Mechanism Kinematics and Dynamics

Final Project

Presentation 10:10-13:00, 12/21 and 12/28

1. The window shield wiper (2)

   For the window wiper in Fig.1.33 on p.26 of the PPT,

   (1). Select the length of all links such that the wiper tip $X_p(t)$ can cover a 120 cm window width.

   (2). Plot the trajectory of X_p and the time response of all links.

   (3). Animate the mechanism motion by $0.5\ rps$ at the motor.

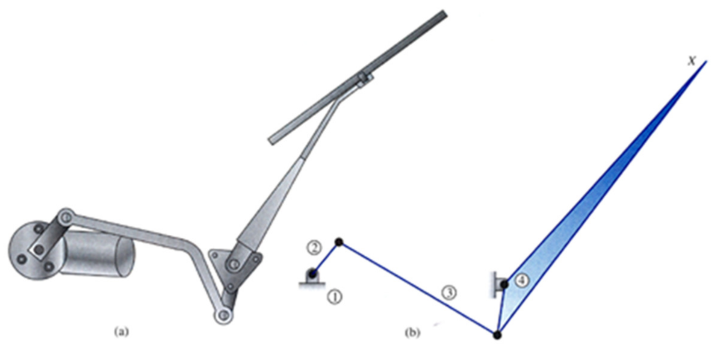


FIGURE 1.33 Rear-window wiper mechanism.

2. The windshield wipers (3)

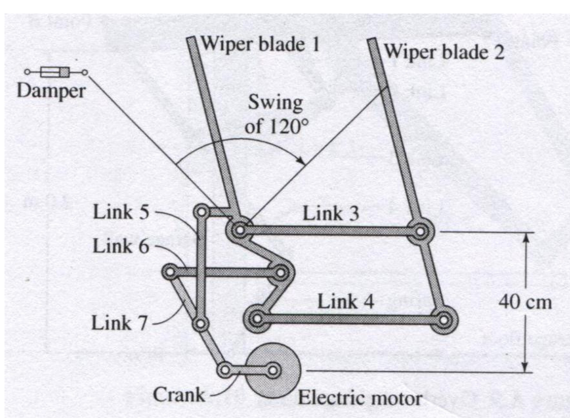
   The task is to have wiper 1 and 2 swing 120° with both parallel at all time.

   The wiper length 50cm, link 3 $=$ 60 cm.

   (1). Select the link length such that the mechanism when stowed is smaller than 40 cm height.

   (2). Animate the mechanism 0motion by $1\ rps$ at the motor.

   (3). Plot the trajectory of both wiper tips in the same plane.



3. The landing gear (2)

For the landing gear in Fig.1.35 and 1.36 on p.29 of the PPT,

(1). Plot the trajectory of $X(t)$ by the driving link $\overline{AB}$ with your selected input.

(2). Plot the time response of all links and of $X(t)$.

(3). Animate the mechanism motion from the stowed to deployed position.

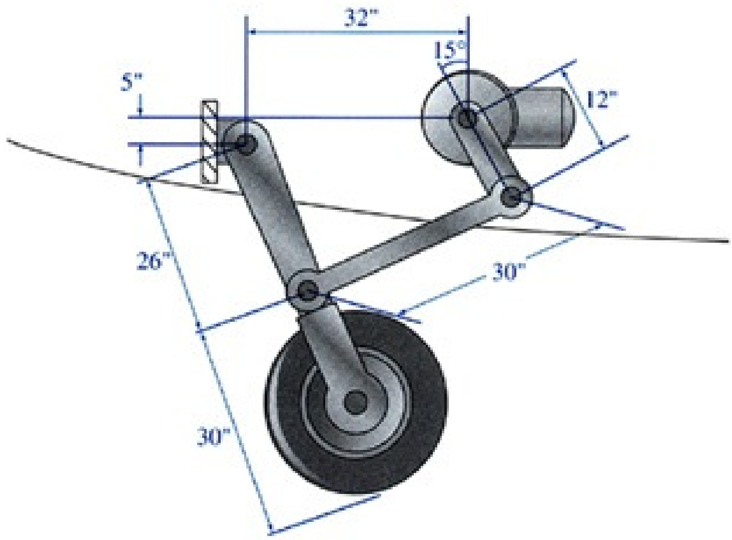


FIGURE 1.35 Nosewheel assembly

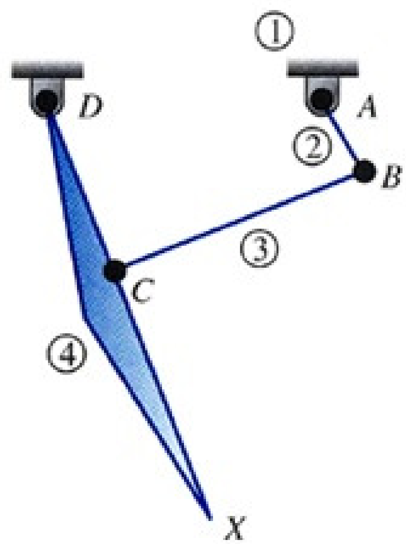


FIGURE 1.36 Kinematic diagram

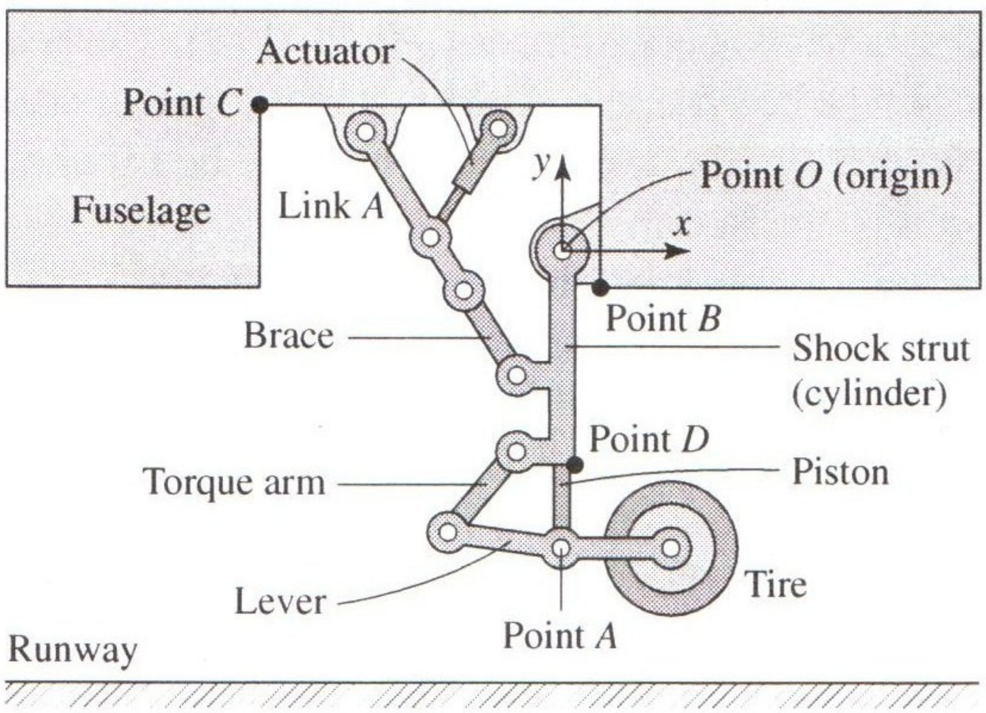
4. The landing gear (4)

Let the tire diameter 30 cm, $B(0.06, -0.13), C(-0.83, 0.43)$. $\overline{OA} =$ 66 cm and $\overline{OD} =$ 53 cm. The position can be modeled by the translation joint.

(1). For the actuator in sine function, select the link length such that the landing gear can be stowed inside the fuselage.

(2). Plot the trajectory at the tire center and the time response of all links.

(3). Animate the mechanism motion from the stowed to deployed position.



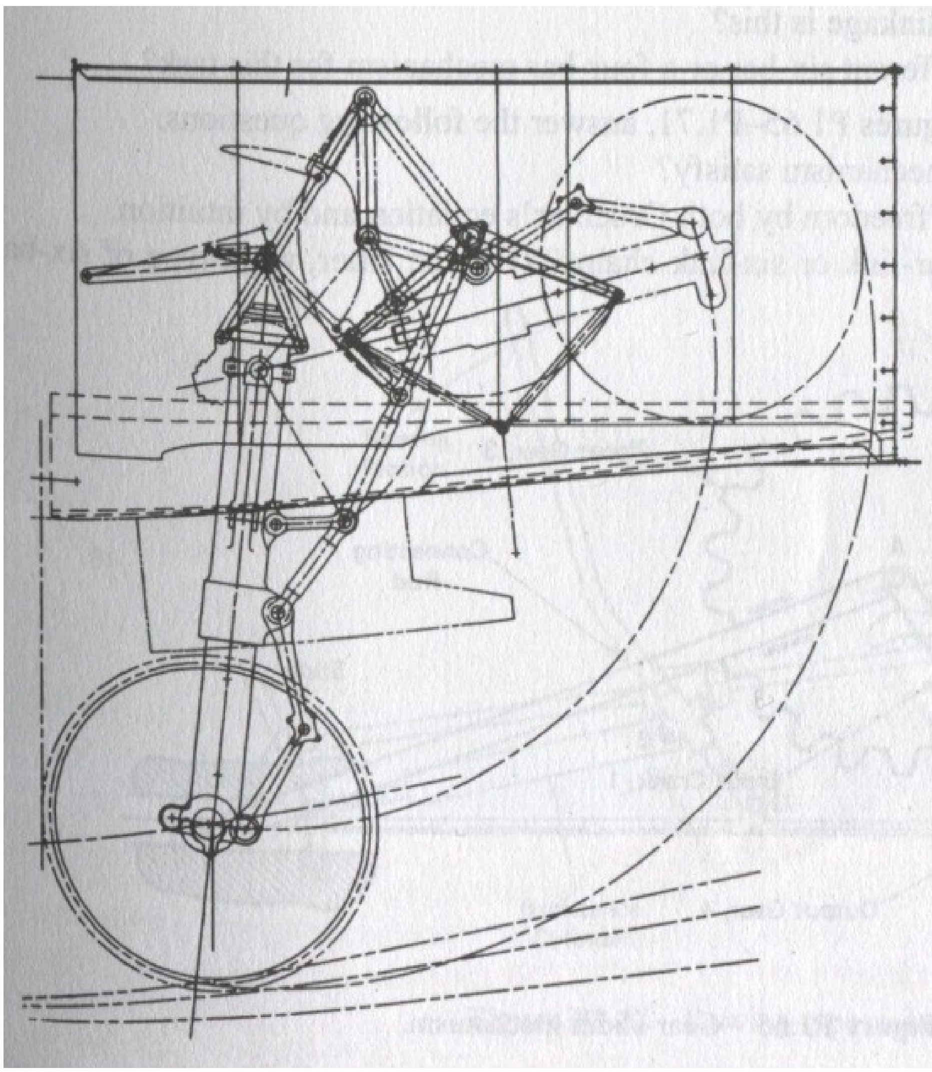
5. Landing gear mechanism (4)

For the MD-80 main landing gear shown below, a hydraulic actuator is to pull the mechanism from the extended to the retracted position.

(1). Create the model in AutoCAD or similar tools.

(2). Model the mechanism in 4-bar linkages.

(3). Animate the mechanism motion.



6. 4-bar straight-line mechanism (2)

On Fig.1.38 (a) at p.31 of the PPT, let the driving link (on the left) be 10 cm rotating at $\omega = 1\ rps$.

(1). Plot the time response of all links and of the midpoint of the connecting link.

(2). Let the midpoint displacement be $X_p(t)$. Plot the relation between ω and the oscillating frequency of the midpoint.

(3). Animate the mechanism motion for at least 5 revolutions.

7. Straight-line mechanism (3)

On Fig.1.38 (b) at p.31 of the PPT, let the driving link rotating at $\omega = 1\ rps$.

(1). Select the dimension of all the links such that the point-of-interest $Y_p(t)$ following the straight line has pitch length of 50 cm.

(2). Plot the time response of all links and of the $Y_p(t)$.

(3). Animate the mechanism motion.

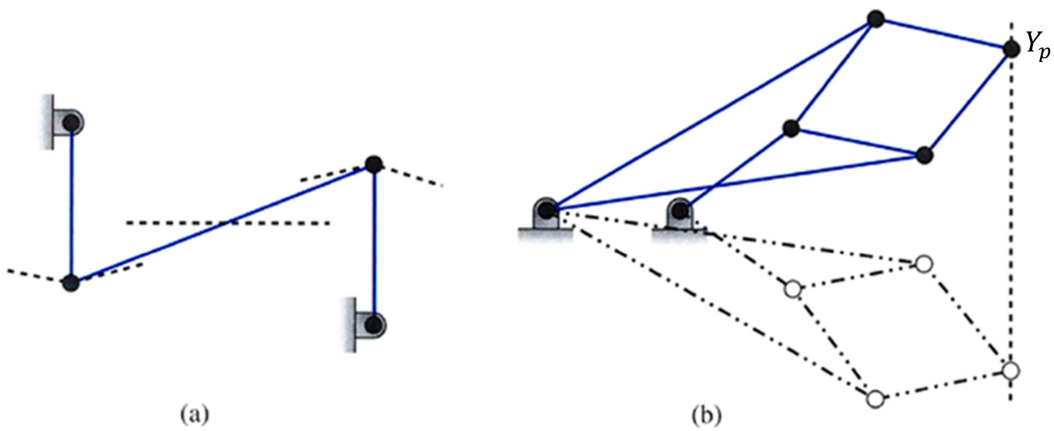


FIGURE 1.38 Straight-line mechanisms

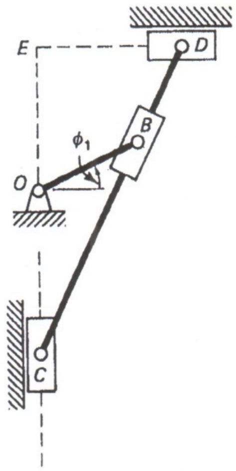
8. Quick return mechanism (3)

For the quick-return mechanism shown, let $\overline{OB} = 0.7$, $\overline{CD} = 2.1$, $\overline{OE} = 0.9$, and the configuration is for $\phi_1 = \pi/6$, $\dot{\phi}_1 = -0.2$ and $\ddot{\phi}_1 = 0$.

(1). Plot the time response of all links.

(2). Calculate and compare the oscillation frequency of slider B, C and D, and explain why it is quick-return mechanism.

(3). Animate the mechanism motion.



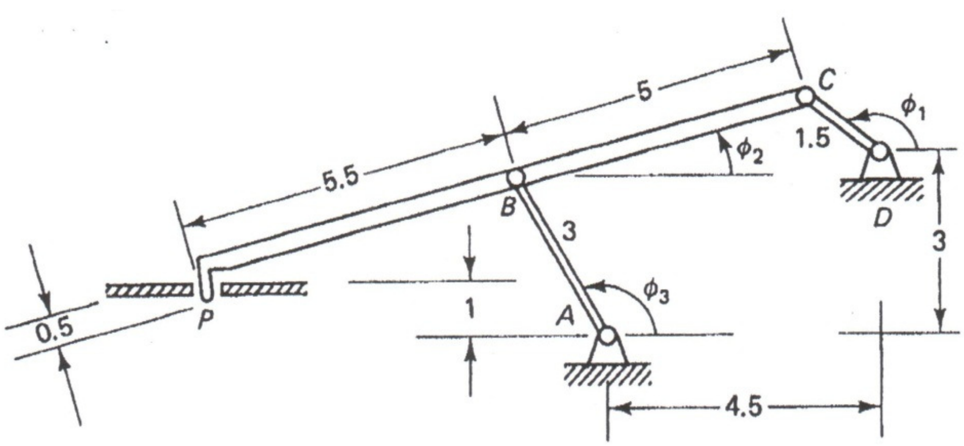
9. Film-strip mechanism (3)

A 4-bar mechanism is used to advance a film strip in a movie projector.

(1). Plot the time response of all links by selecting a $\dot{\phi}_1$, so that point P's motion is 30 frame/sec.

(2). Plot the trajectory of point P.

(3). Animate the mechanism motion.



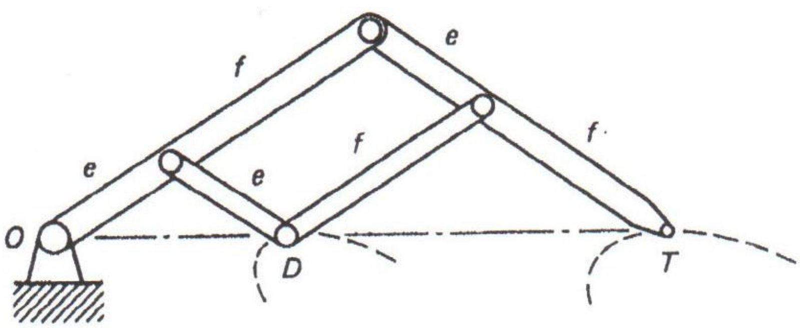
10. The pantograph mechanism (2)

    In the mechanism, point D is the drawing point and point T is the tracing point.

    (1). Select the link length.

    (2). Plot the trajectory of T when D is drawing a sine function.

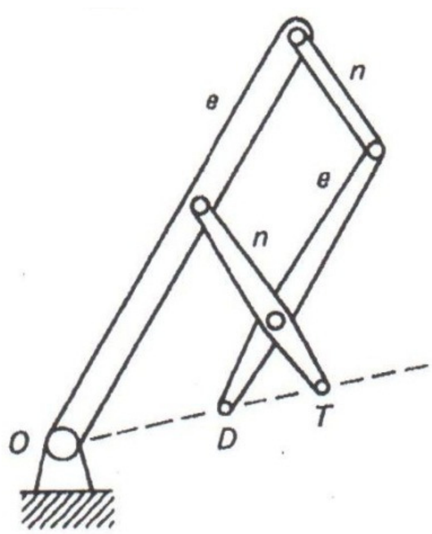
    (3). Animate the mechanism motion.



(a)

11. The pantograph mechanism (2)

    Same as Problem 10.



(b)

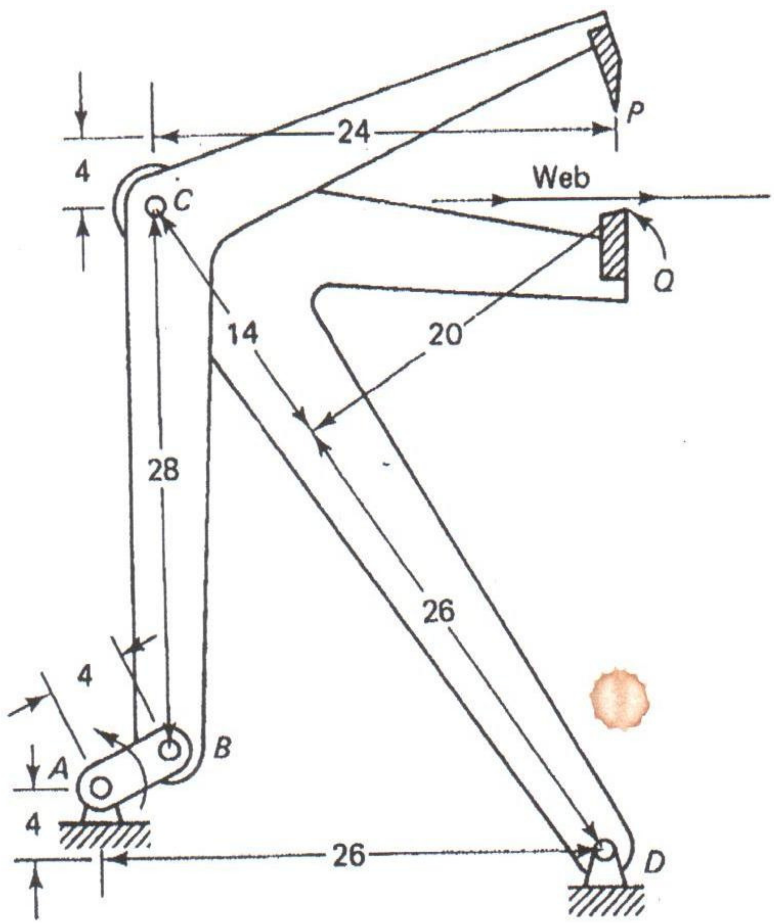
12. The web cutter mechanism (2)

For the link $\overline{AB}$ rotating at $1\,rps$.

(1). Calculate the velocity of point P and Q at the time of cutting and calculate the web length after cut.

(2). Plot the time response of all links and the trajectory of point P and Q.

(3). Animate the mechanism motion.

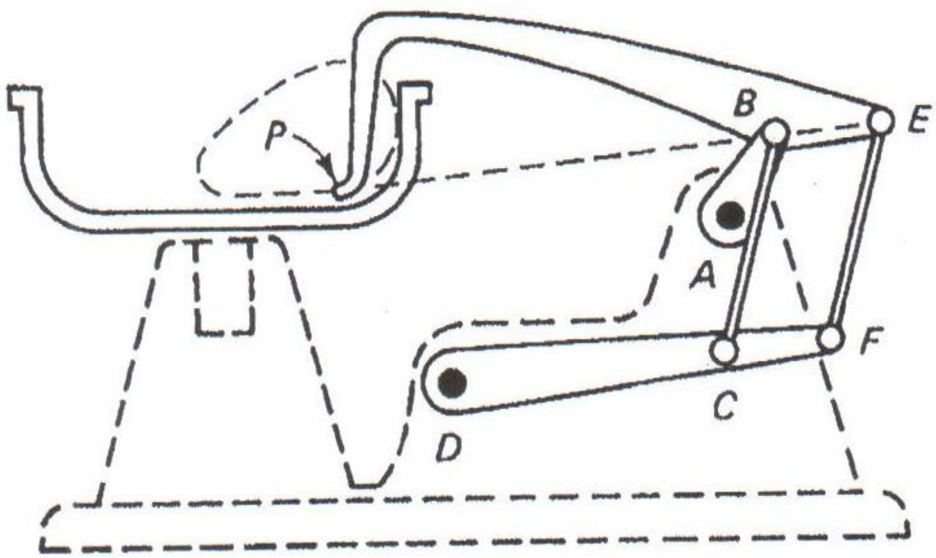


13. The dough-kneader mechanism (2)

The crank $\overline{AB}$ rotates though 360°. Note that in order to model this mechanism two revolute joints are needed at B. Let $\overline{AB} = 6$, $\overline{BC} = \overline{CF} = 13$, $\overline{BE} = \overline{CF} = 6$, $\overline{DC} = 15$, $\overline{AD} = 18$, $\overline{BP} = 26$.

(1). Plot the trajectory of $P(t)$ and the time response of $\overline{AB}$, $\overline{BE}$ and $\overline{DF}$.

(2). Animate the mechanism motion.



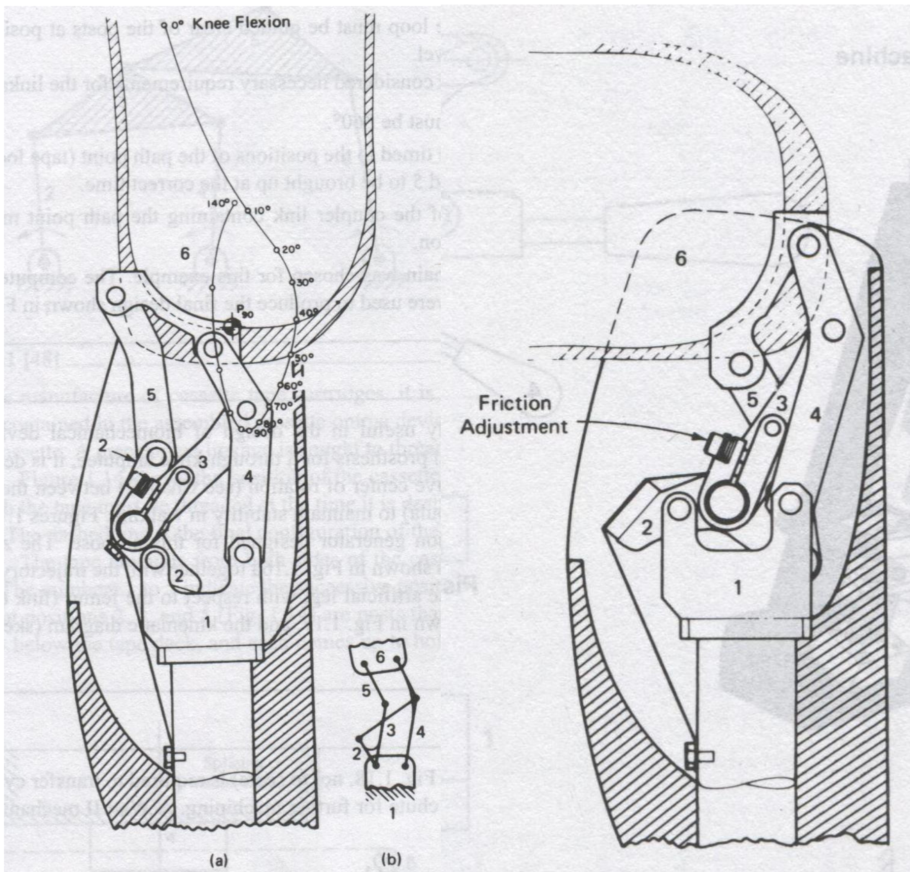
14. Prosthetic mechanism (4)

The 6-bar linkage shown below (Left: extension position, Right: flex position)

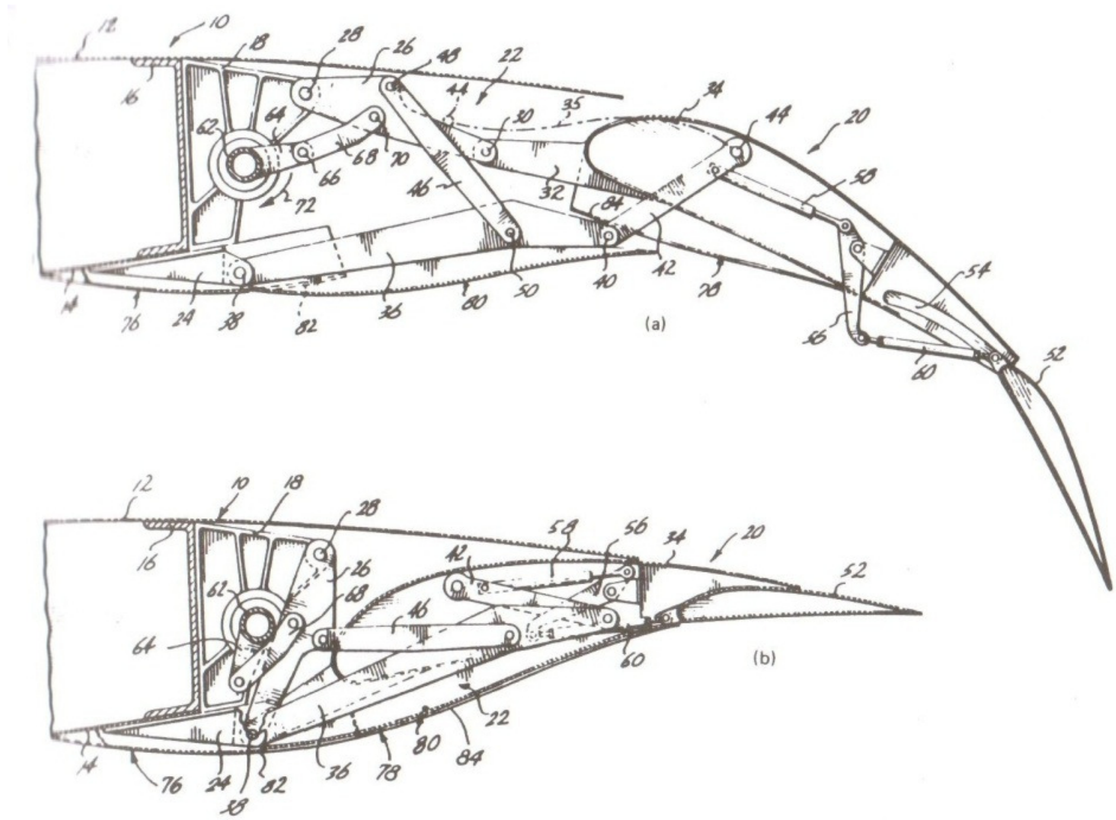
(1). Select the dimension of the links.

(2). Animate the motion from the flex to extension position.

(3). Plot the trajectory of the point connection link 3 and 4.



15. Trailing edge flap and actuating mechanism (4) (US Patent 3853289)
    (1). Create the model in AutoCAD or similar tools.
    (2). Model the mechanism in 4-bar and 6-bar linkages and calculate the degree of freedom.
    (3). Let 72 be the driving link. Animate the mechanism motion from the extended to retracted position.



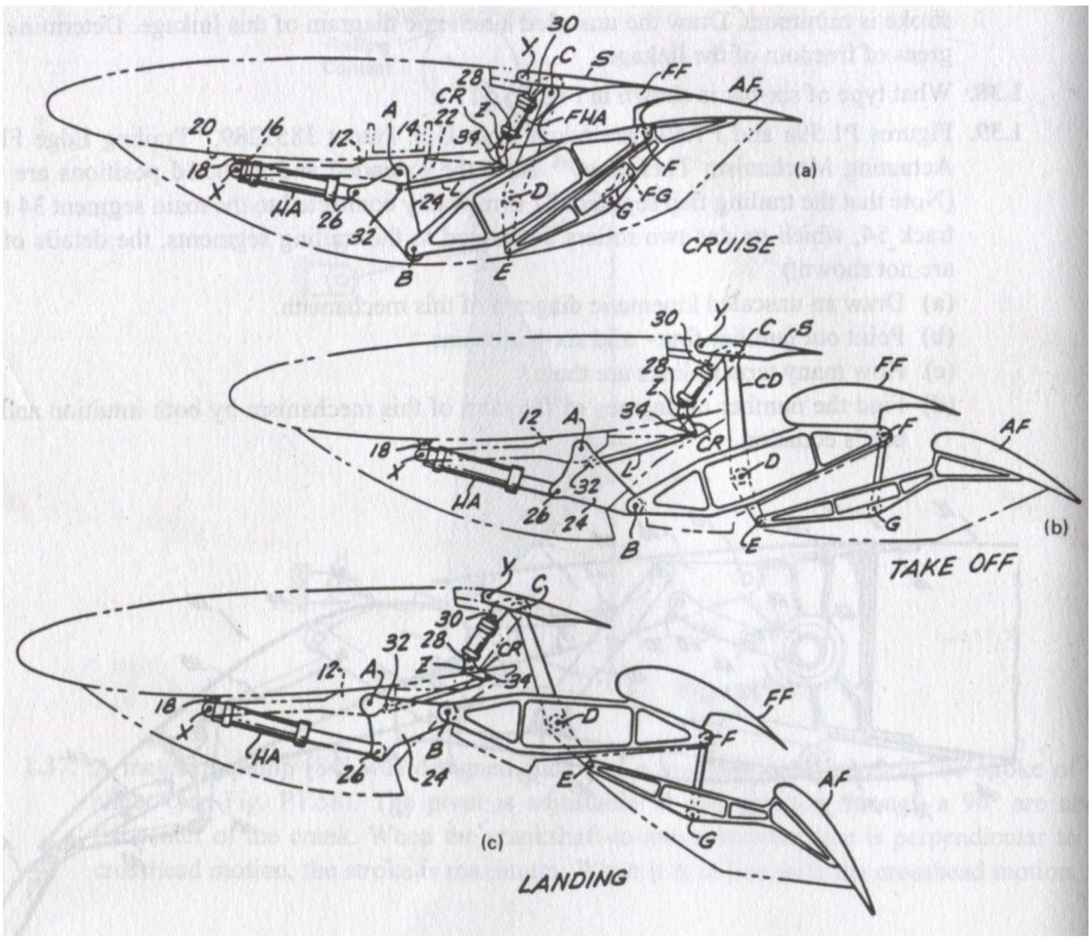
16. Short take-off wing mechanism (4) (US Patent 3874617)

    The cruise, take-off and landing position is shown below

    (1). Create the model in AutoCAD or similar tools.

    (2). Model the mechanism in 4-bar and 6-bar linkages.

    (3). Let $\overline{HA}$ be the driving link. Animate the mechanism motion from the extended to retracted position.



17. The spoiler in vehicles (4)

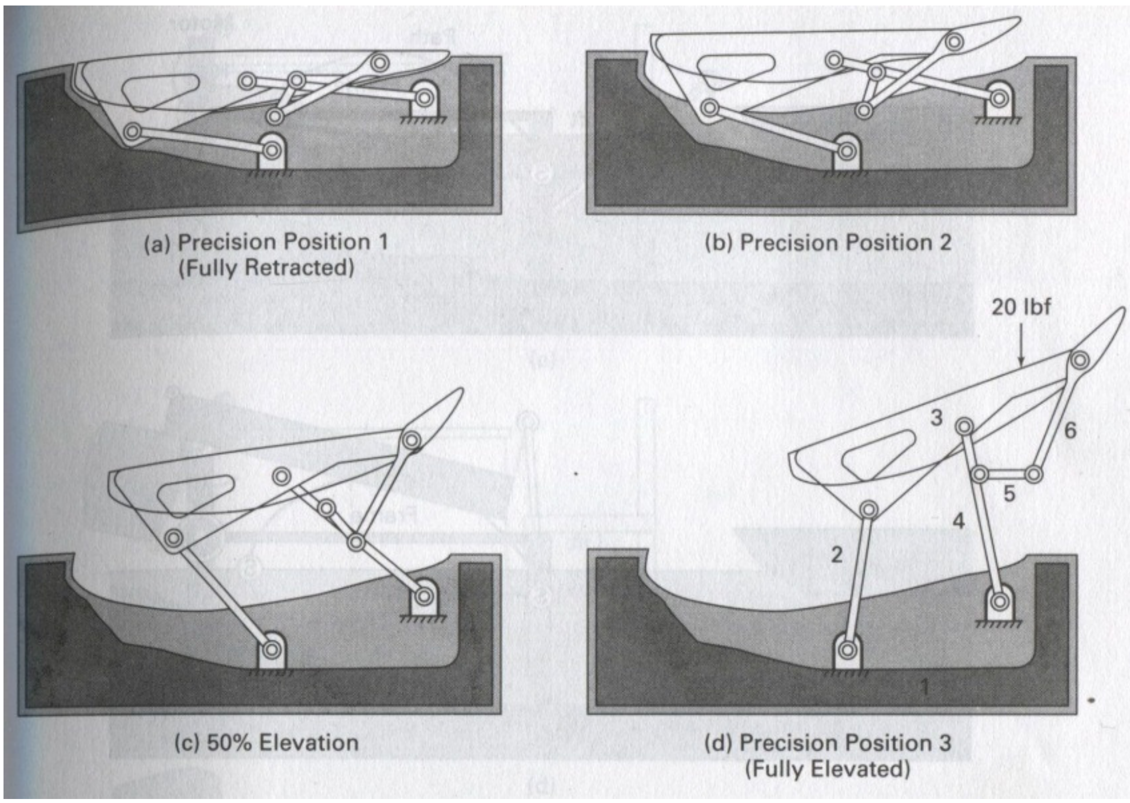
The spoiler in a race-car as shown below.

(1). Select the link length and create the model.

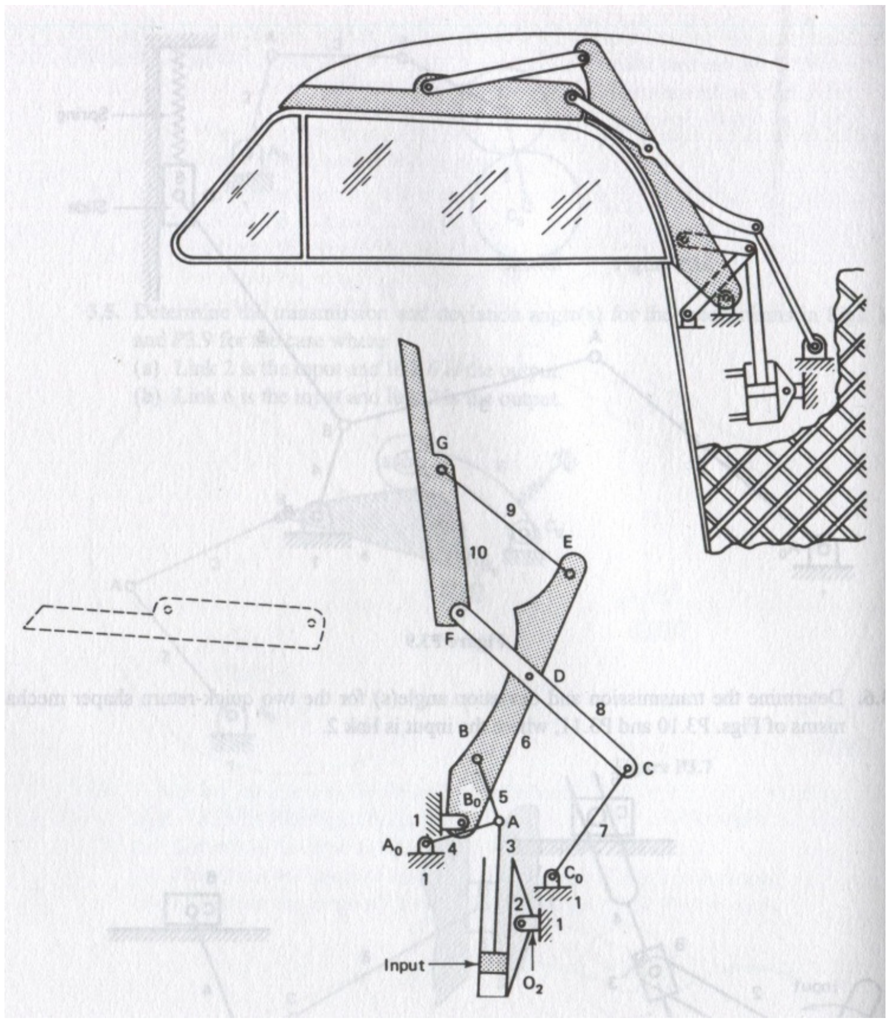
(2). Plot the trajectory at the tip of link 6 and the time response of all links.

(3). Animate the mechanism motion from the fully retracted to elevated position.

(4). From mechanics view point, discuss the difference should one use link 2 and 4 as the driving link.



18. The convertible top mechanism (3)
    (1). Select the link length and create the model.
    (2). Determine the degree of freedom and plot the trajectory at the tip of the convertible top.
    (3). Animate the mechanism motion from the stowed to deployed position.



19. Planetary Gear and Differential in vehicles (1)
    (1). Create the model.
    (2). Explain the mechanism in animation.
    (3). Conduct input/output analysis.

20. Universal joint (1)
    (1). Create the model and explain the mechanism.
    (2). Establish the mathematical model in 3-D by deriving the constraint equations.
    (3). Animate the motion by rotating 2-revolution.