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Question Paper Code : 33580

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2013.

Fourth Semester

Mechanical Engineering

ME 1252/070120014 — KINEMATICS OF MACHINERY

(Common to Third Semester, Mechatronics Engineering)

(Regulation 2004/2007)

(Common to B.E. (Part-Time) Third Semester — Mechanical Engineering
Regulation 2005)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Determine the degree of freedom for the linkage shown in Fig. 1.

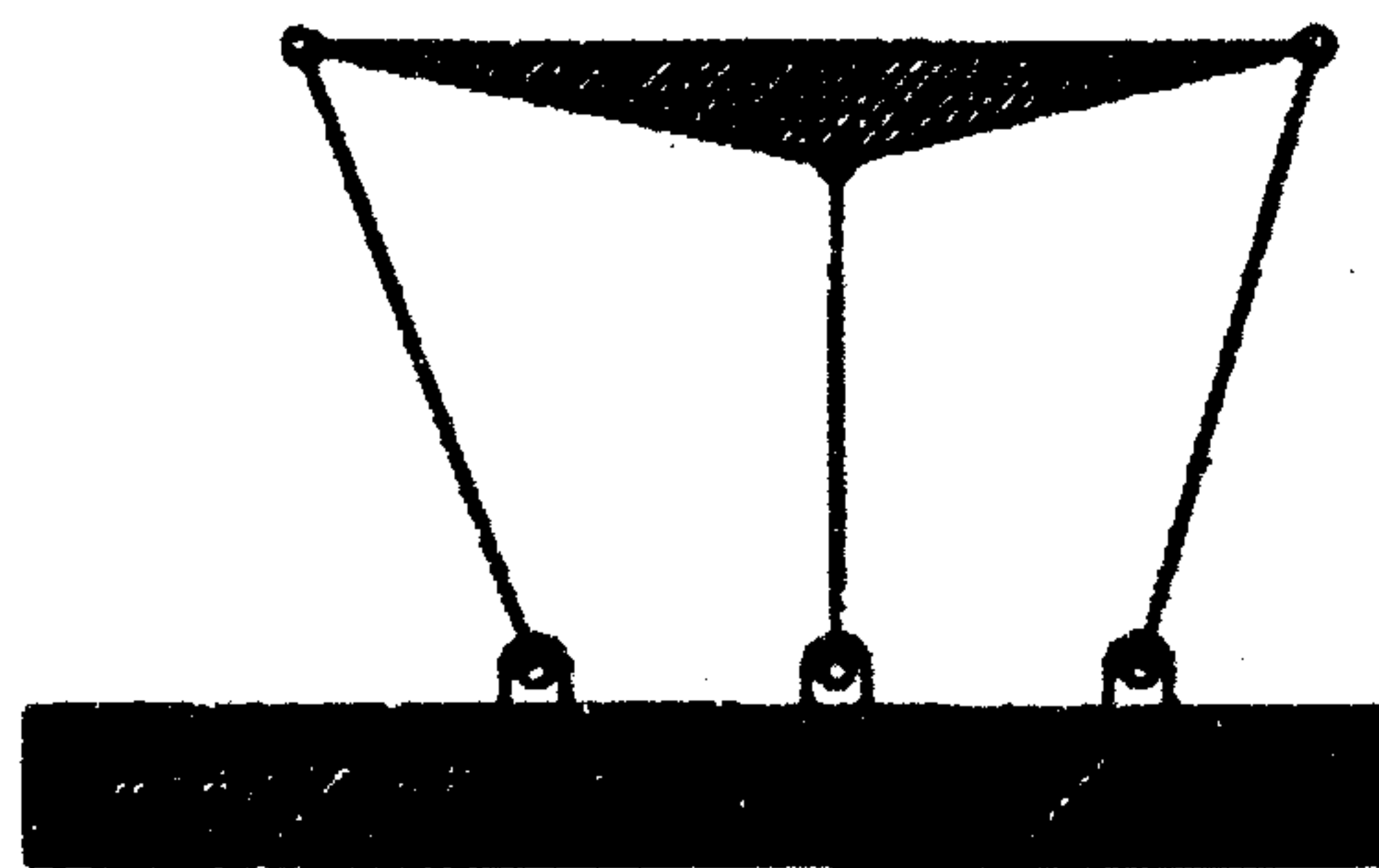


Fig. 1 Linkage

2. Define: Mechanical advantage.
3. State the significance of computer aided analysis of mechanisms.

4. Identify the direction of Coriolis component for the given link (velocity vector qV_p) that rotates at an angular velocity ω (Fig.2(a) and Fig.2(b)).



Fig. 2(a)

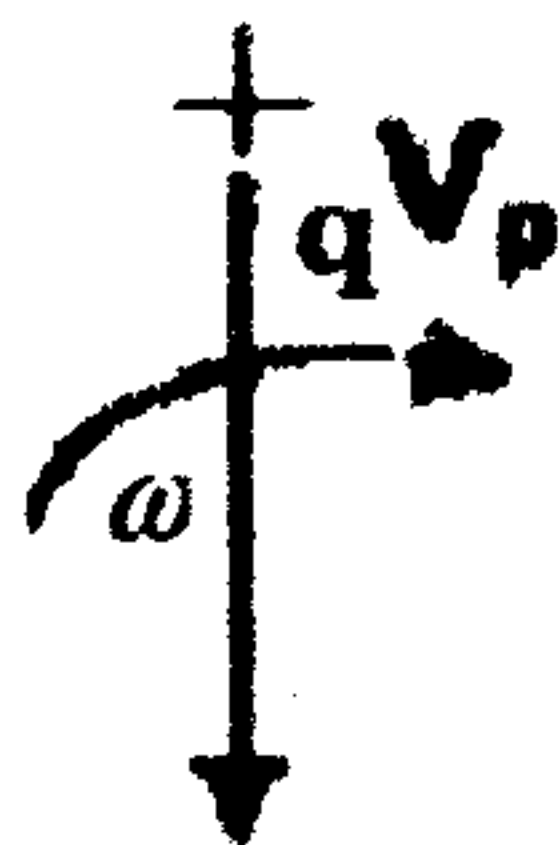


Fig. 2(b)

5. List the advantages and limitations of a mushroom follower.
6. Under what conditions, does a cam gets undercut?
7. Define: module of a gear.
8. 'For two wheels of equal size with 20° pressure angle and addendum equal to 1 module, the minimum number of teeth on each wheel to avoid interference must be 13' — Prove.
9. Mention the significance of multi-plate clutch.
10. The brake drum of a single block brake of diameter 320 mm is rotating at 420 rpm. If the angle of contact is 90° , co-efficient of friction between the drum and brake block is 0.25, determine the equivalent co-efficient of friction.

PART B — (5 × 16 = 80 marks)

11. (a) (i) With a neat sketch, explain the first inversion of a slider crank chain. (4)
- (ii) A crank-rocker mechanism has a 70 mm fixed link, a 20 mm crank, a 50 mm coupler and 70 mm rocker. Draw the mechanism and determine the maximum and minimum values of the transmission angle. Locate the two toggle points and find the corresponding crank angles and transmission angles. (12)

Or

- (b) (i) Identify the type of mechanisms shown in Fig.3(a) to Fig.3(d), whether it is crank-rocker or double-crank or double-rocker and justify the answer. The dimensions are provided in standard units of length. (8)

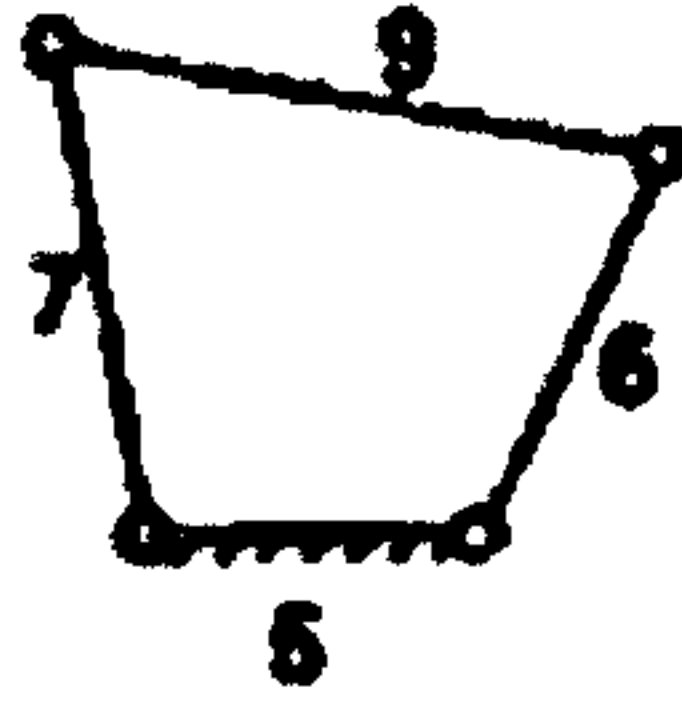


Fig. 3(a)



Fig. 3(b)

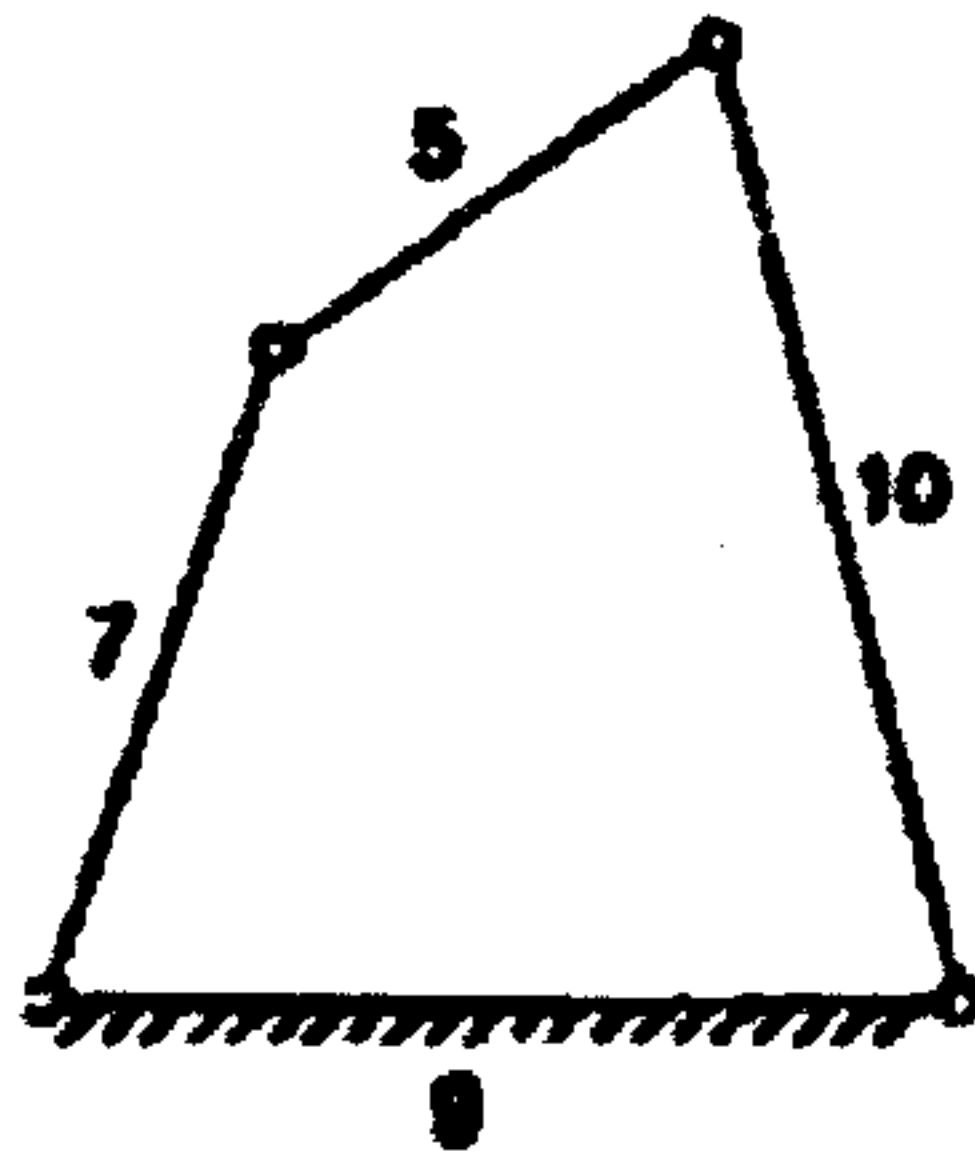


Fig. 3(c)

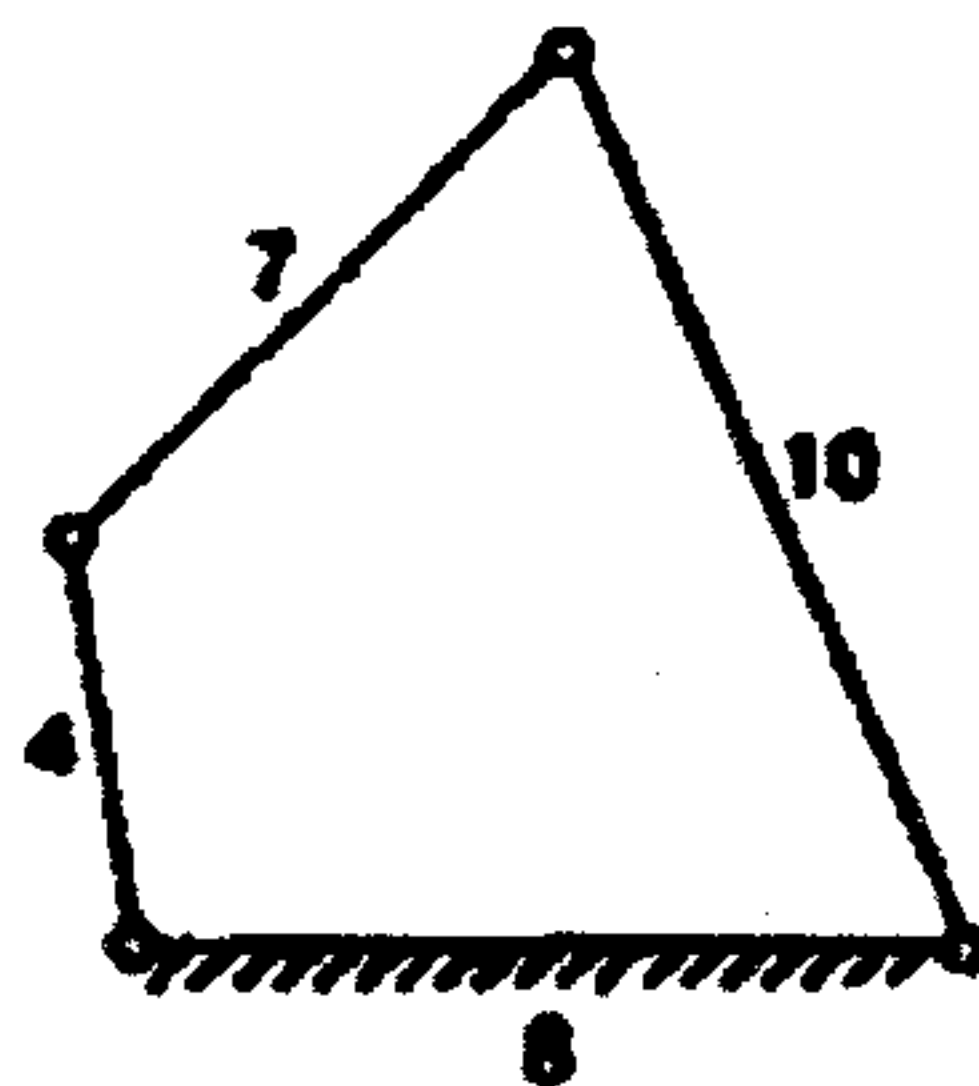


Fig. 3(d)

- (ii) With a neat sketch, explain the crank and slotted lever mechanism. (8)

12. (a) In a mechanism shown in Fig. 4, the angular velocity of the crank OA is 15 rad/s and the slider at E is constrained to move at 2.5 m/s. The motion of both the sliders is vertical and the link BC is horizontal in the position shown. Determine the

- (i) rubbing velocity at B if the pin diameter is 15 mm (8)
(ii) velocity of slider D. (8)

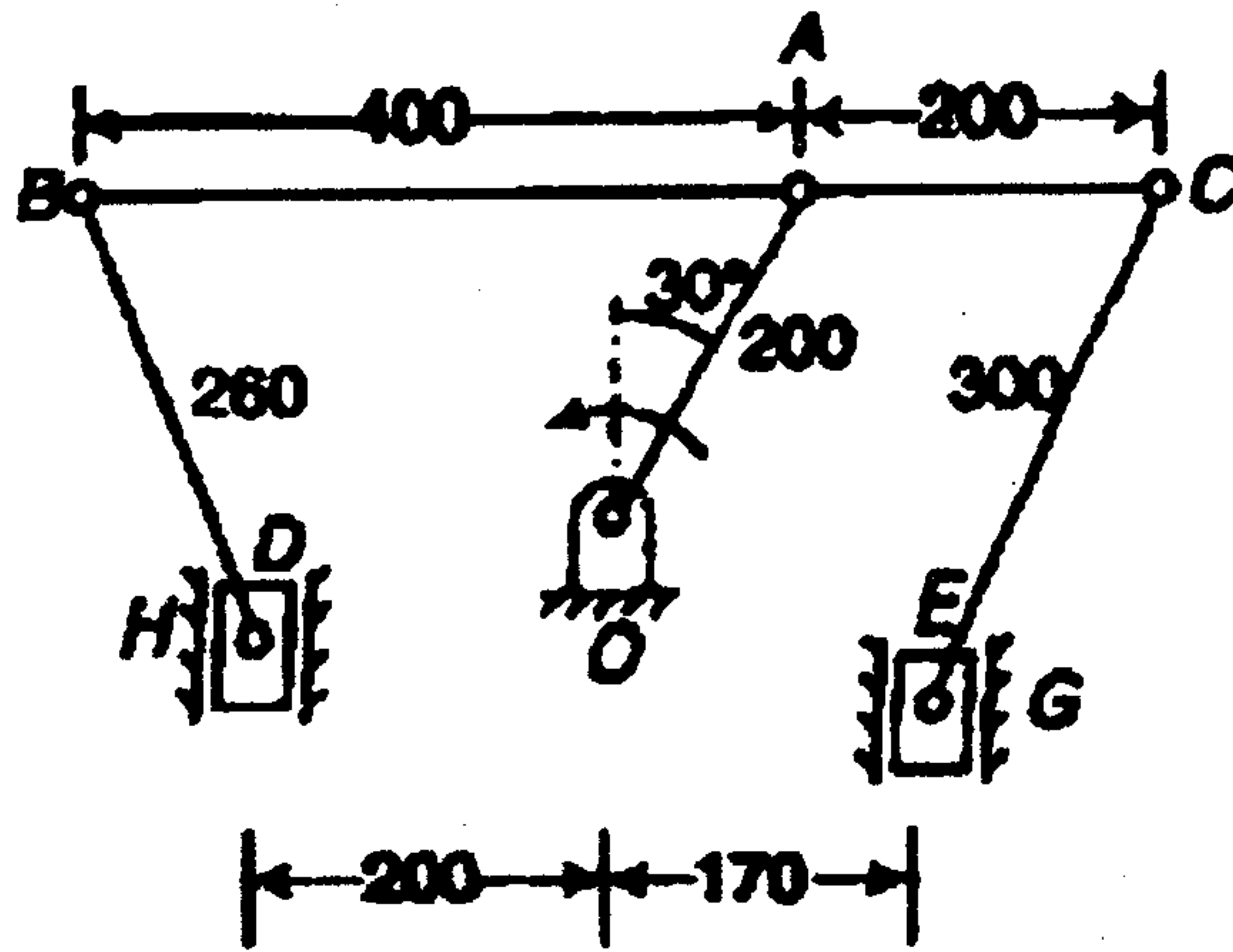


Fig. 4

Or

- (b) In the mechanism shown in Fig. 5, the slider is moving to the right with a velocity of 1 m/s and an acceleration of 2.5 m/s^2 . The dimensions of various links are $AB = 3 \text{ m}$ inclined at 45° with the vertical and $BC = 1.5 \text{ m}$ inclined at 45° with the horizontal. Determine

- (i) acceleration of point B and its magnitude of horizontal and vertical component (8)
(ii) the angular acceleration of the links AB and BC. (8)

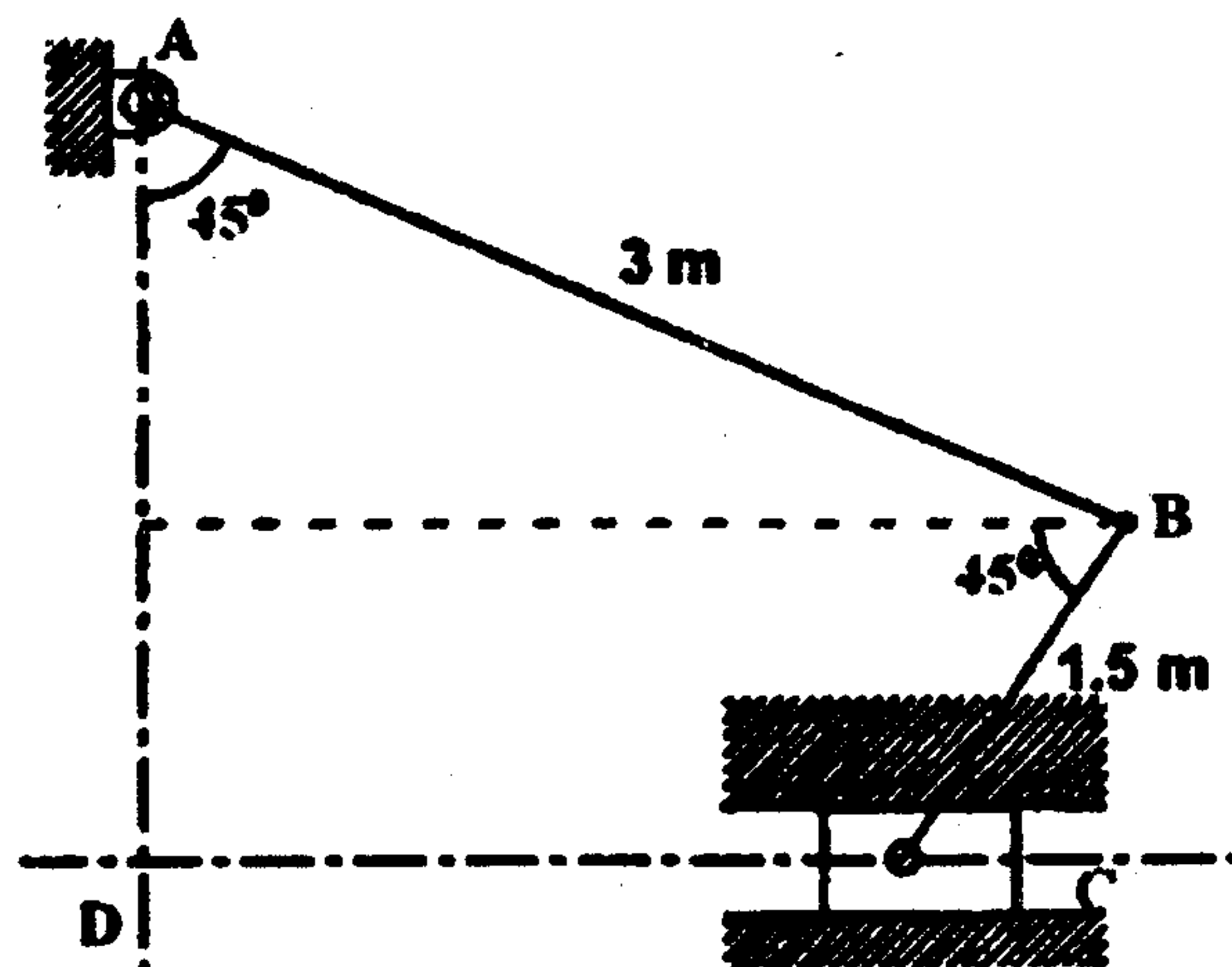


Fig. 5

Mechanism

13. (a) A cam with a minimum radius of 25 mm is to be designed for a knife-edge follower with the following data :

- To raise the follower through 35 mm during 60° rotation of the cam
- Dwell for next 40° of the cam rotation
- Descending of the follower during the next 90° of the cam rotation
- Dwell during the rest of the cam rotation

Draw the profile of the cam if the ascending and descending of the cam is with simple harmonic motion and the line of stroke of the follower is offset 10 mm from the axis of the cam shaft. Determine the maximum velocity and acceleration of the follower during the ascent and descent if the cam rotates at 150 rpm.

Or

(b) A symmetrical circular cam operating a flat-faced follower has the following particulars :

Minimum radius of cam = 50 mm; Total lift = 30 mm ; Angle of lift = 80°; Nose radius = 12 mm; Speed = 210 rpm ; Find

- (i) the principal dimensions of the cam. (8)
- (ii) the acceleration of the follower at the beginning of the lift, at the end of contact with the circular flank, at the beginning of contact with nose and at the apex of the nose. (8)

14. (a) Two involute gears in a mesh have a module of 8 mm and a pressure angle of 20°. The larger gear has 57 while the pinion has 23 teeth. If the addenda on pinion and gear wheels are equal to one module? find the

- (i) contact ratio. (5)
- (ii) angle of action of the pinion and gear wheel. (5)
- (iii) ratio of sliding to rolling velocity at the beginning of contact, pitch point and end of contact. (6)

Or

(b) An epicyclic gear train is shown in the Fig. 6. The number of teeth on A and B are 80 and 200. Determine the speed of the arm 'a', if

- (i) A rotates at 100 rpm clockwise and B at 50 rpm counter-clockwise. (8)
- (ii) A rotates at 100 rpm clockwise and B is stationary. (8)

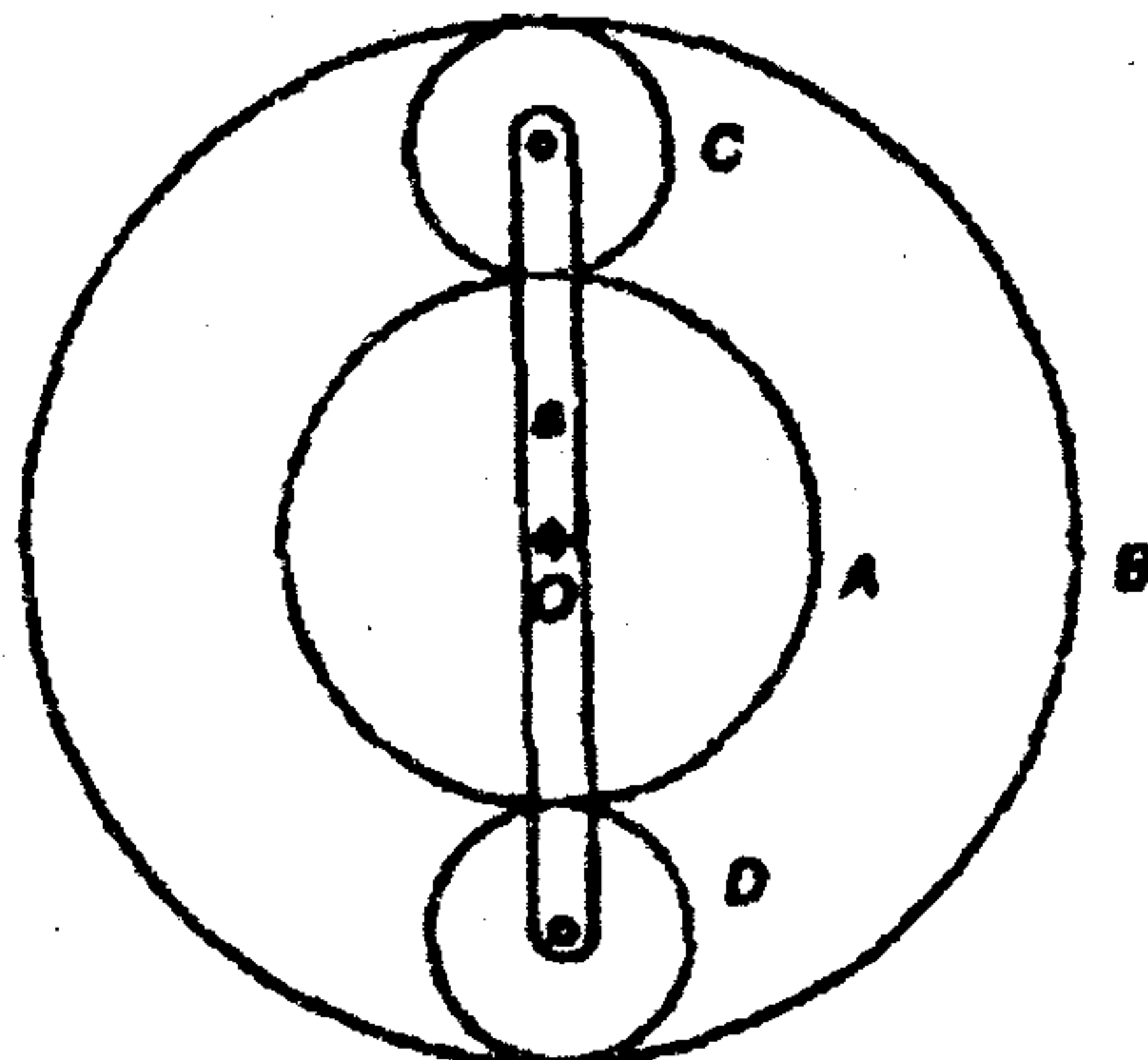


Fig. 6
Gear train

15. (a) A friction clutch is used to rotate a machine from a shaft rotating at a uniform speed of 250 rpm. The disc-type clutch has both of its sides effective, the coefficient of friction being 0.3. The outer and the inner diameters of the friction plate are 200 mm and 120 mm respectively. Assuming uniform wear of the clutch, the intensity of pressure is not to be more than 100 kN/m². If the moment of inertia of the rotating parts of the machine is 6.5 kgm², determine the time to attain the full speed by the machine and the energy lost in slipping of the clutch. What will be the intensity of pressure if the condition of uniform pressure of the clutch is considered? Also, determine the ratio of power transmitted with uniform wear to that of uniform pressure.

Or

- (b) (i) A square threaded bolt with a core diameter of 25 mm and a pitch of 10mm is tightened by screwing a nut. The mean diameter of the bearing surface of the nut is 60 mm. The coefficient of friction for the nut and the bolt is 0.12 and for the nut and the bearing surface, it is 0.15. Determine the force required at the end of a 400 mm long spanner if the load on the bolt is 12 kN. (6)
- (ii) A belt drive transmits 8 kW of power from a shaft rotating at 240 rpm to another shaft rotating at 160 rpm. The belt is 8 mm thick. The diameter of the smaller pulley is 600 mm and the two shafts are 5 m apart. The coefficient of friction is 0.25. If the maximum stress in the belt is limited to 3 N/mm², find the width of the belt for
- (1) an open belt drive (5)
- (2) a cross-belt drive. (5)