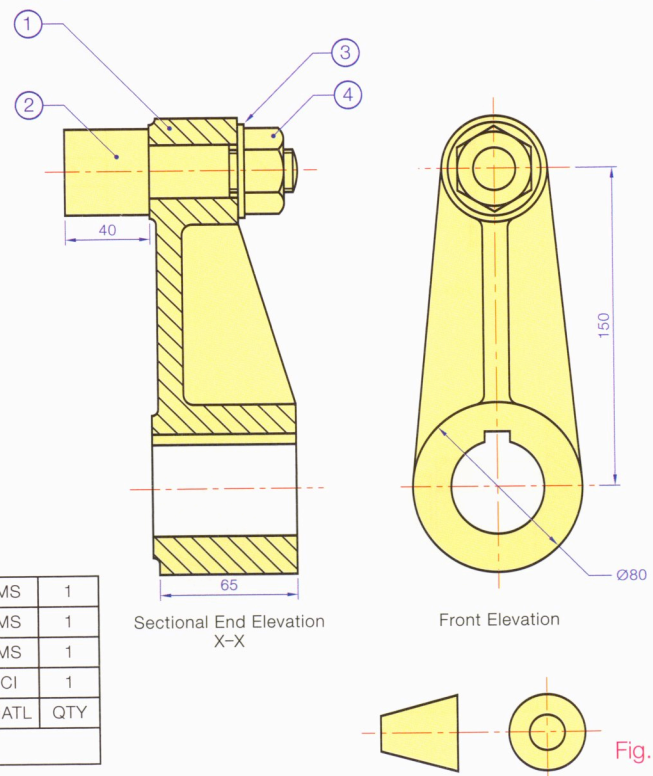


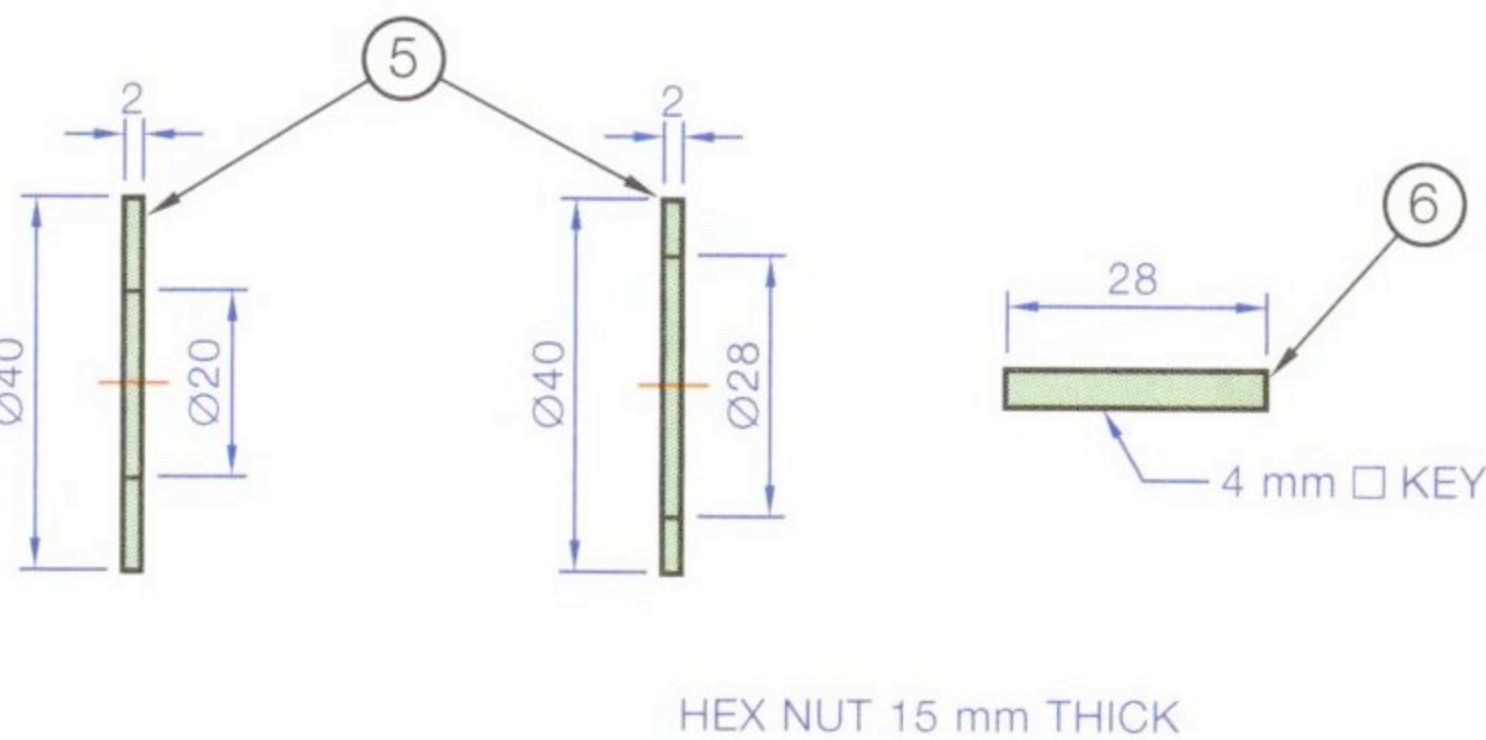
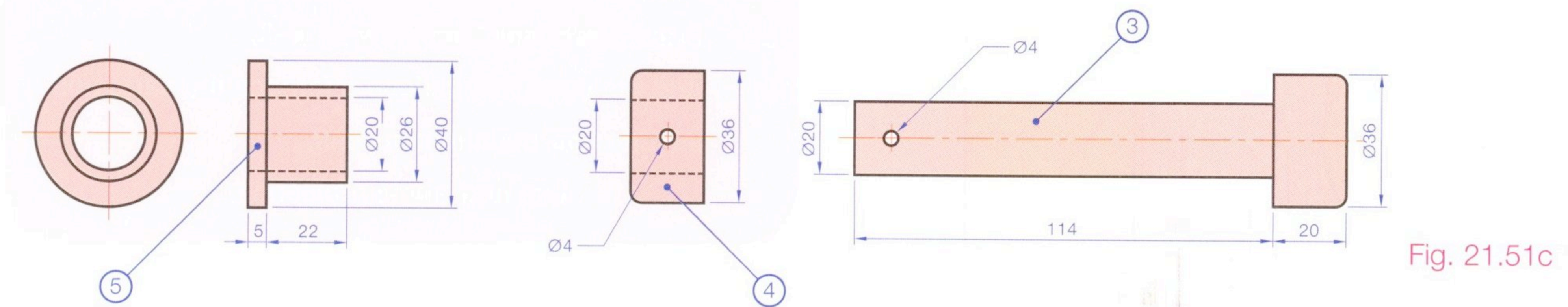
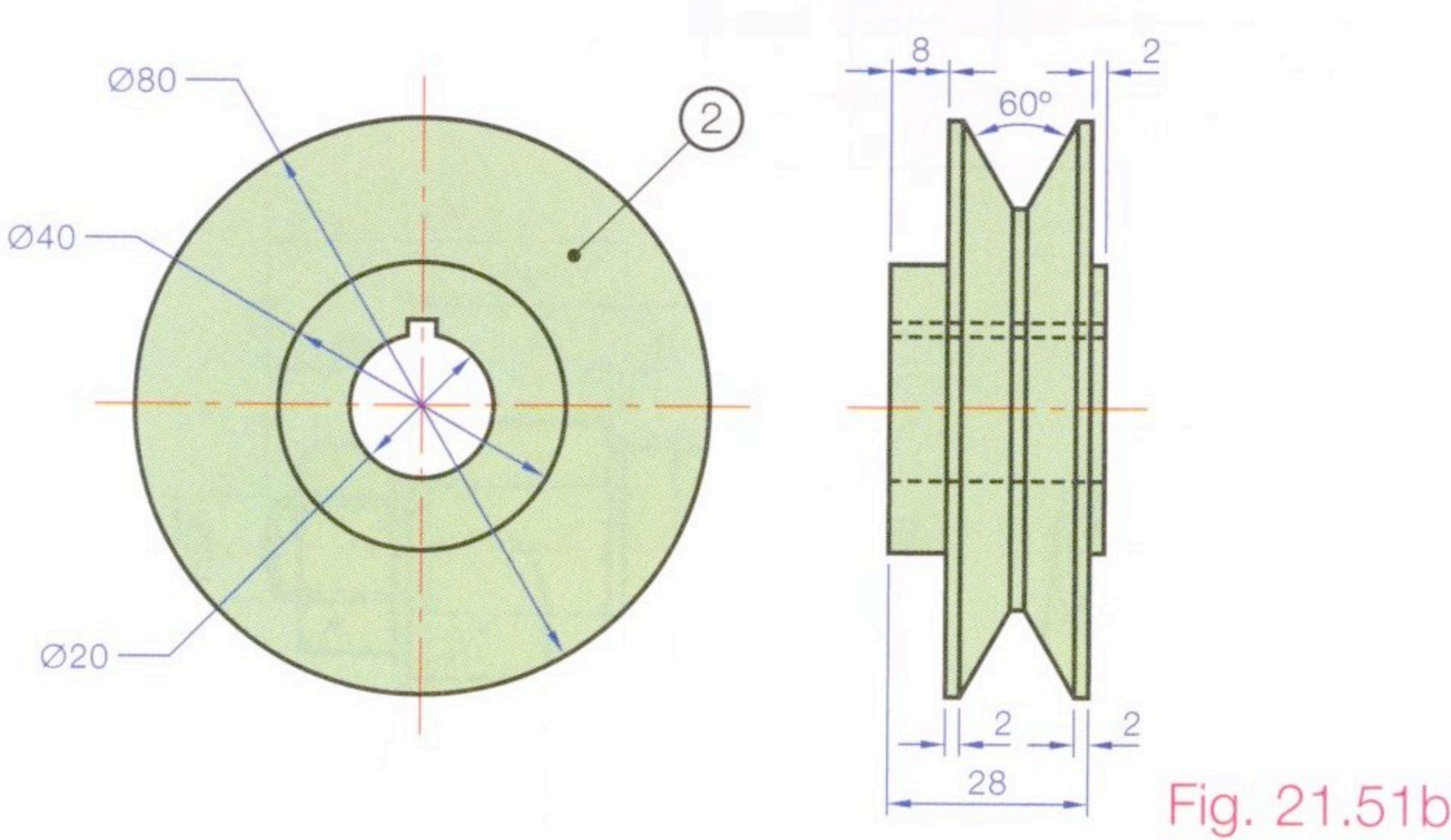
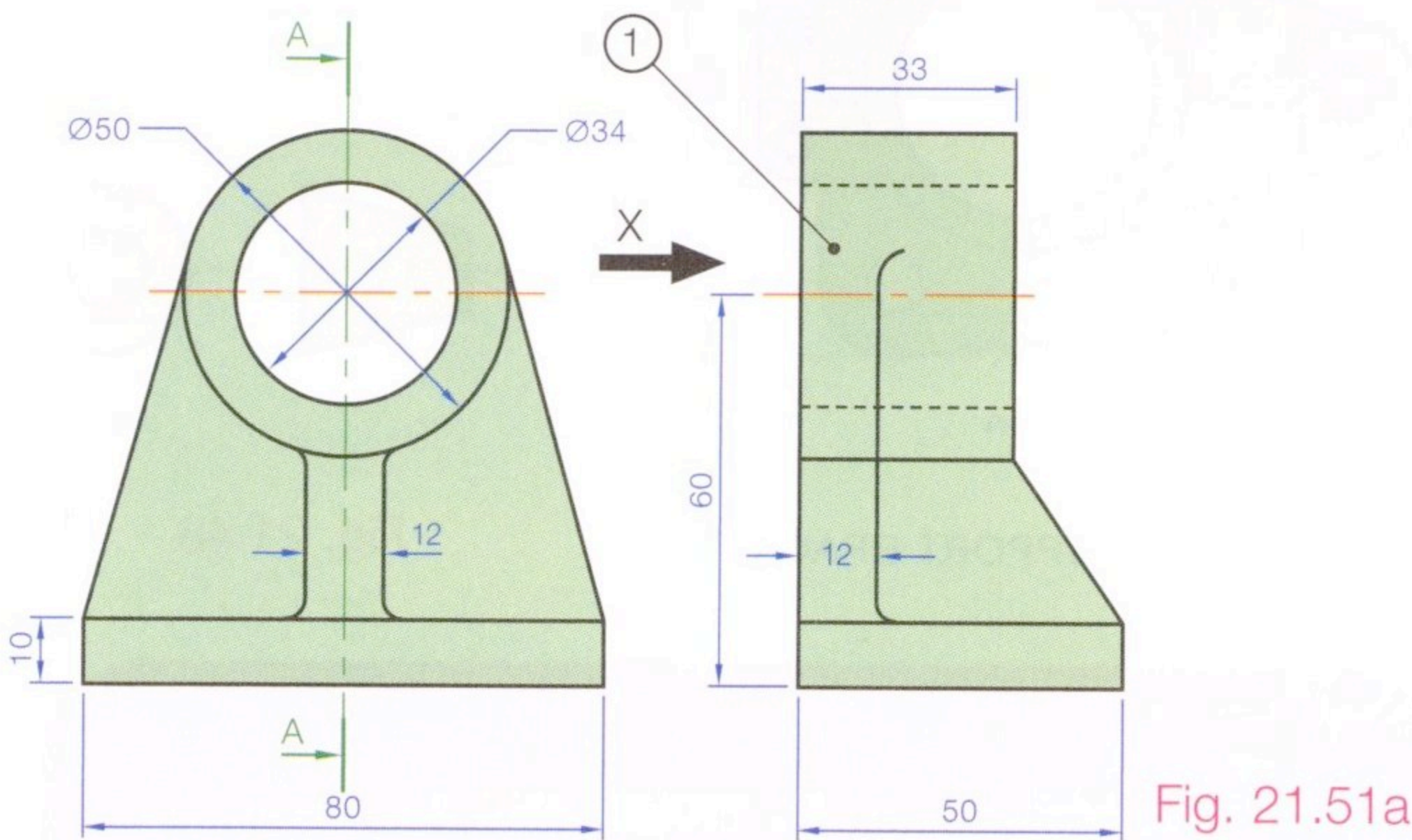
Fig. 21.50



# Worked Examples: Assemblies

Details of a Pulley Assembly are shown in Figures 21.51a to 21.51d with the parts list tabulated.

- (i) Make a sectional front elevation of the assembled parts on section plane A-A.
- (ii) Project a side elevation in the direction of arrow X.
- (iii) Insert the following on the drawing:
  - Title: Pulley Assembly,
  - ISO projection symbol,
  - Four leading dimensions.



INDEX	PART	REQUIRED
7	HEXAGONAL NUT	1
6	PARALLEL KEY	1
5	WASHERS	2
4	SPINDLE	1
3	BRONZE BUSH	1
2	PULLEY	1
1	SUPPORT BRACKET	1

Fig. 21.51d

## Solution

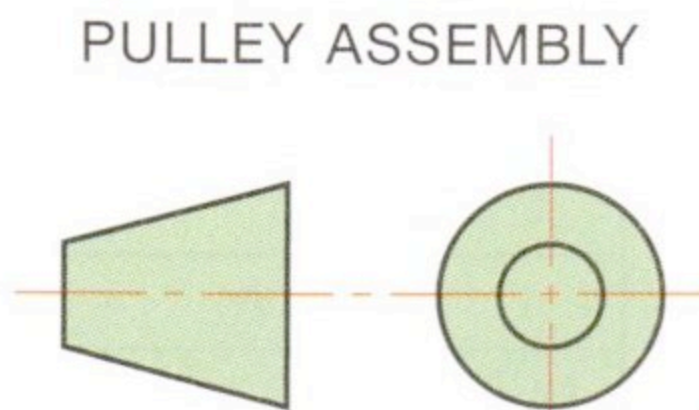
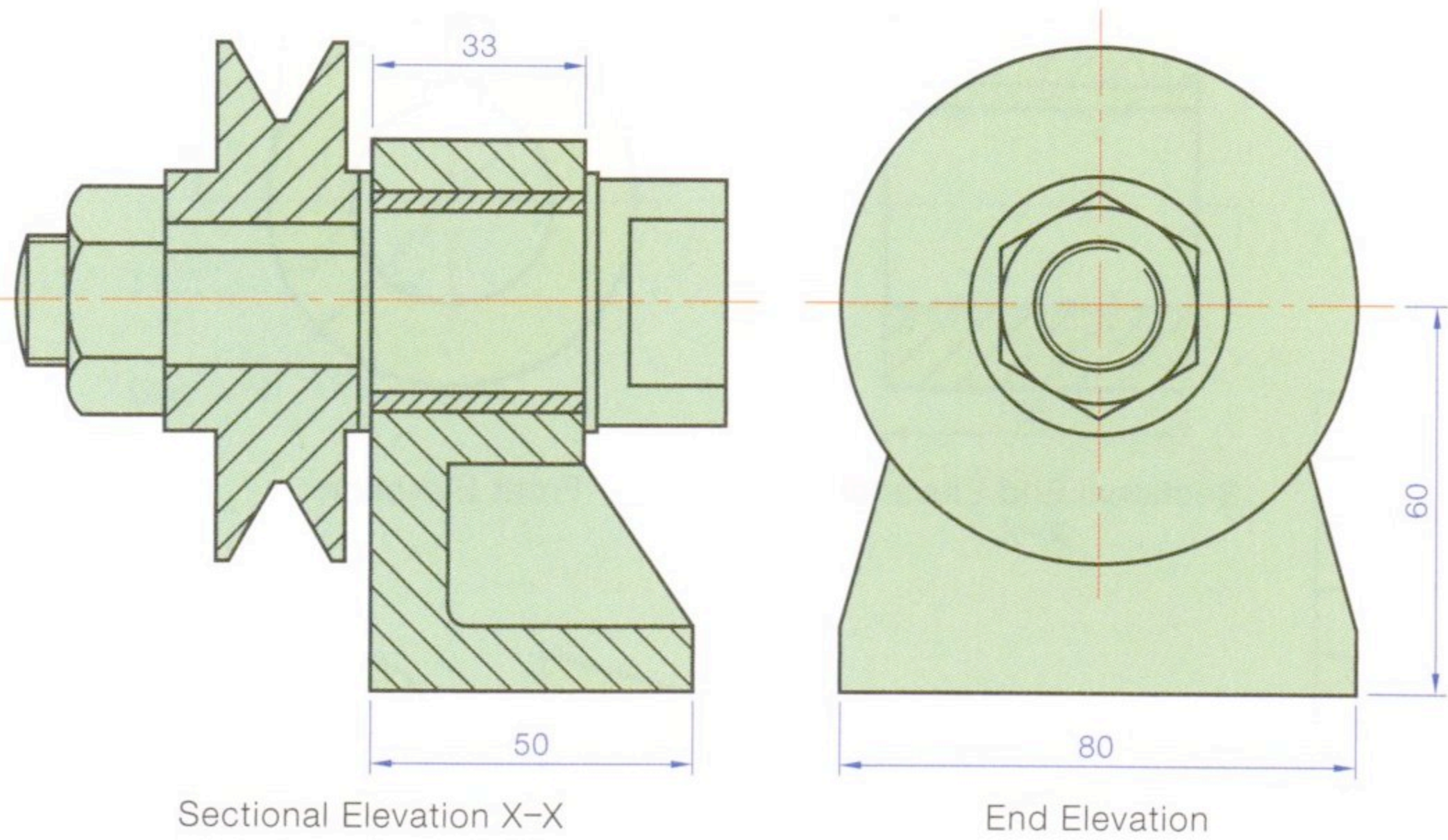


Fig. 21.52



Details of a PIVOT SUPPORT are shown in Figures 21.53a to 21.53d with parts list tabulated. Make the following drawings of the assembled parts:

- (i) A sectional elevation in the direction of arrows A-A.
- (ii) A sectional end elevation in the direction of arrows X-X.
- (iii) A plan projected from the front elevation.

**Insert the title PIVOT SUPPORT and the ISO symbol.**

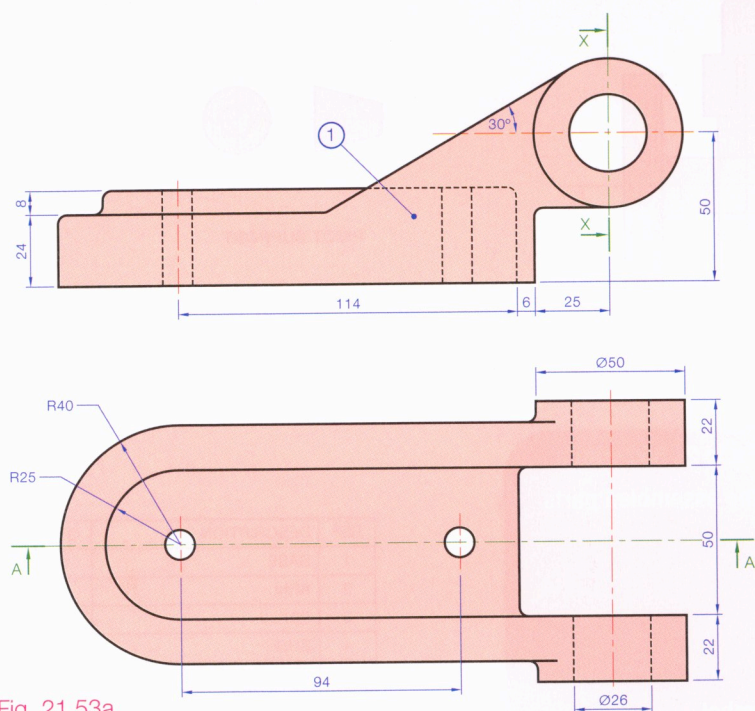


Fig. 21.53a

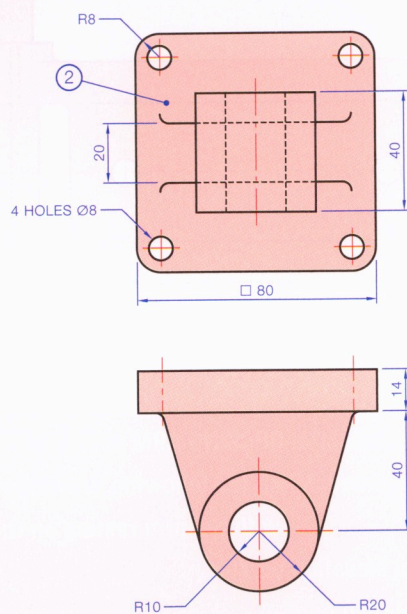


Fig. 21.53b

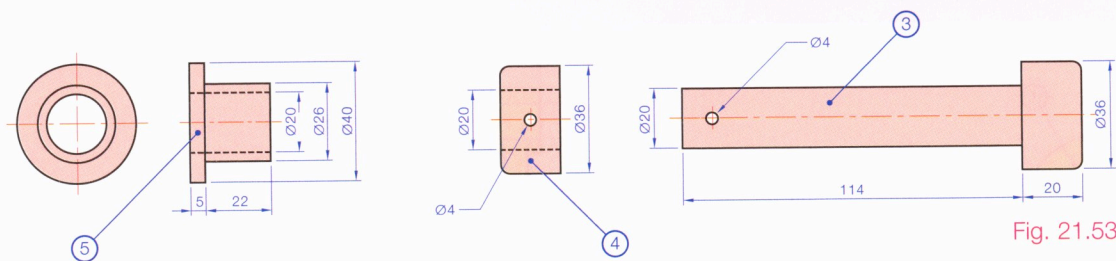


Fig. 21.53c

INDEX	PART	REQUIRED
1	BODY CASTING	1
2	SUPPORT CASTING	1
3	PIN	1
4	COLLAR	1
5	BRONZE BUSH	2
6	SPLIT PIN	1

Fig. 21.53d







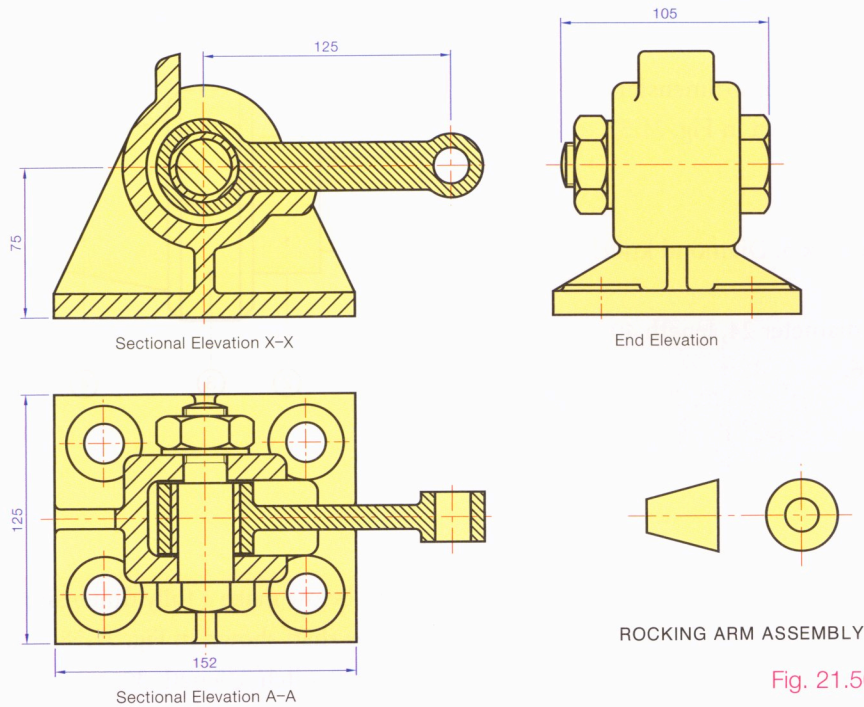
**Solution**

Fig. 21.56

# Activities

## DRAWING TYPES

Q1. Explain the difference between a detail drawing and an assembly drawing.

Q2. Why is it rare to use hidden lines in an assembly drawing?

Q3. List the parts of an assembly that should not be hatched.

Q4. Explain what is meant by the following abbreviations, use diagrams where appropriate:

- A/C • A/F • ASSY • CHAM • CSK • C'BORE • CH HD
- PCD • MATL • RD HD • SQ • U'CUT • FIM • NTS

Q5. make a neat diagram of a typical sheet layout and indicate where the following information would be placed:

- projection symbol, • parts list, • name of assembly, • name of firm,
- drawing number, • date, • scale, • signature.



## DIMENSIONS

Q6. Using the data below, make a fully dimensioned drawing of the machine part shown in Fig. 21.57.

1. Diameter 22, length 24.
2. Square 32, length 16.
3. Diameter 54, length 20, chamfer  $3 \times 3$ . Diamond knurl finish.
4. Taper: Max. diameter 40, min. diameter 24, length 40.
5. Undercut, length 3, diameter 16.
6. Included angle of  $60^\circ$ .

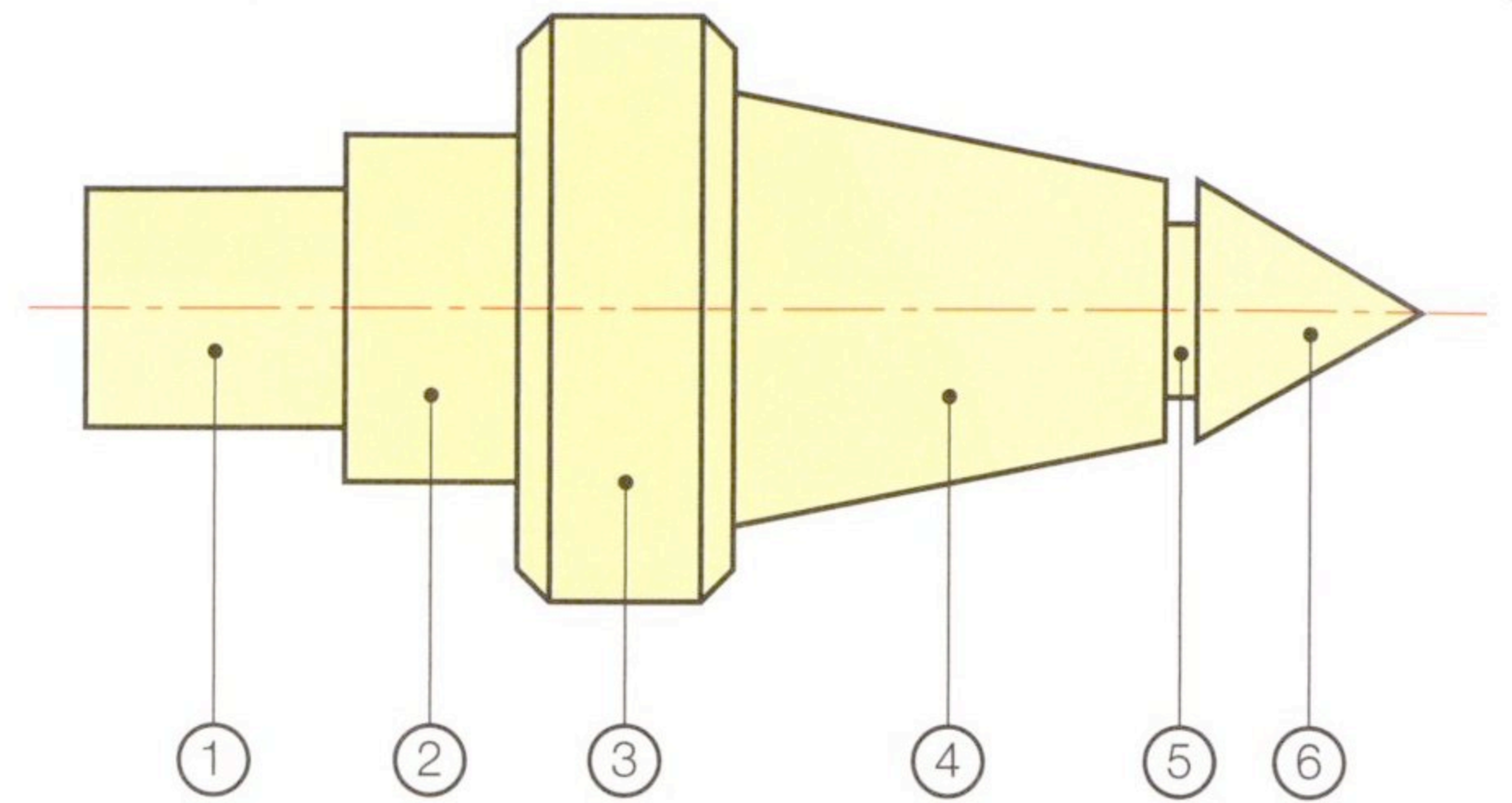


Fig. 21.57

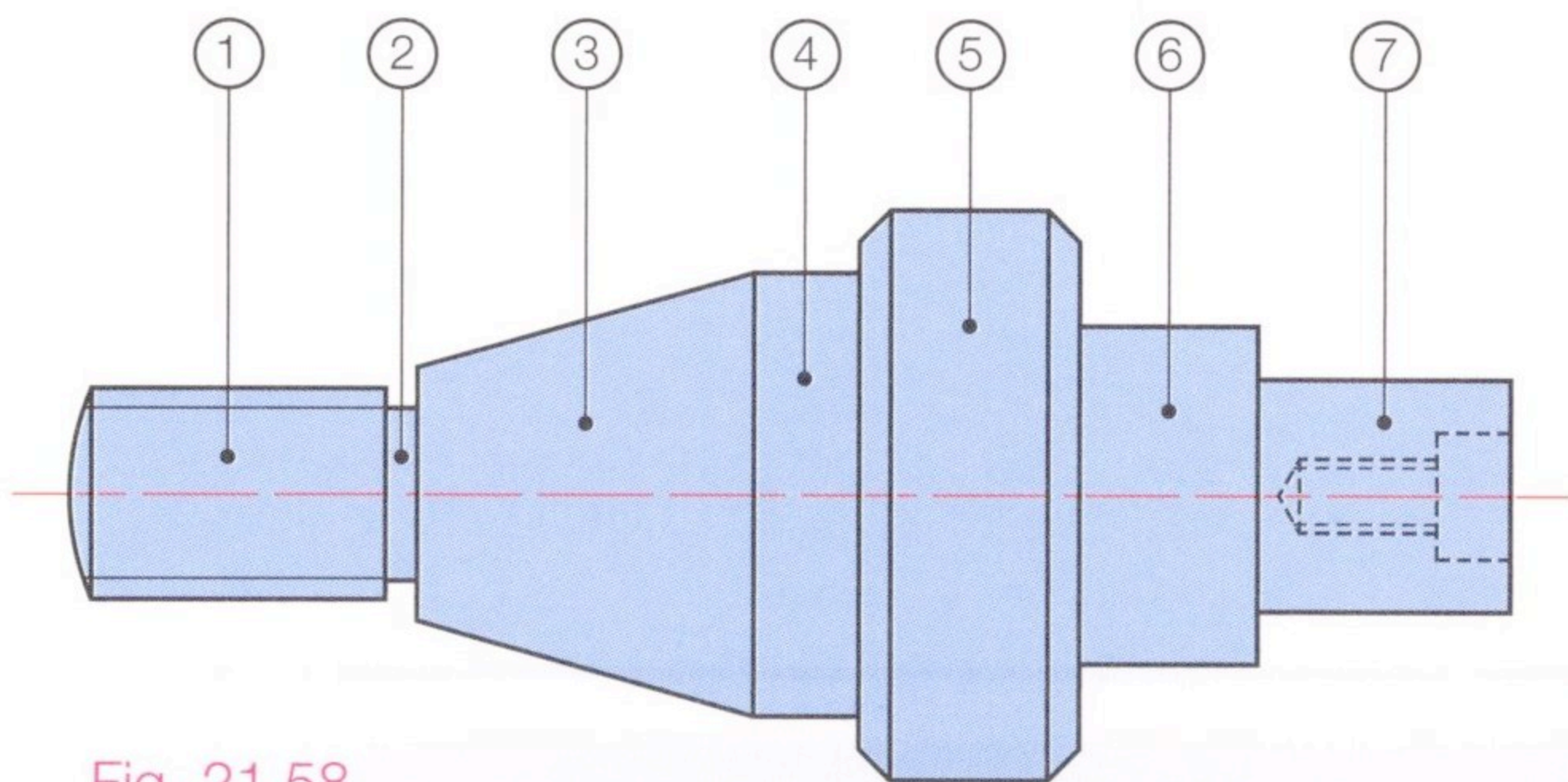


Fig. 21.58

Q7. Using the data below make a fully dimensioned drawing of the shaft shown in Fig. 21.58.

1. Screwthread: metric 20, pitch 2, length 30.
2. Undercut: length 3, diameter 16.
3. Taper: max. diameter 42, min. diameter 24, length 32.
4. Diameter 42, length 10.
5. Diameter 54, length 21, chamfer  $3 \times 3$ . Diamond knurl finish.
6. Diameter 32, length 17.
7. Square 22, length 24, hole threaded M7, 20 deep, counter-bored diameter 12, 7 deep.

Q8. Using the data given below make a fully dimensioned drawing of the machined part shown in Fig. 21.59.

1. Screw thread: M25, pitch 2, length 50 mm.
2. Undercut: length 4 mm, diameter 20 mm.
3. Taper: length 80 mm, min. diameter 28 mm, max. diameter 50 mm, woodruff keyway  $\varnothing 30$  depth and  $6 \text{ mm} \times 3 \text{ mm}$  wide.
4. Shaft: diameter 50 mm, length 100 mm, fillet radius 7 mm.
5. Flange: length 20 mm, diameter 120 mm, recess 10 mm deep and 40 mm A/F hexagonal.

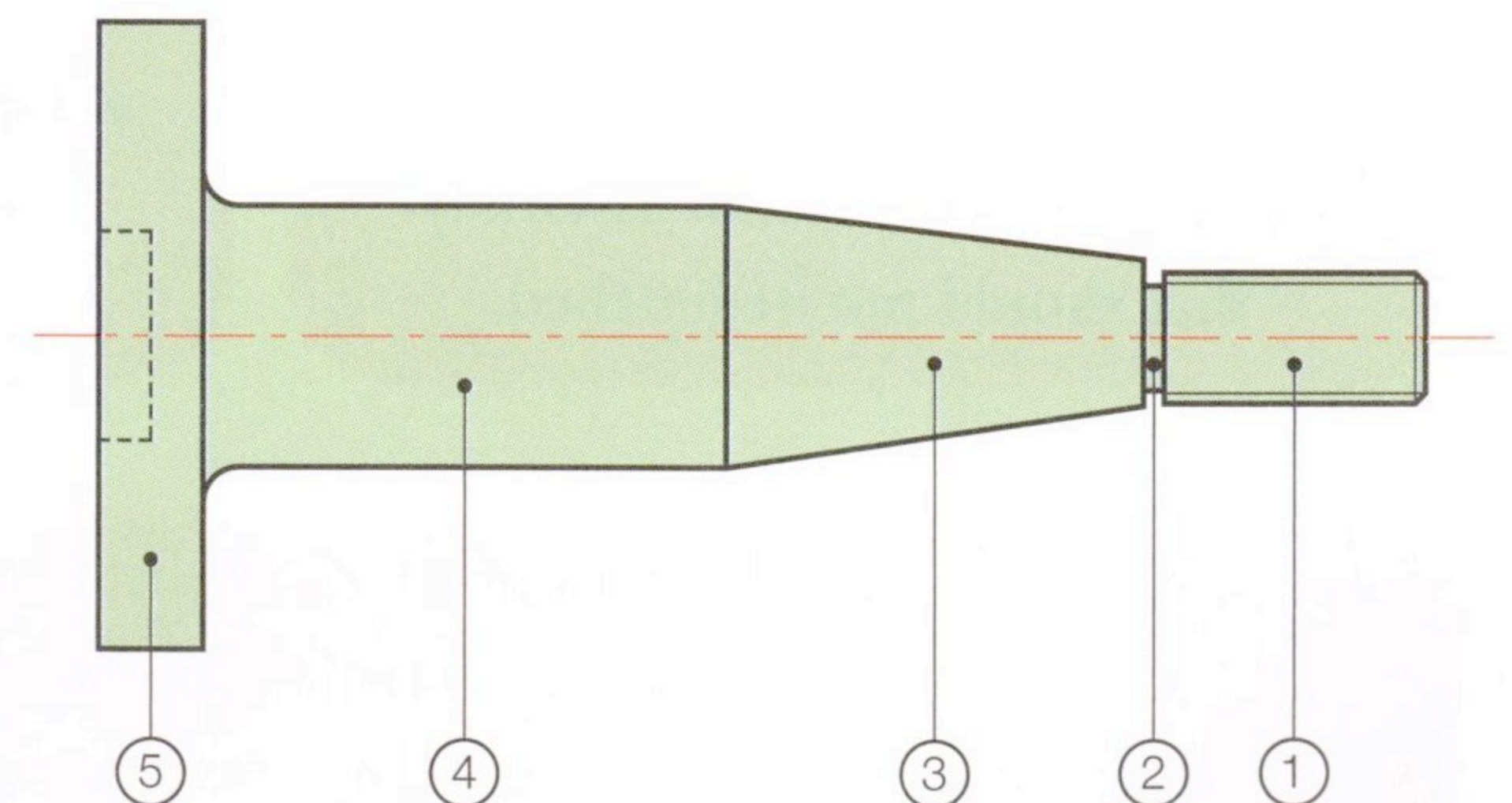


Fig. 21.59



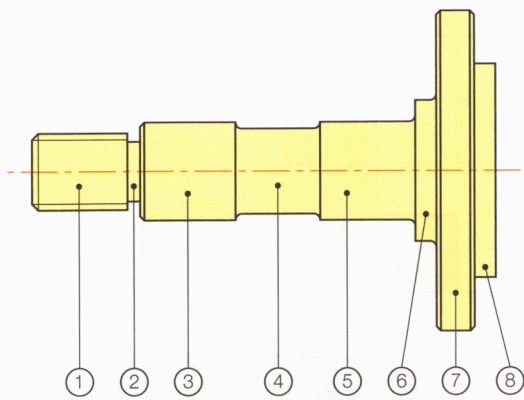


Fig. 21.60

Q9. Fig. 21.60 shows a stub axle. Using the data below draw an elevation and end view. Fully dimension the views.

1. Screwthread: M36, pitch 3, length 45.
2. Undercut: 4 mm deep  $\times$  6 mm long.
3. Diameter: 46 mm  $\times$  45 mm long, chamfer 2 mm  $\times$  45°.
4. Diameter: 40 mm  $\times$  40 mm long, fillet radius 3 mm.
5. Diameter: 46 mm  $\times$  45 mm long, fillet radii 3 mm.
6. Diameter: 66 mm  $\times$  10 mm long, fillet radii 3 mm.
7. Flange diameter 150 mm, thickness 18 mm, chamfer 2 mm  $\times$  45°, 6  $\times$  diameter 10 mm holes on 122 mm PCD.
8. Spigot diameter 100 mm  $\times$  10 mm long.

## SECTIONAL VIEWS

Q10. A front elevation and plan of a casting are shown in Fig. 21.61.

- (i) Draw a sectional elevation on plane B–B.
- (ii) Draw a sectional plan on plane A–A.
- (iii) An end view showing all hidden detail.
- (iv) Insert five leading dimensions, the first-angle projection symbol and the title 'GATE SUPPORT'.

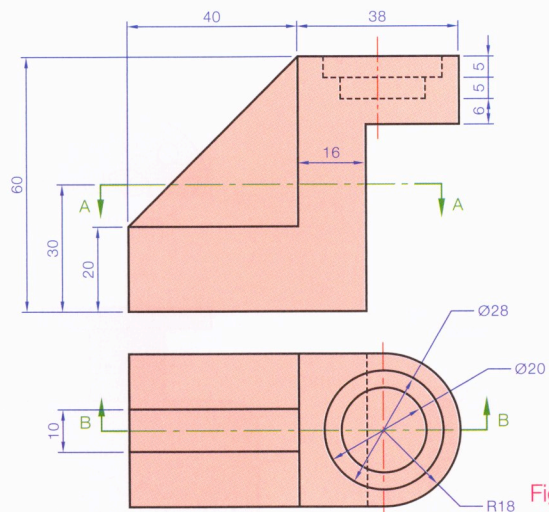


Fig. 21.61

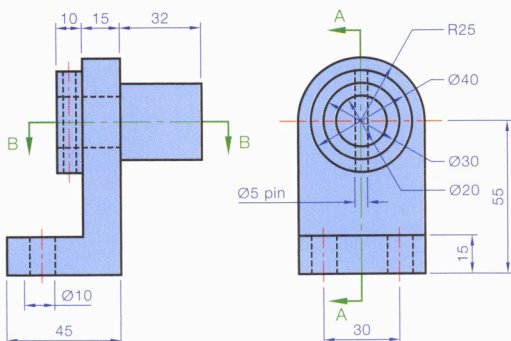


Fig. 21.62

Q11. A front elevation and end view of a ring, a shaft, a pin and a bracket.

- (i) Draw a sectional elevation on A–A.
- (ii) Draw a sectional plan on B–B.
- (iii) Insert four leading dimensions, the projection symbol and the title 'SHAFT SUPPORT BRACKET'.



Q12. The object shown in Fig. 21.63 is to have a 30 mm long M12 HEX HD bolt inserted in the top.

- Draw the given plan and elevation with the bolt included and inserted 15 mm into the threaded hole.
- Draw a sectional end elevation on plane A–A.
- Insert four leading dimensions, the projection symbol and the title 'BASE PLATE AND UPRIGHT'.

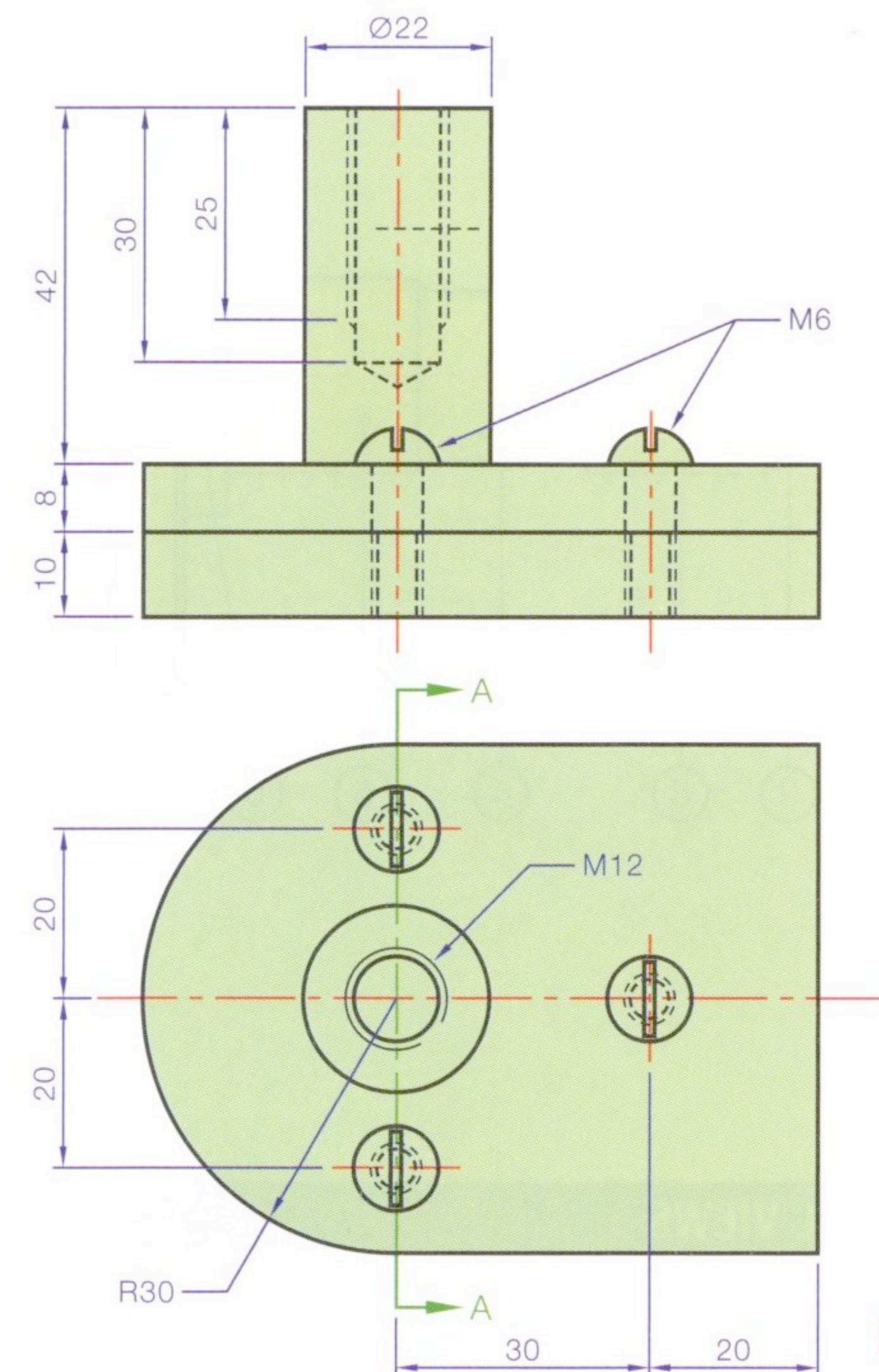


Fig. 21.63

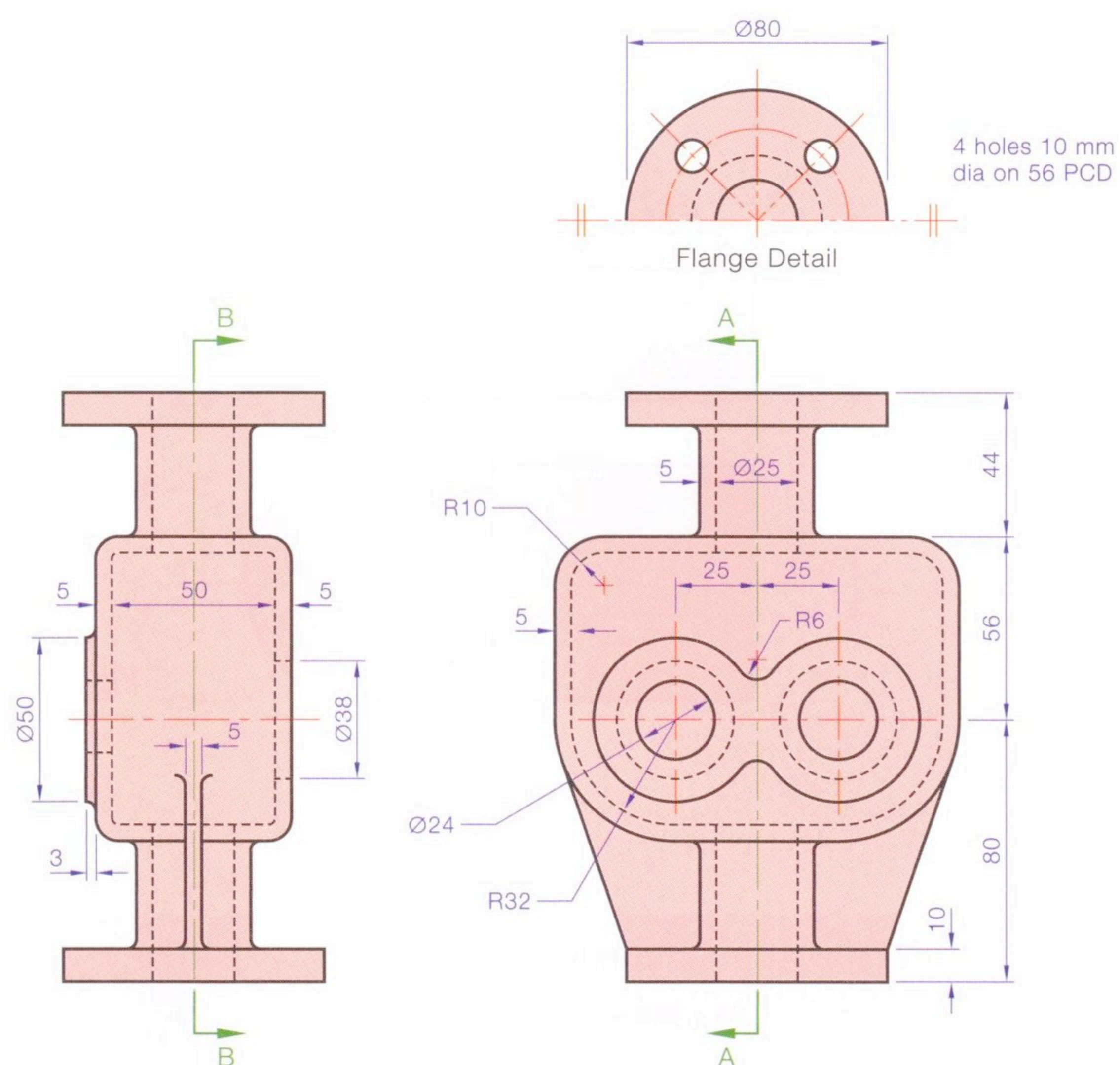


Fig. 21.64

Q13. Shown in Fig. 21.64 is a pump body casing.

- Draw a sectional end elevation on A–A.
- Draw a sectional front elevation on B–B.
- Draw a full plan projected from (ii).
- Insert five leading dimensions, the ISO projection symbol and the title 'PUMP BODY'.



## ASSEMBLIES

Q14. Details of a pulley assembly are given in Fig. 21.65a. The parts list is tabulated.

- (1) Make the following drawings of the assembled parts:
  - (i) A sectional front elevation on section plane A–A.
  - (ii) A full plan projected from the front elevation.
  - (iii) An end elevation in the direction of arrow B.
- (2) Insert the following on the drawing:
  - (i) Title: 'PULLEY ASSEMBLY'.
  - (ii) ISO projection symbol.
  - (iii) Five leading dimensions.

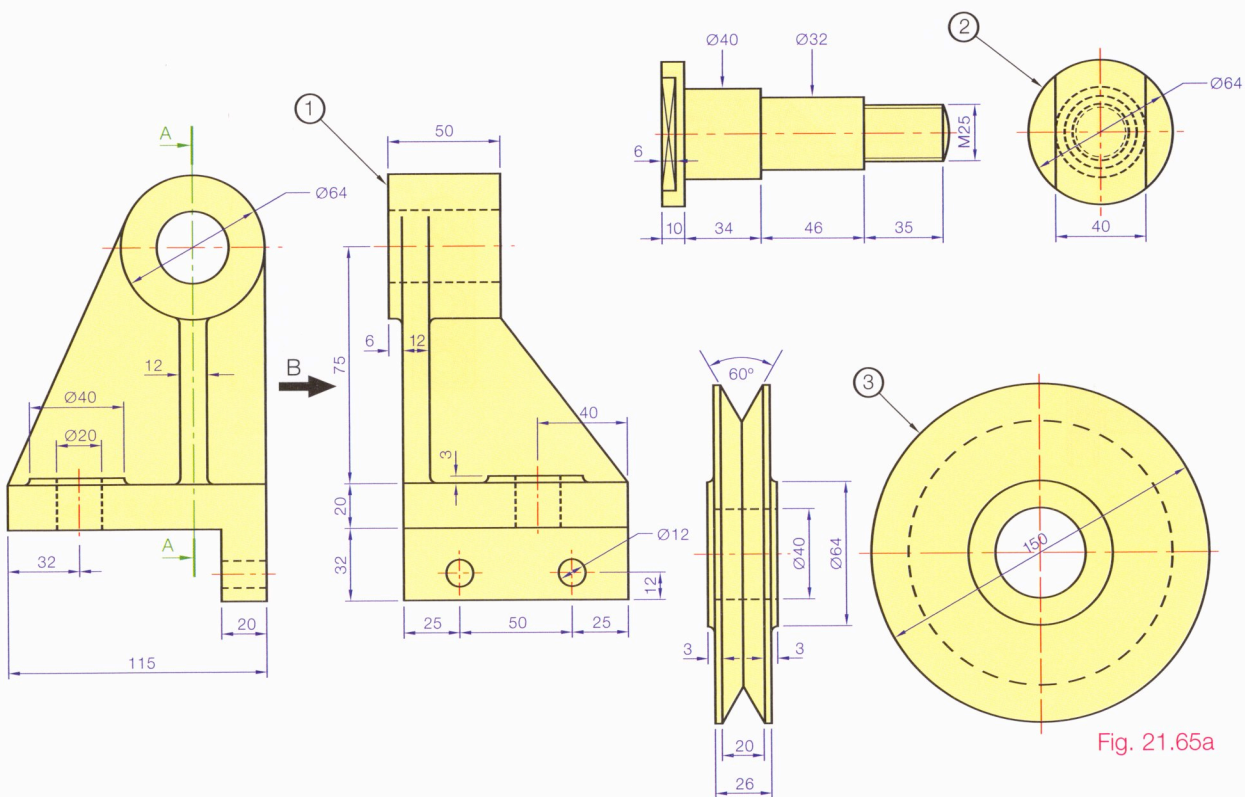


Fig. 21.65a

Index	Part	Required
1	Support Bracket	1
2	Shaft	1
3	Pulley	1
	Hex Nut M25	1
	Washer Ext Ø64, Int Ø42 1.5 mm thick	1
	Washer Ext Ø64, Int Ø28 2 mm thick	1

Fig. 21.65b



Q15. Details of a clamping device are shown in Fig. 21.66a. The parts list is tabulated.

- (1) Make the following drawings of the assembled parts:
  - (i) A sectional front elevation on section plane A–A.
  - (ii) A full plan.

The movable jaw should be shown in the mid-position.

- (2) Insert the following on the drawing:
  - (i) Title: ‘CLAMPING DEVICE’.
  - (ii) ISO projection symbol.
  - (iii) Five leading dimensions.

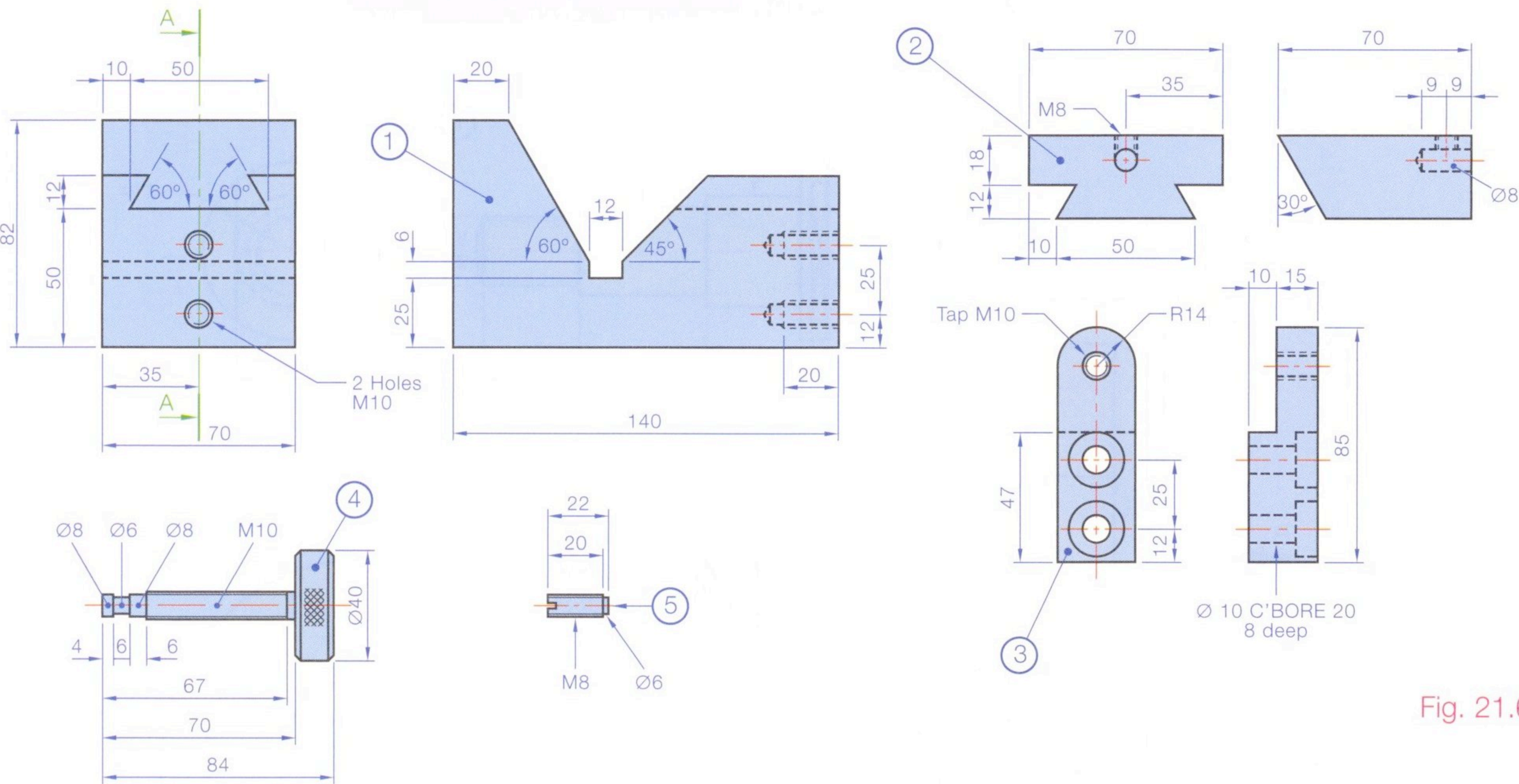


Fig. 21.66a

Index	Part	Quantity
1	Base	1
2	Sliding Jaw	1
3	End Plate	1
4	Clamping Screw	1
5	Grub Screw	1
6	Cheese Head Screw	2
	M10 x 35 mm long	

Fig. 21.66b





Fig. 21.67b