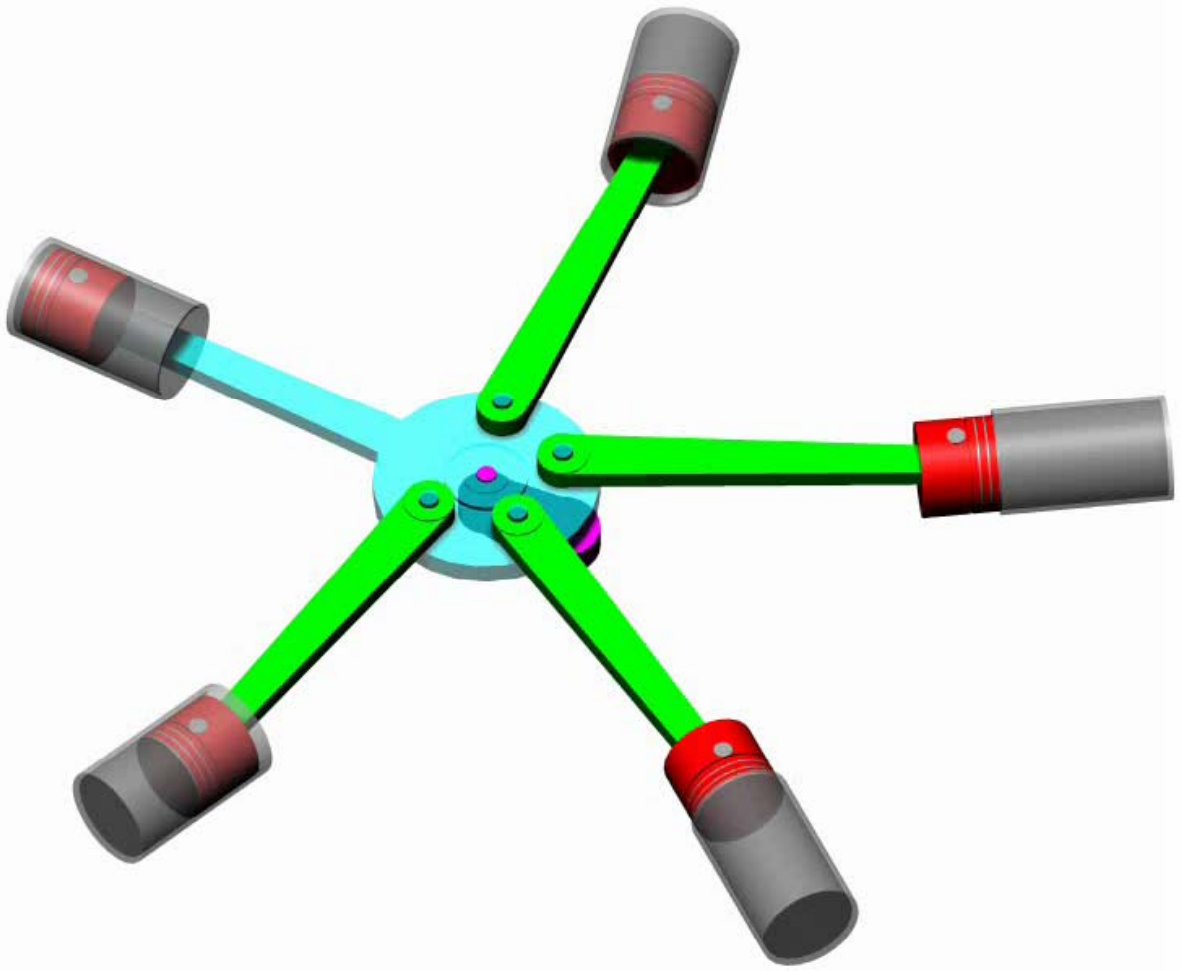
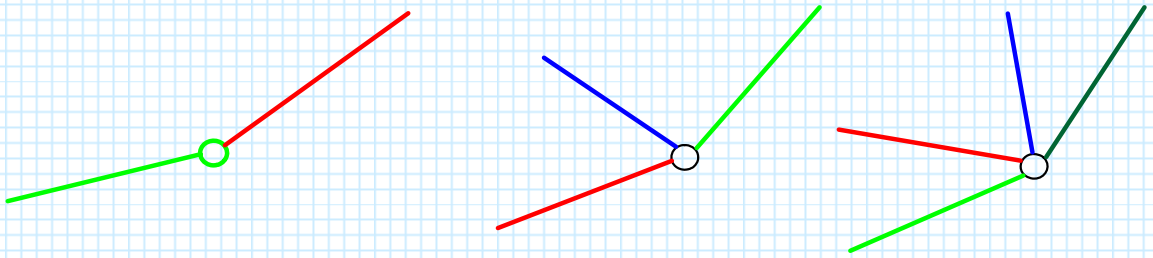


Degree of a joint

- the degree-of a joint is the number of links connected at the joint minus one.



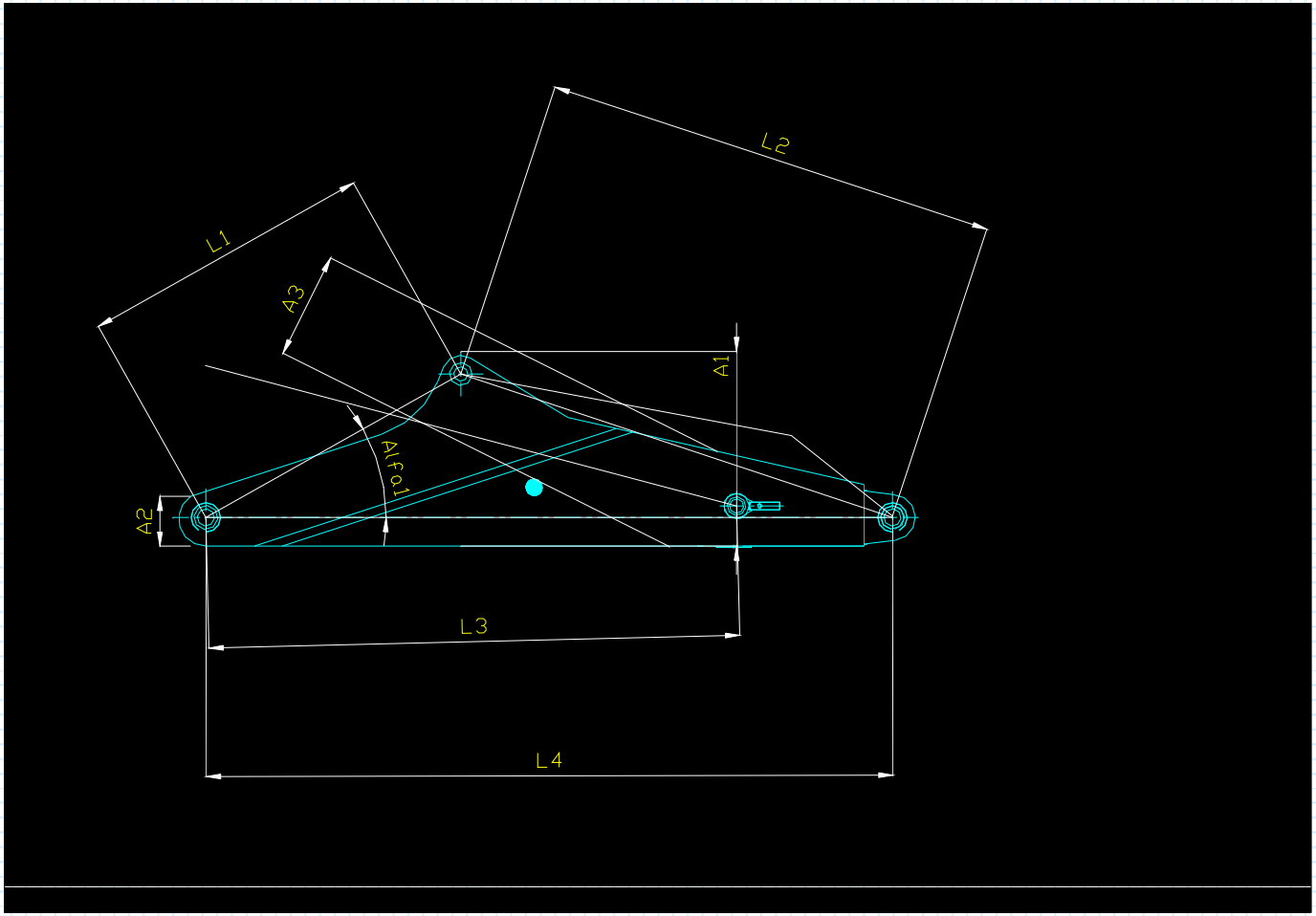
Binary Joint Ternary Joint Quarternary Joint

!!!! **Do not confuse with the degree of freedom of a joint**

Note that the number of joints at that connection is equal to the degree of a joint.

Degree of freedom of a joint is the number of independent parameters required to define the position of one link relative to the other connected by that joint.

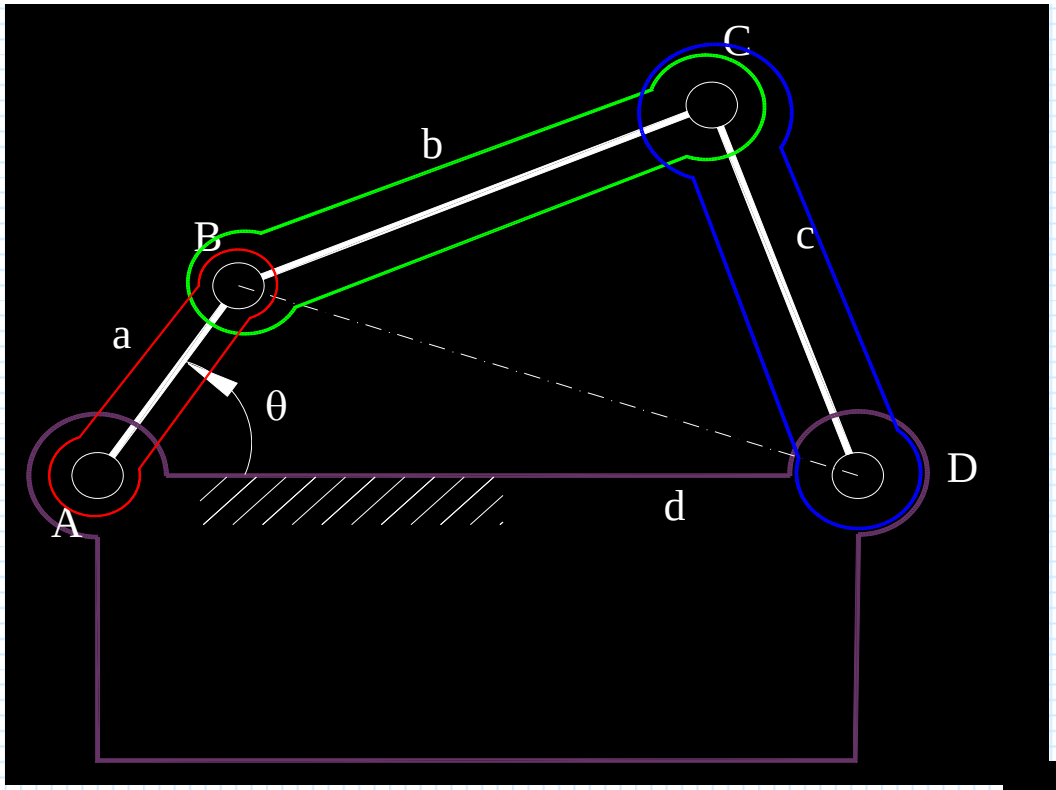
Link dimensions

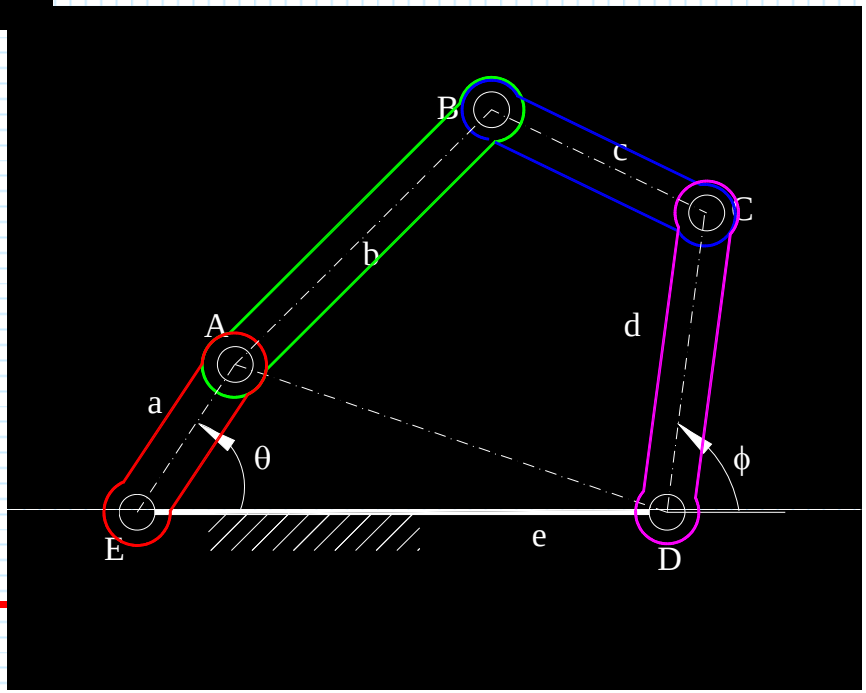


Degree of freedom of a mechanism

is the number of **independent parameters** required to define the position of ***every link*** in that mechanism.

Reading Assignment: upto page 33 (End of Chapter 1) by October 13 '08





Degree of freedom of a mechanism:

- Depends on:
  - The degree of freedom of space
  - The degree of freedom of the joints
  - The number of links and joints in the mechanism
  - The distribution of links and joints within the mechanism

  Does not depend on

  The shape of the links

Determination of the Degree of freedom

Let

- λ= Degree-of-freedom of space:

  λ = 3 for planar and spherical space

  λ = 6 for spatial space

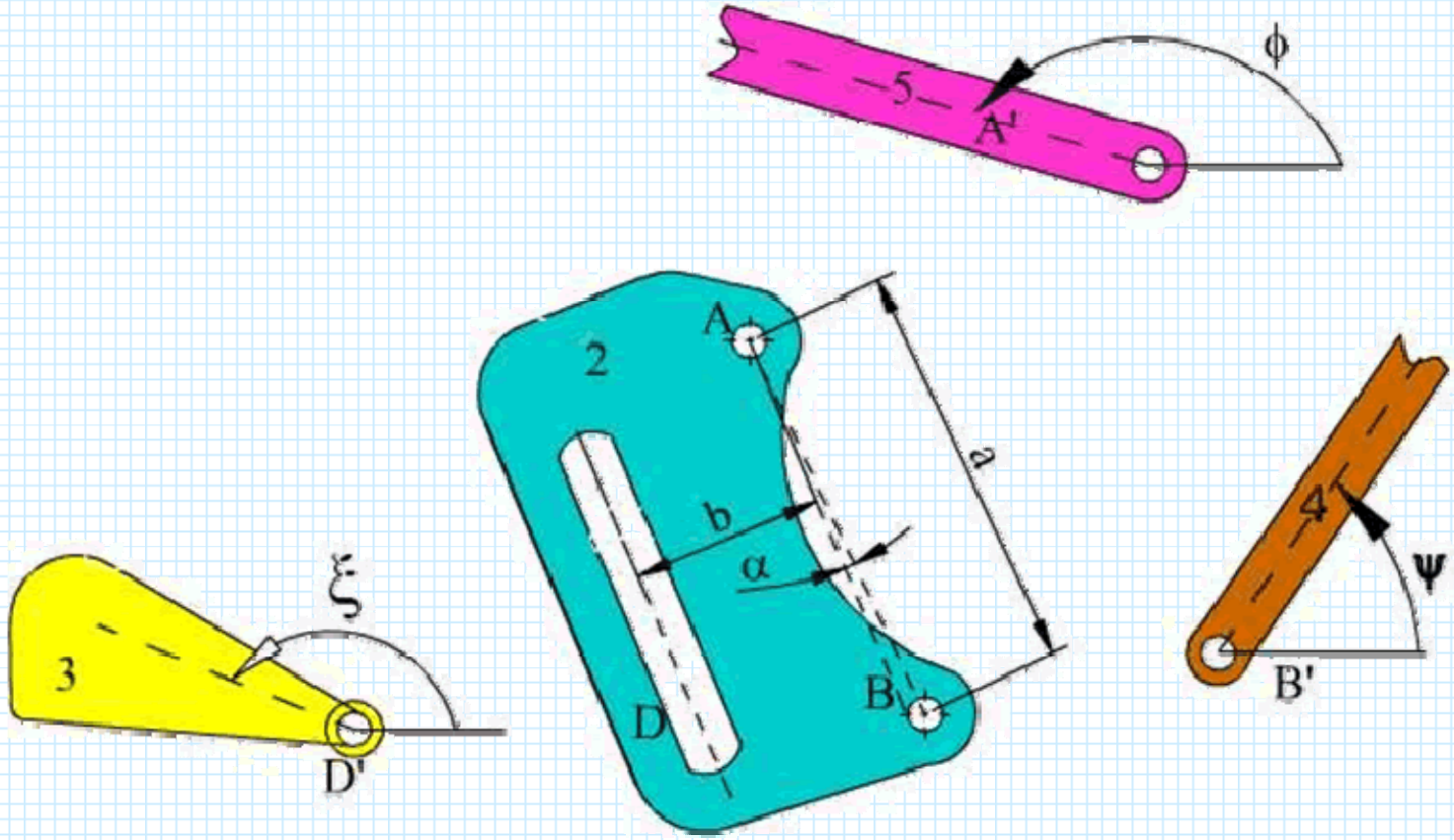
  ℓ = Number of links in a mechanism (including the fixed link).

  j = Number of joints in the mechanism

  f = Degree-of-freedom of the ith joint

  F = Degree-of- freedom of the mechanism

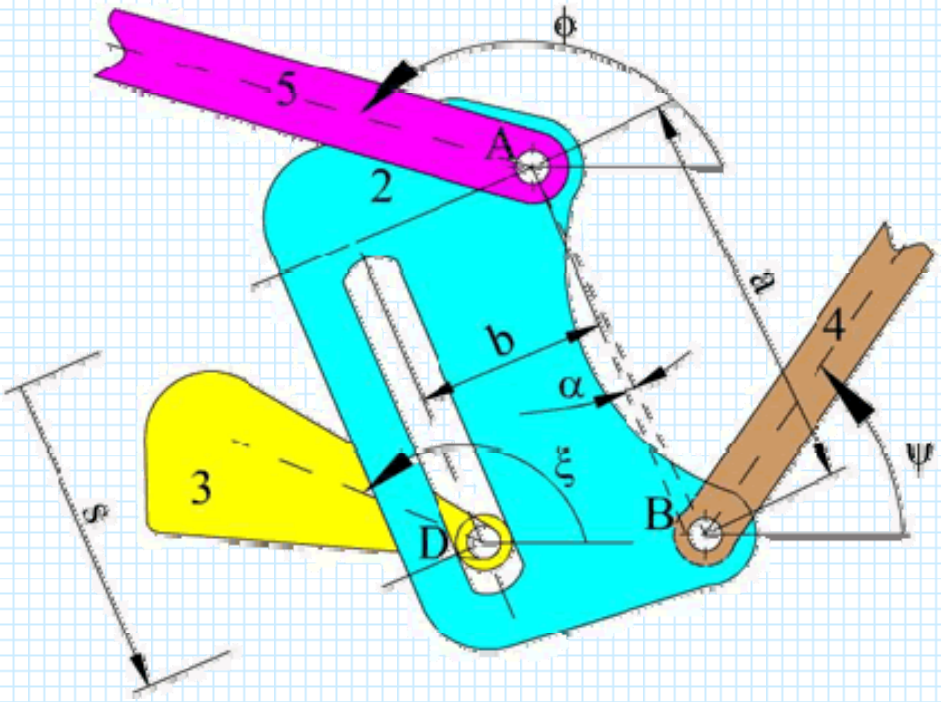
Consider four links in plane motion



For 4 links 4*3=12 parameters are needed

For ℓ links (with one link fixed):

$\lambda(\ell-1)$ parameters are required. This is the number of parameters needed without joints (constraints)



With the joints shown:

Link 2 3Parameters

Link 3 2 Parameters (Cylinder in slot joint has 2 Dof, constrains 1 Dof in plane motion).

Link 4 1 Parameter (revolute Joints has 1 Dof, constrains 2 Dof in Plane motion)

Link5 1 Parameter (revolute Joints has 1 Dof, constrains 2 Dof in Plane motion)

With these 3 joints 1+2+2 = 5 freedoms are constrained

Therefore now we need (12-5) 7 parameters to determine the position of these 4 links

If the joint freedom is f_i, then that joint constrains $\lambda - f_i$ freedoms. j joints will constrain:

$$\sum_{i=1}^{j}(\lambda - f_i) = \lambda j - \sum_{i=1}^{j} f_i \qquad \text{freedoms}$$

Degree of Freedom of a mechanism, F

- F = Degree of freedom without constraint —Number of constraints (Eq.l.c)

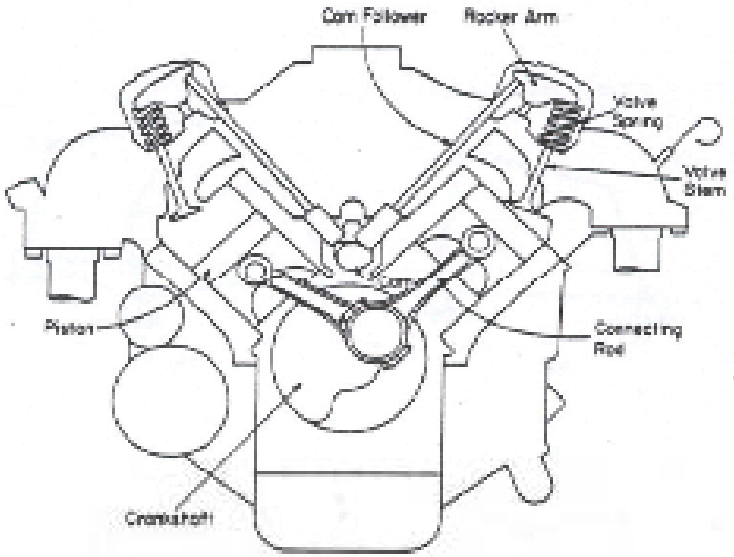
$$F = \lambda(\ell - 1) - (\lambda j - \sum_{i=1}^{j} f_i)$$

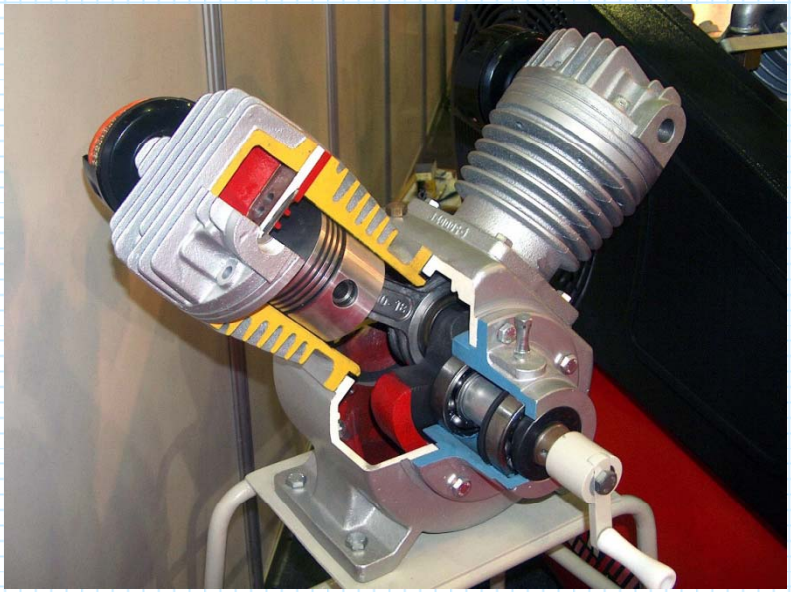
or

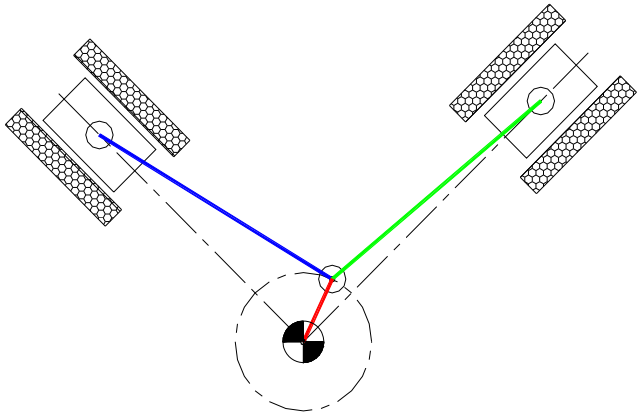
$$F = \lambda(\ell - j - 1) + \sum_{i=1}^{j} f_i$$

General Degree-of-freedom equation

Example- V Engine or V-Pump

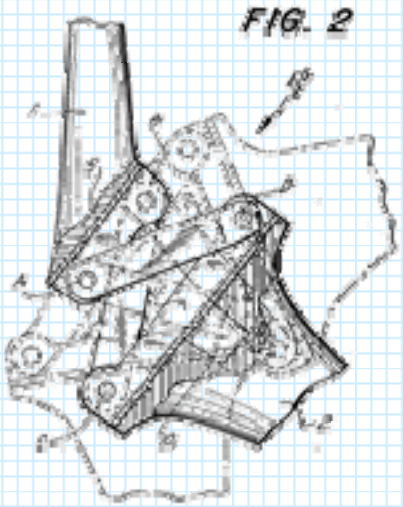


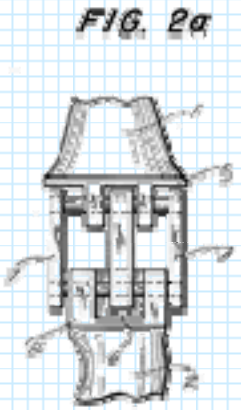


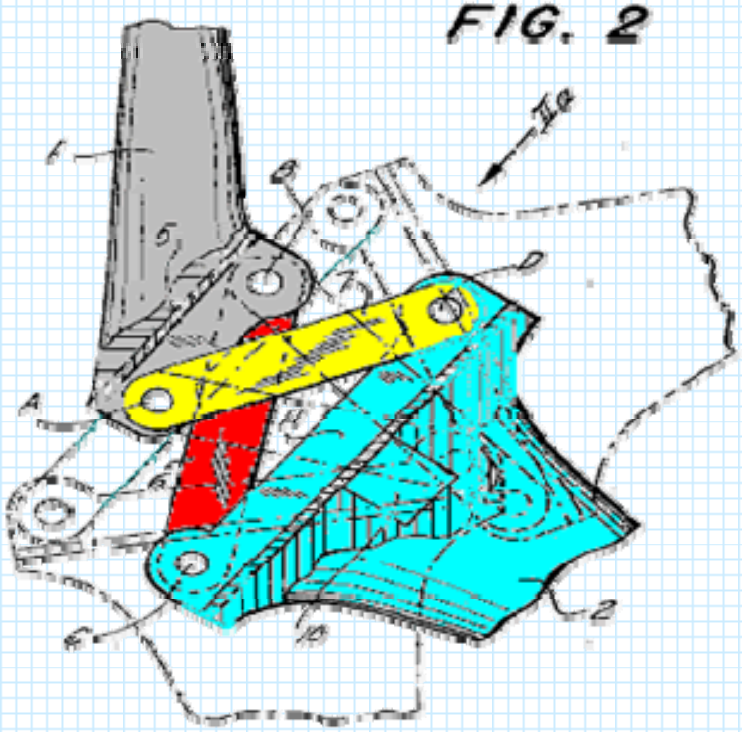


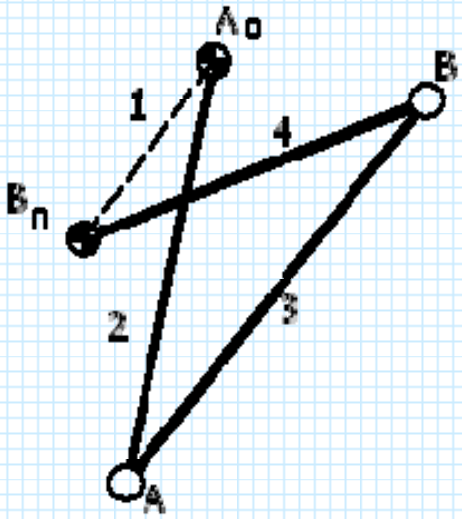
Example

U.S. Patent 3,969,773 July 20 1976





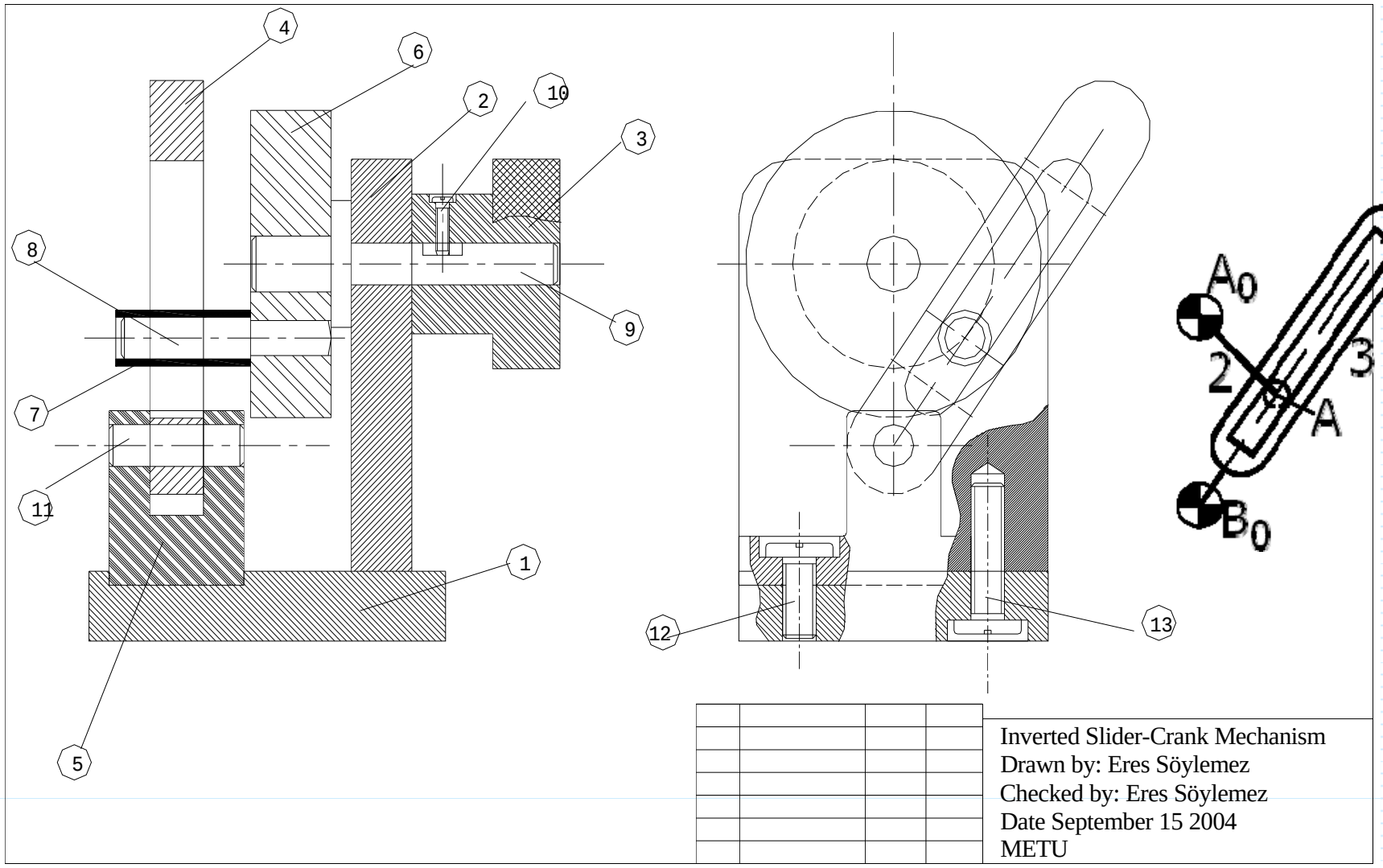




Schematic Drawing

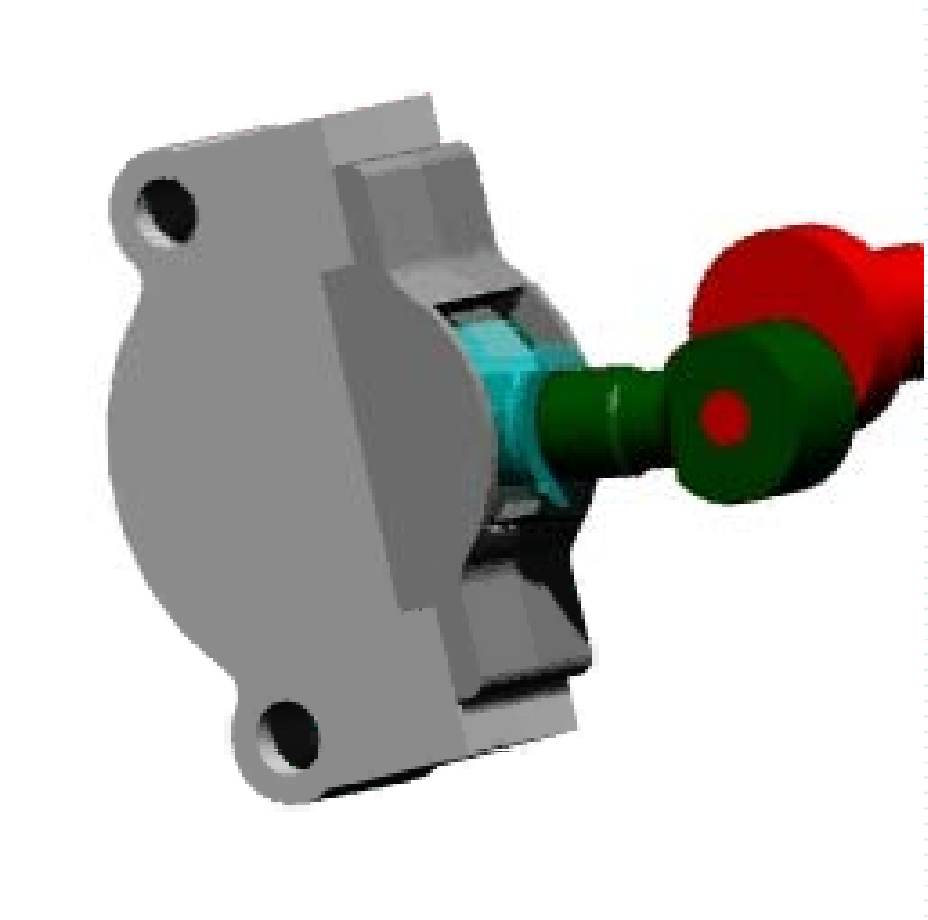
Example

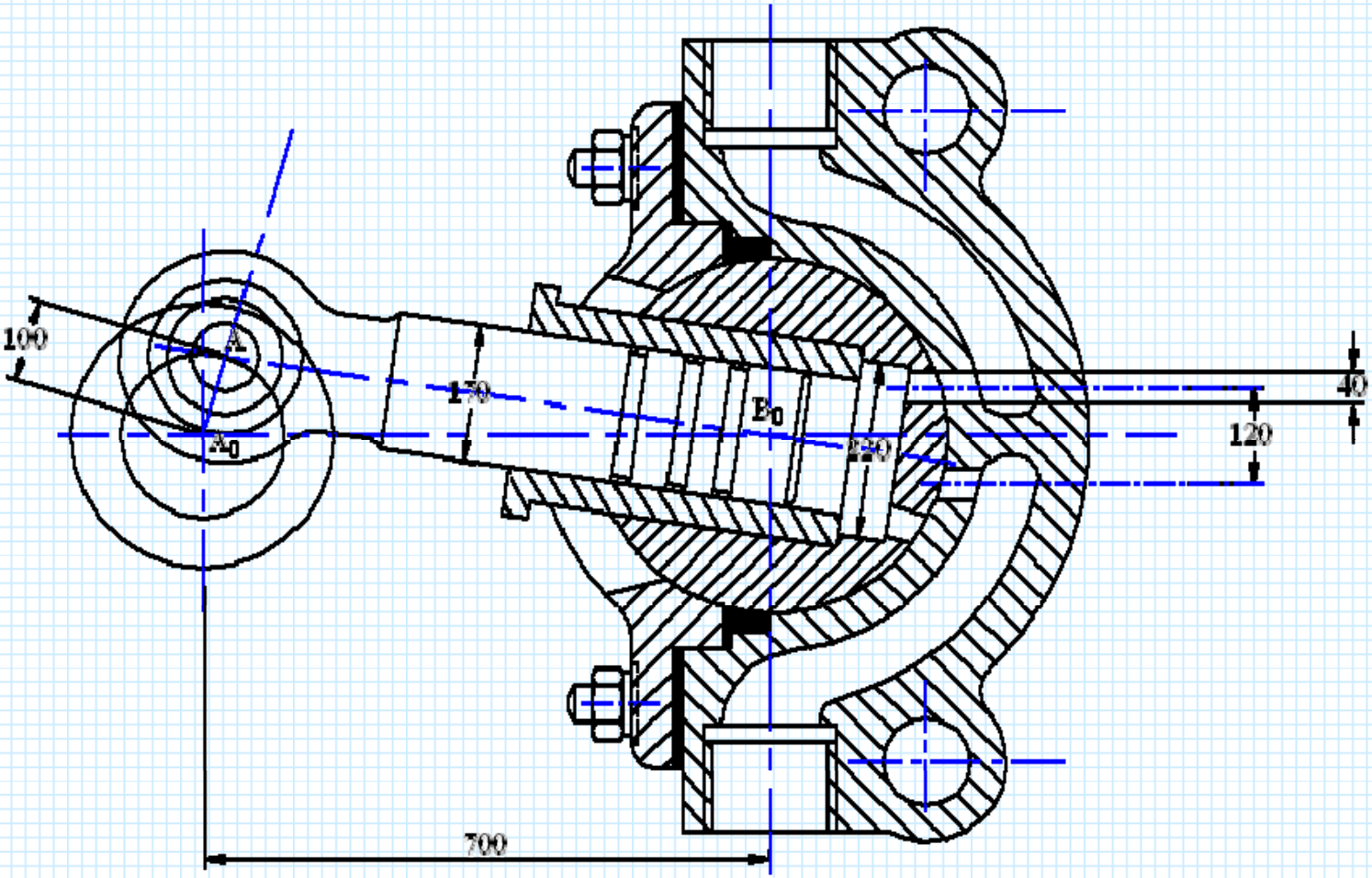
Virtual Model

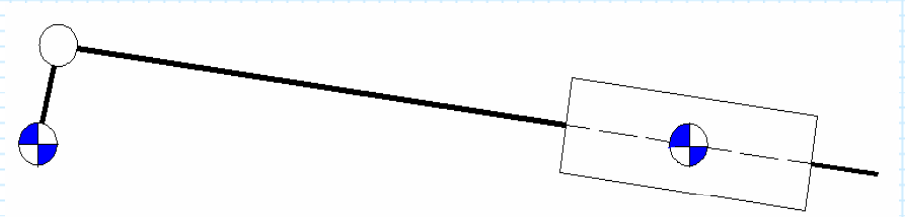


Inverted Slider-Crank Mechanism
Drawn by: Eres Söylemez
Checked by: Eres Söylemez
Date September 15 2004
METU

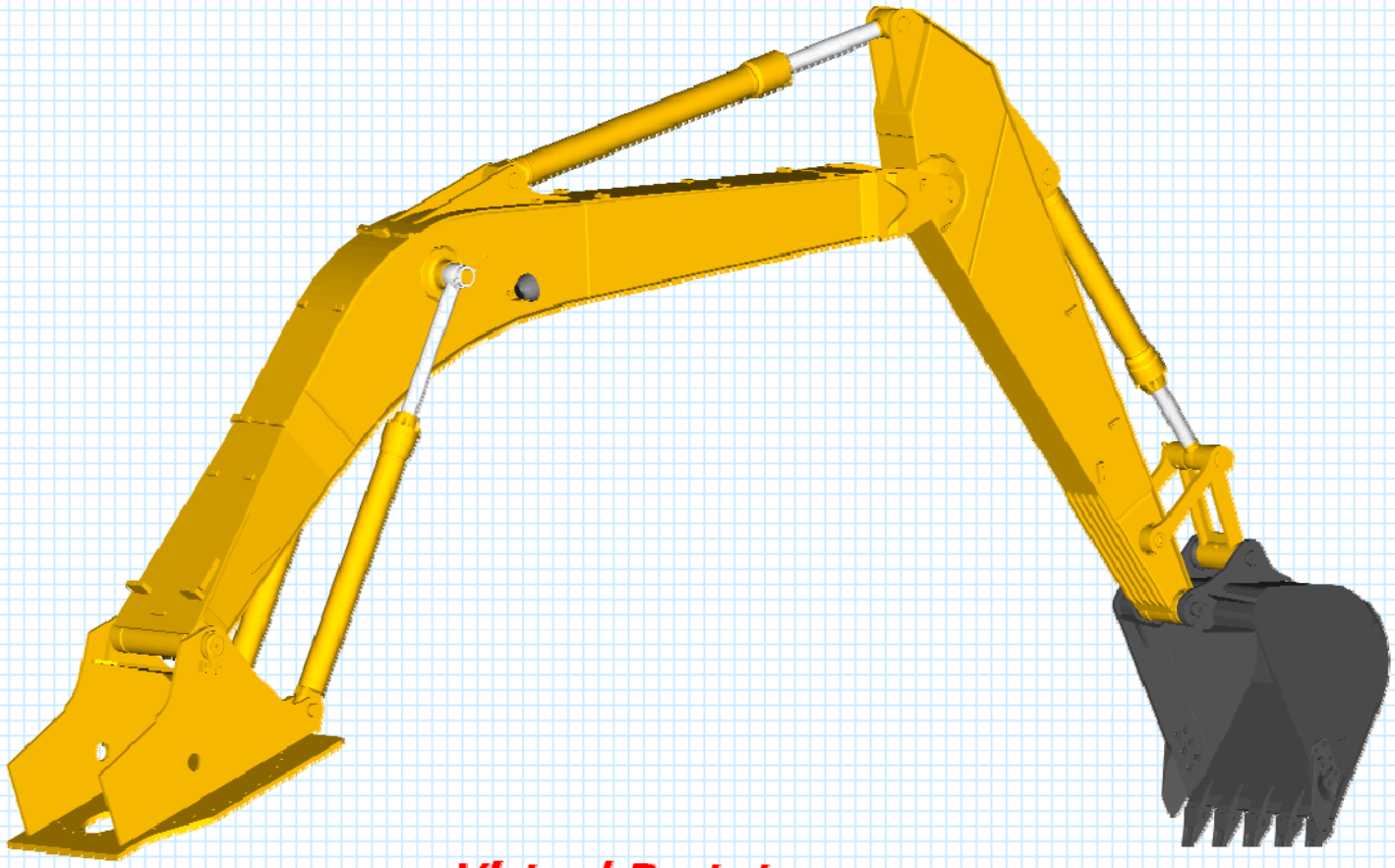
Example







Example: Excavator



Virtual Prototype

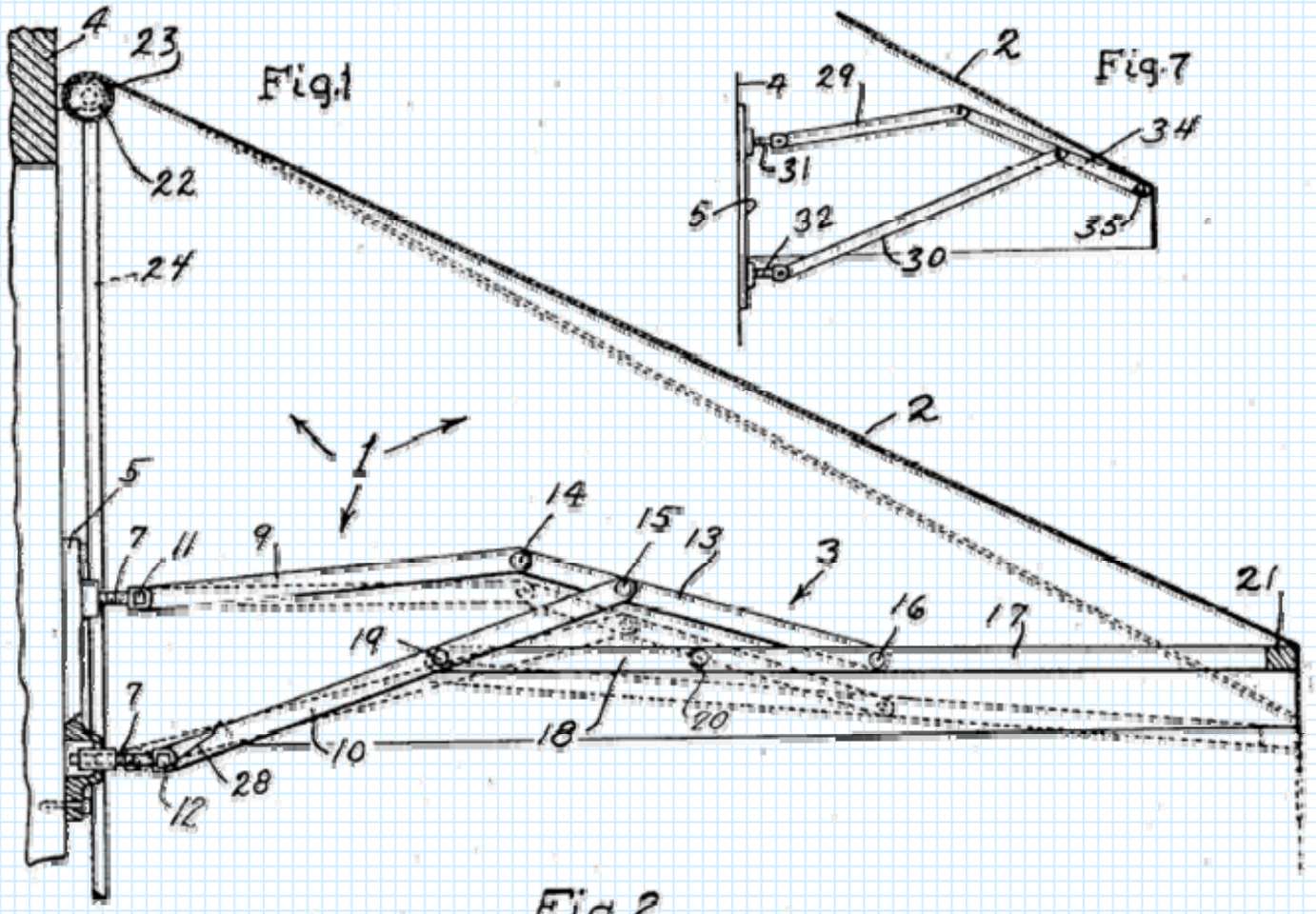
Example-Folding Chair

Example

June 28, 1932. F. M. CHRISTIAN 1,865,083

AWNING

Filed March 5, 1929



Example

Hinge
US3673635
1972

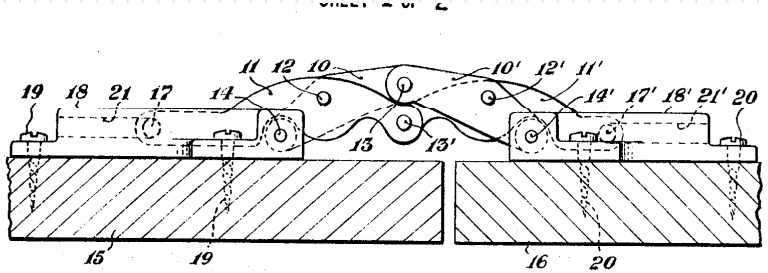


Fig.1

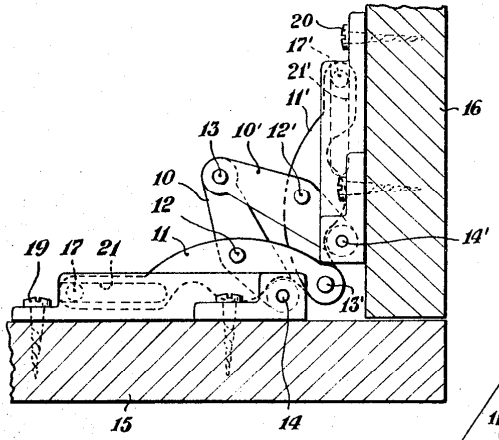


Fig.2

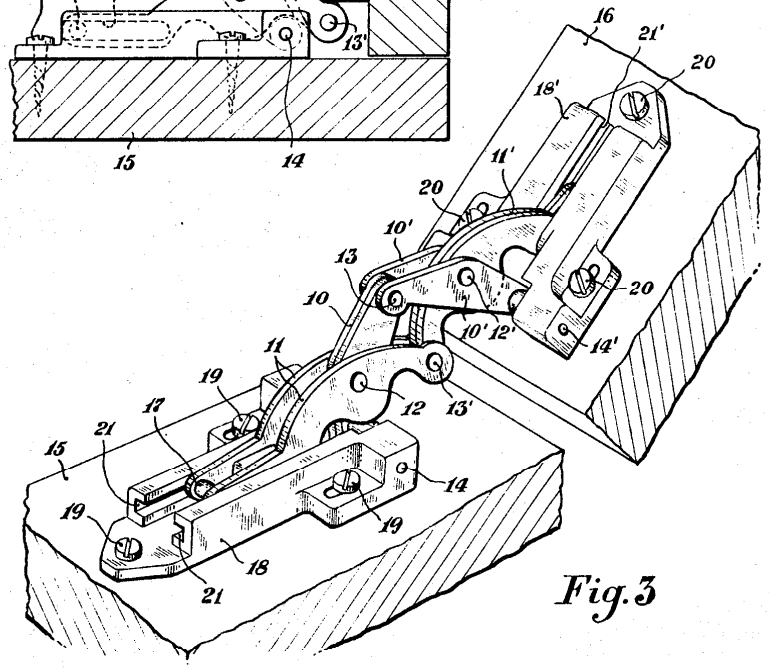
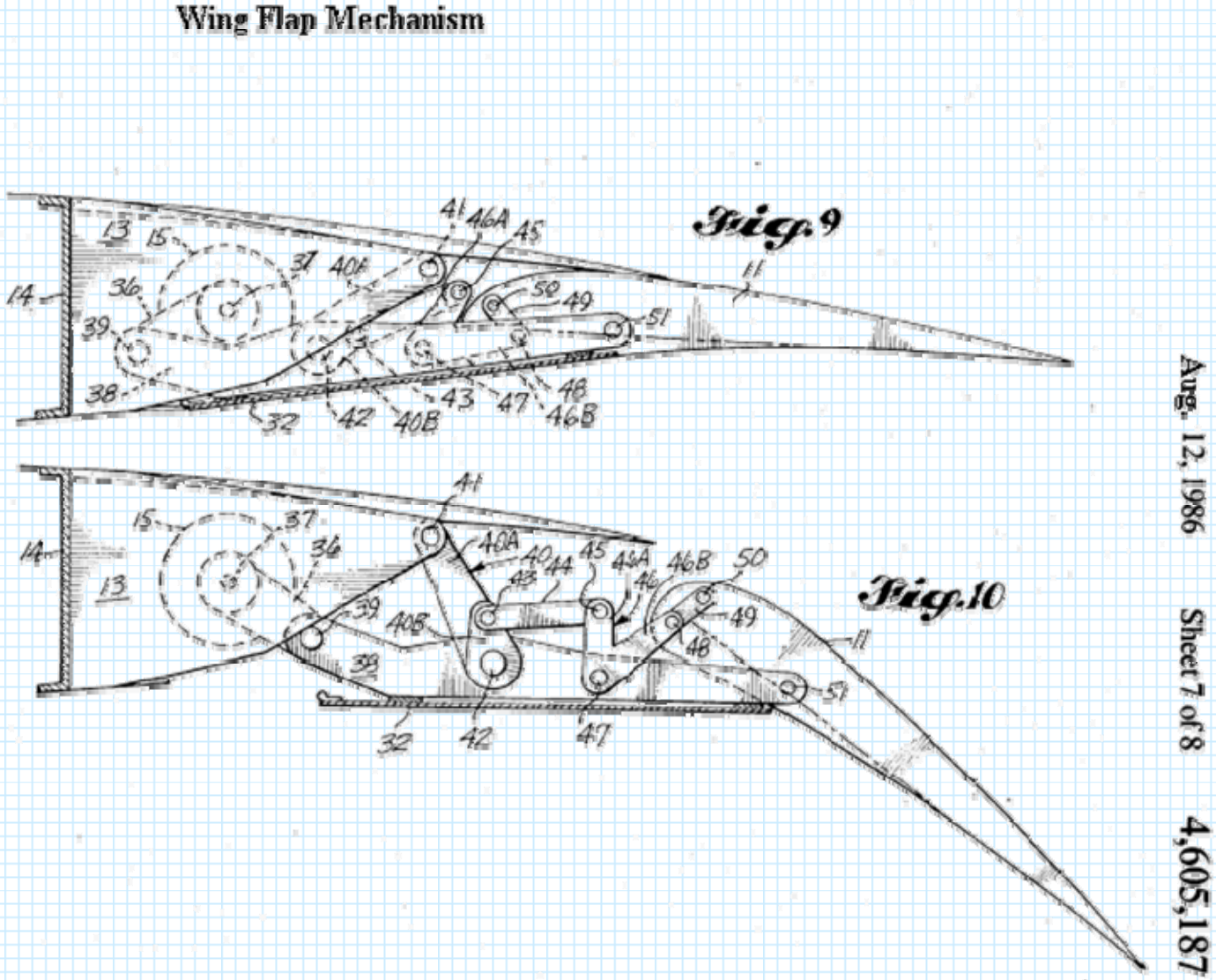


Fig.3

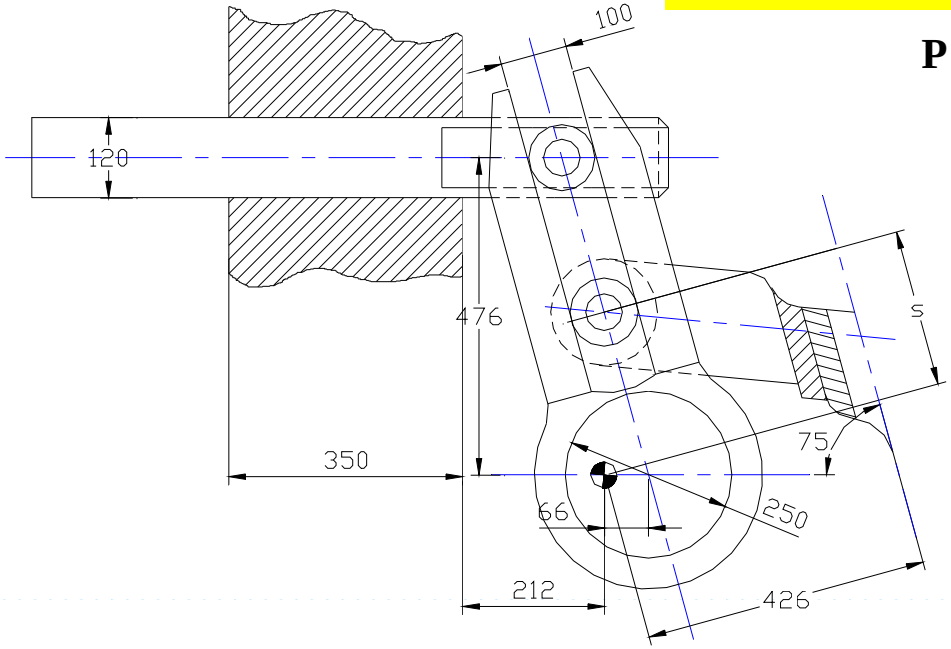
Example

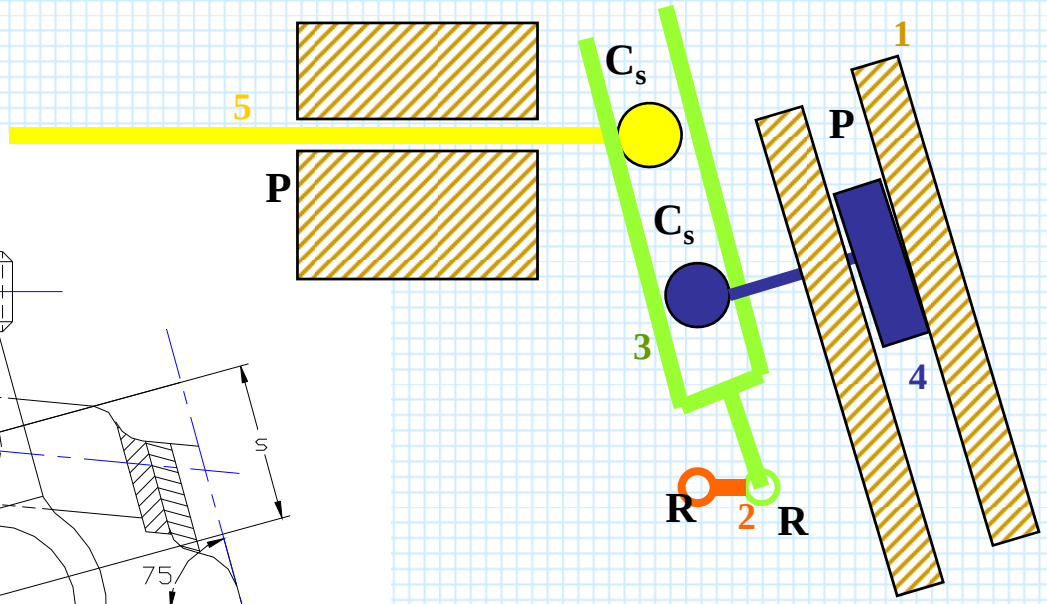


Example:

ADJUSTABLE STROKE PUMP.

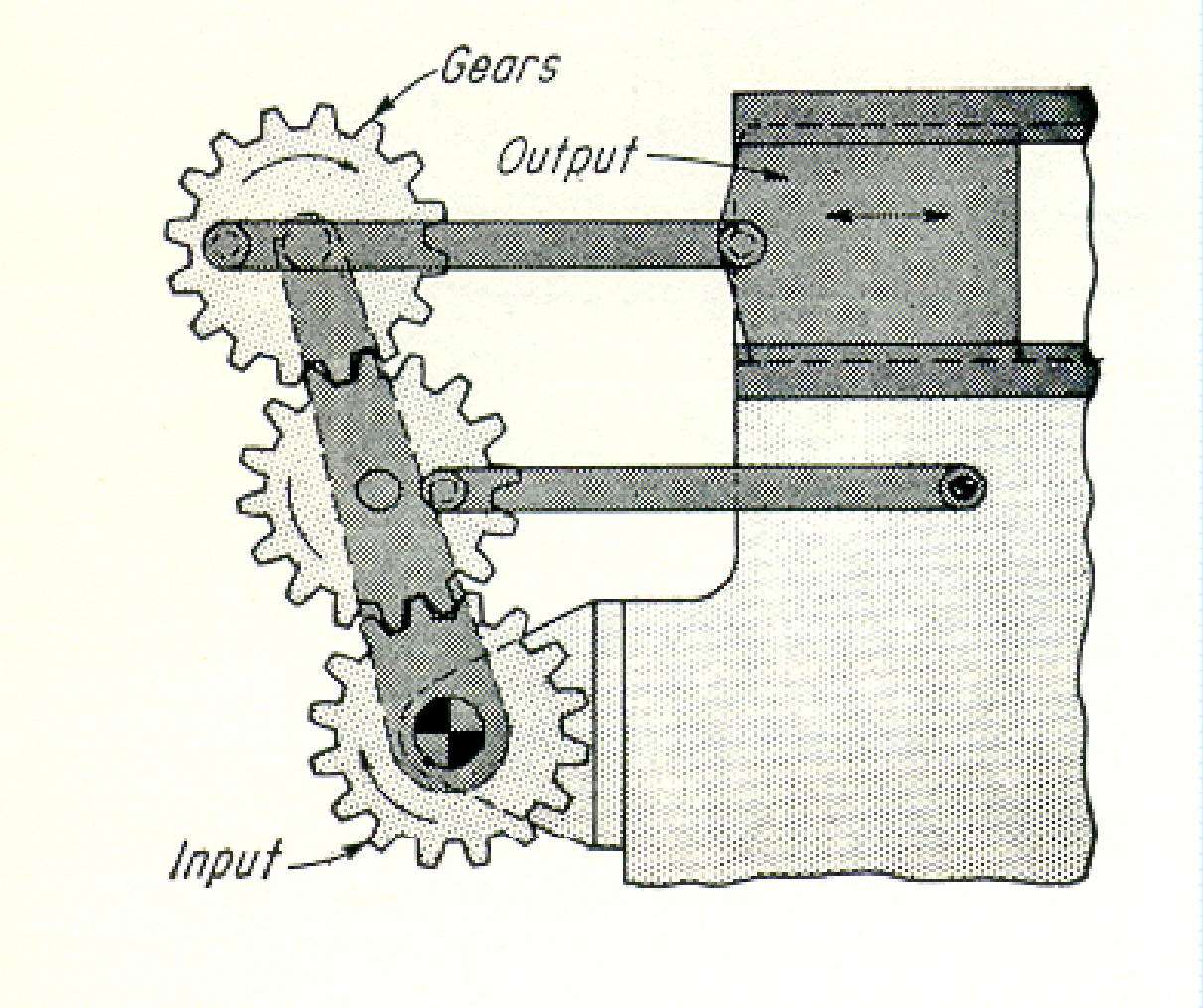
The mechanism shown is an adjustable stroke pump. The mechanism is driven by an electric motor attached to the input crank to impart a translating motion to the piston. The adjustment on the amount of stroke of the pump is made by a screw (not shown) which changes the position of the pin A.





Example

Three Gear Drive



Example

Landing Gear door with controlled Kinematic Control
(US 2005/0211848)

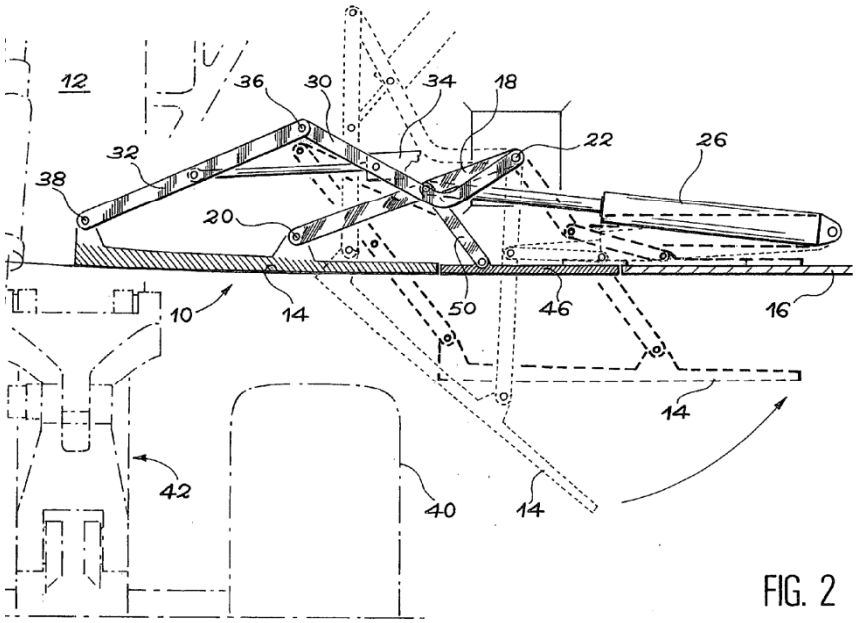


FIG. 2

Patent Application Publication Sep. 29, 2005 Sheet 2 of 5 US 2005/0211848 A1

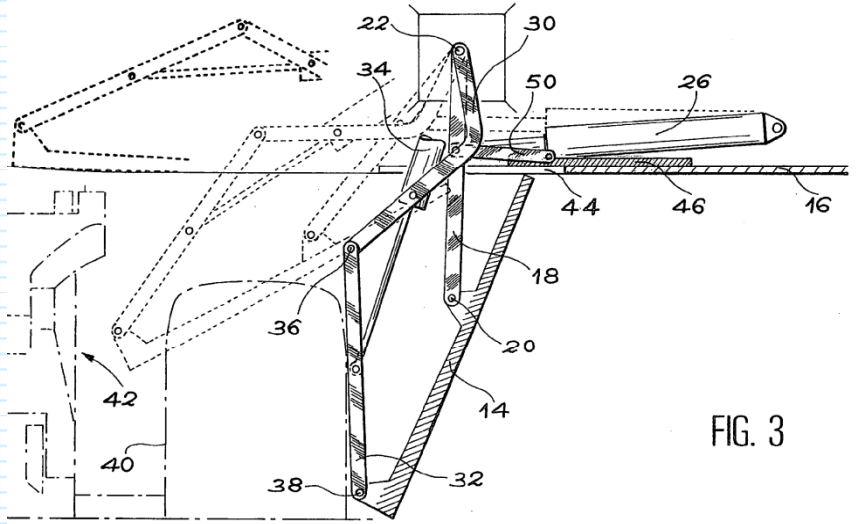


FIG. 3

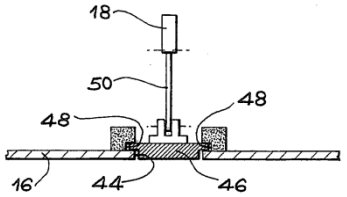


FIG. 6

Example

FIG. 2A

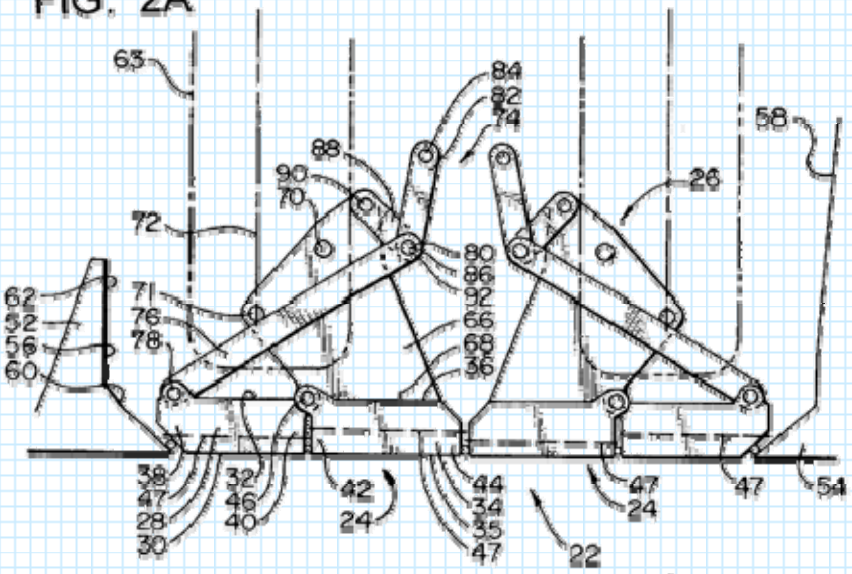


FIG. 2C

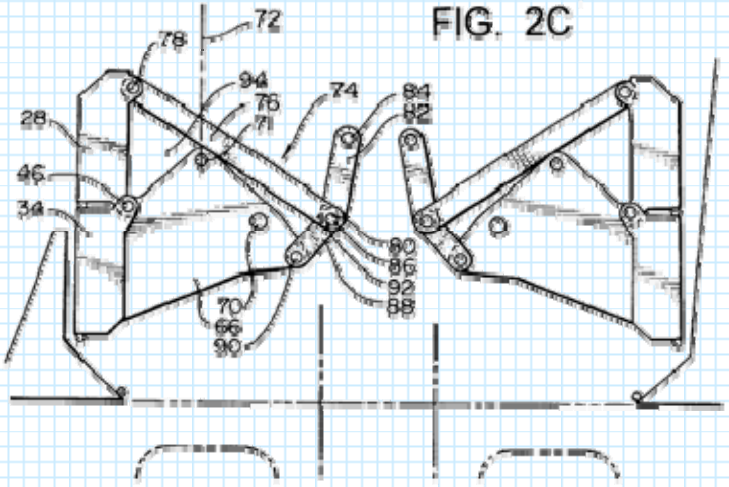


FIG. 2A

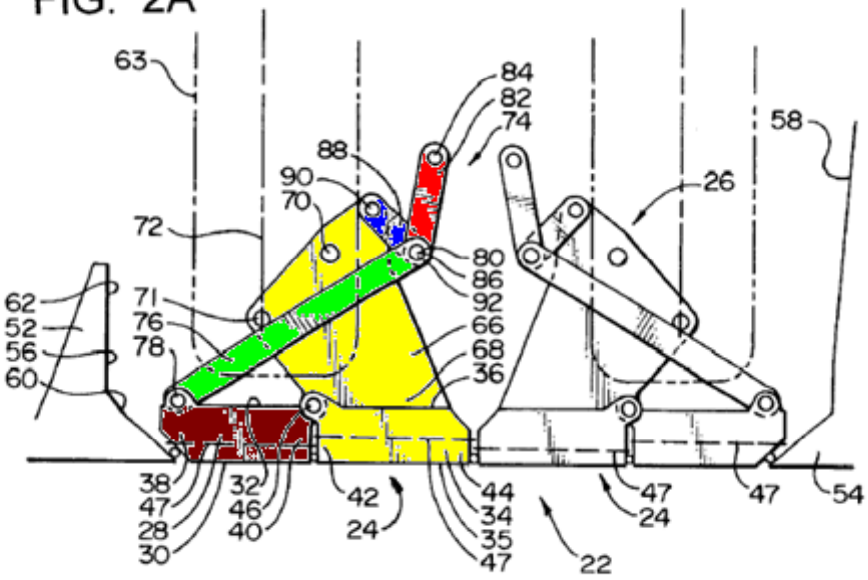
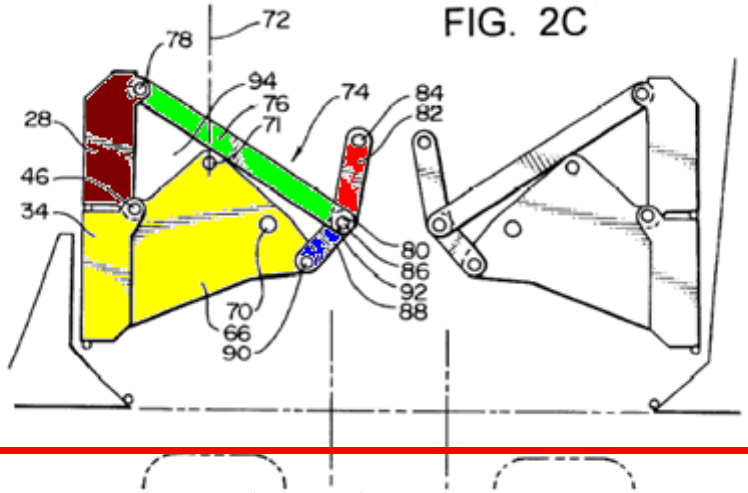


FIG. 2C



Example (Radial Misalignment Coupling)

U.S. Patent April 18, 1978 4,084,411

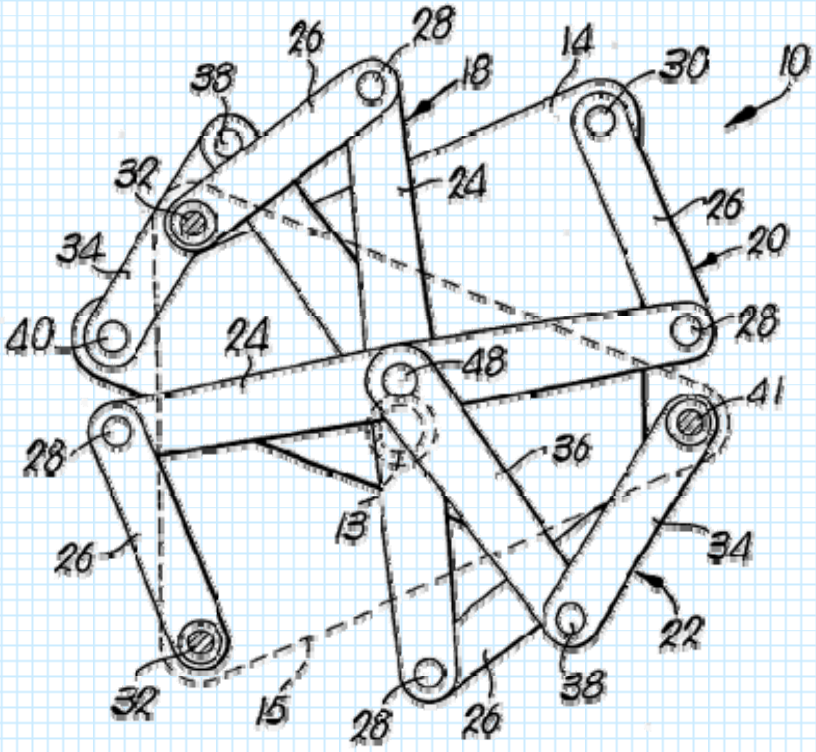


Fig. 2.

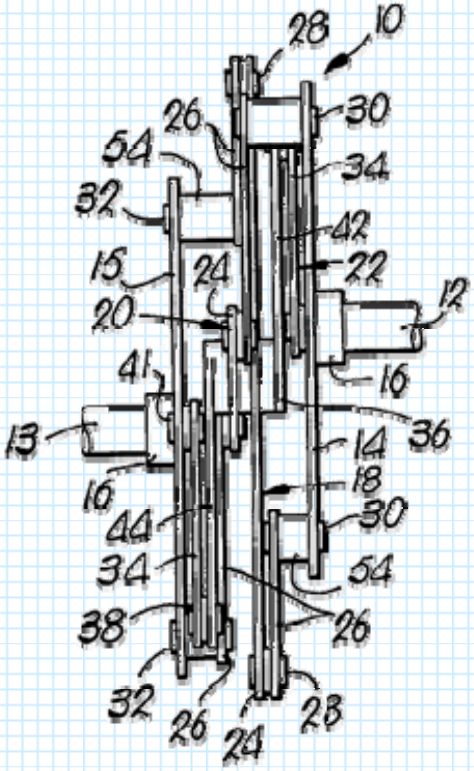


Fig. 1.

U.S. Patent April 18, 1978 4,084,411

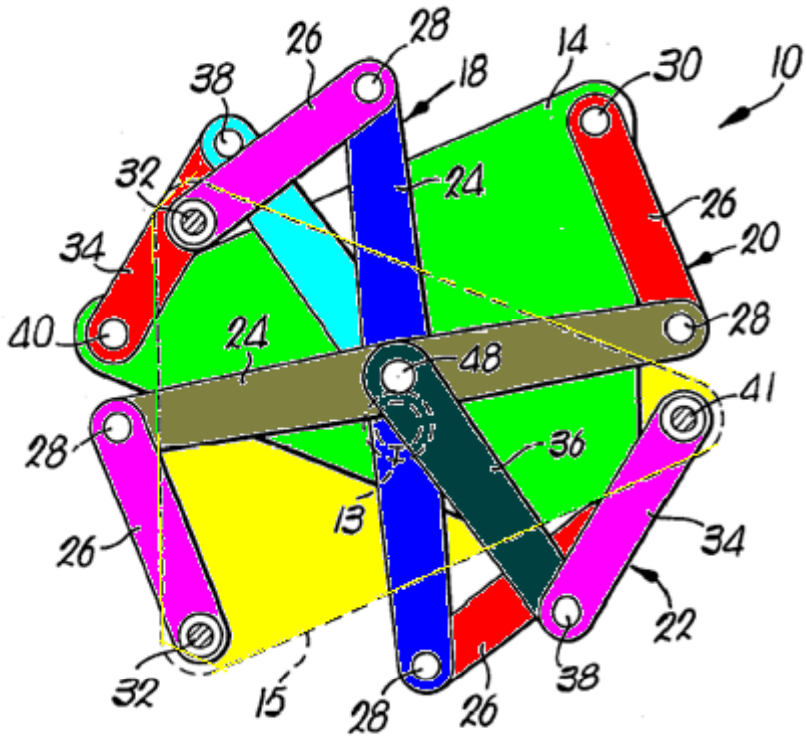


Fig. 2.

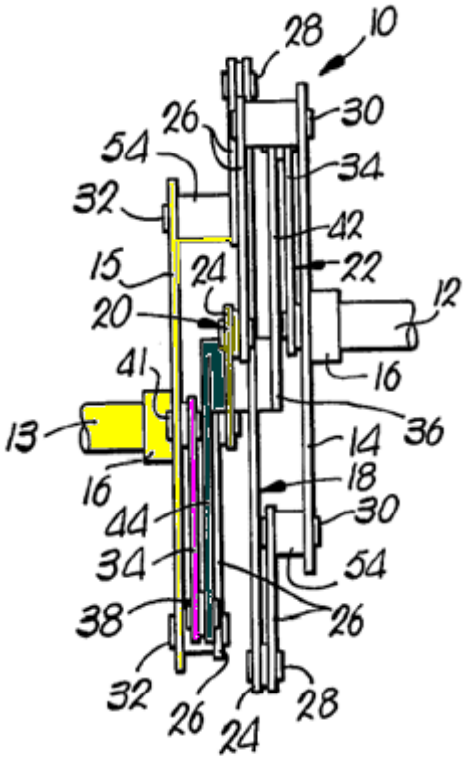


Fig. 1.

Example

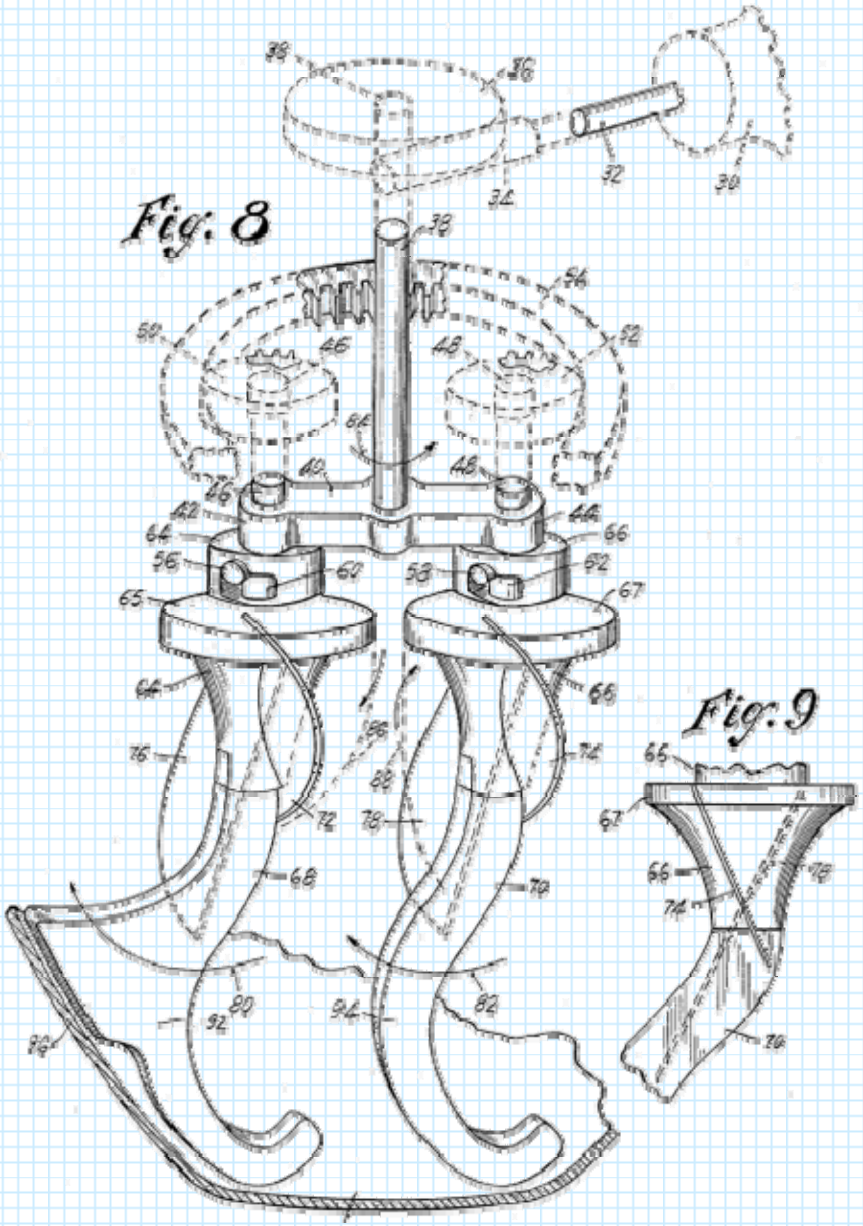


Fig. 8

Fig. 9

Linked Multi-Segment Landing Gear Door for Aircraft

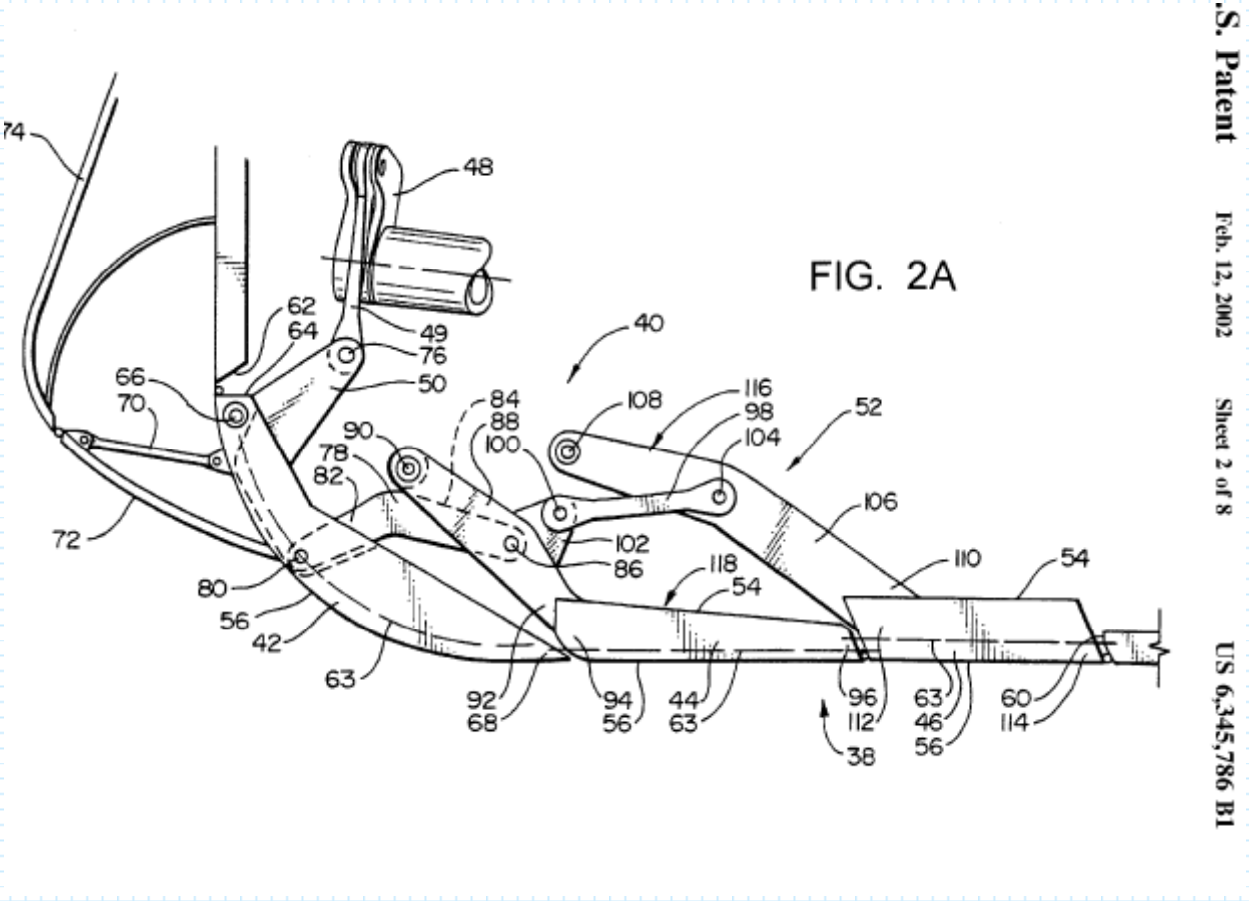
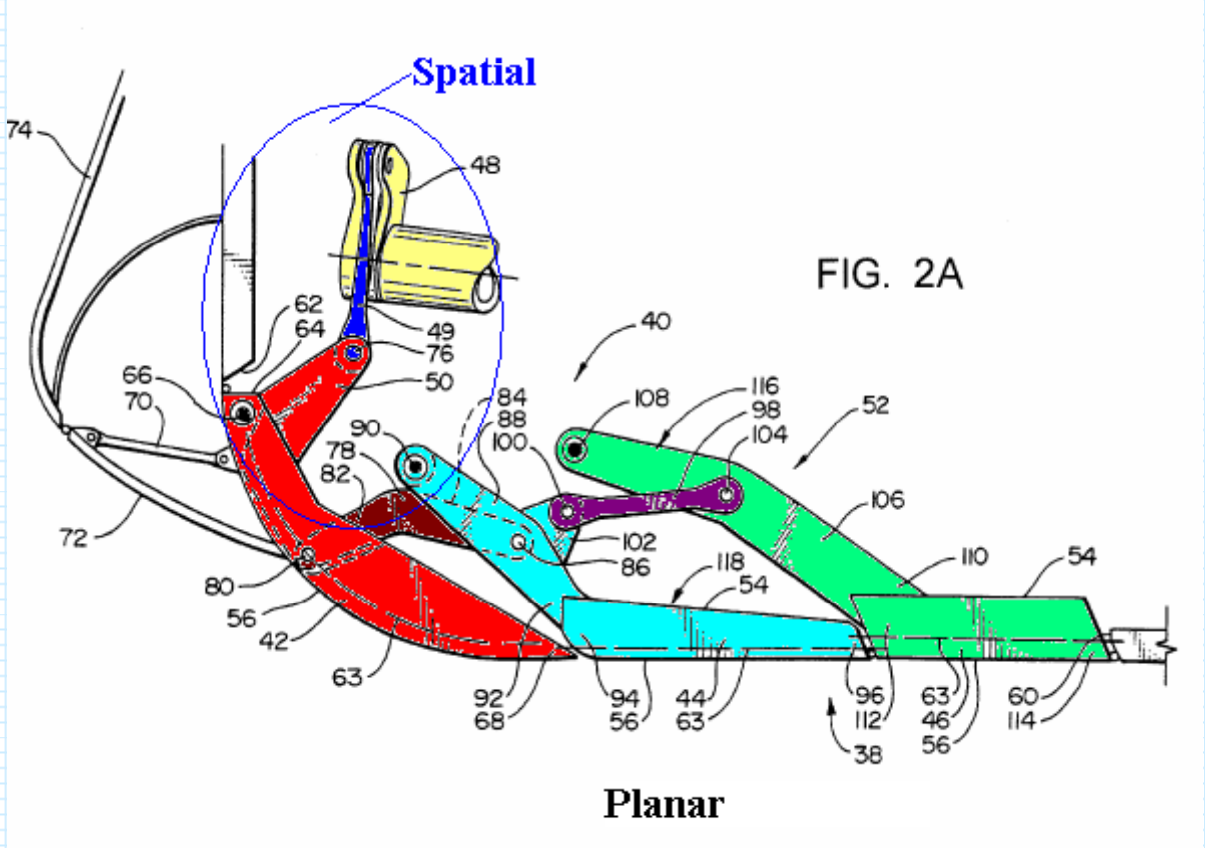


FIG. 2A

U.S. Patent Feb. 12, 2002 Sheet 2 of 8 US 6,345,786 B1


Spatial
74
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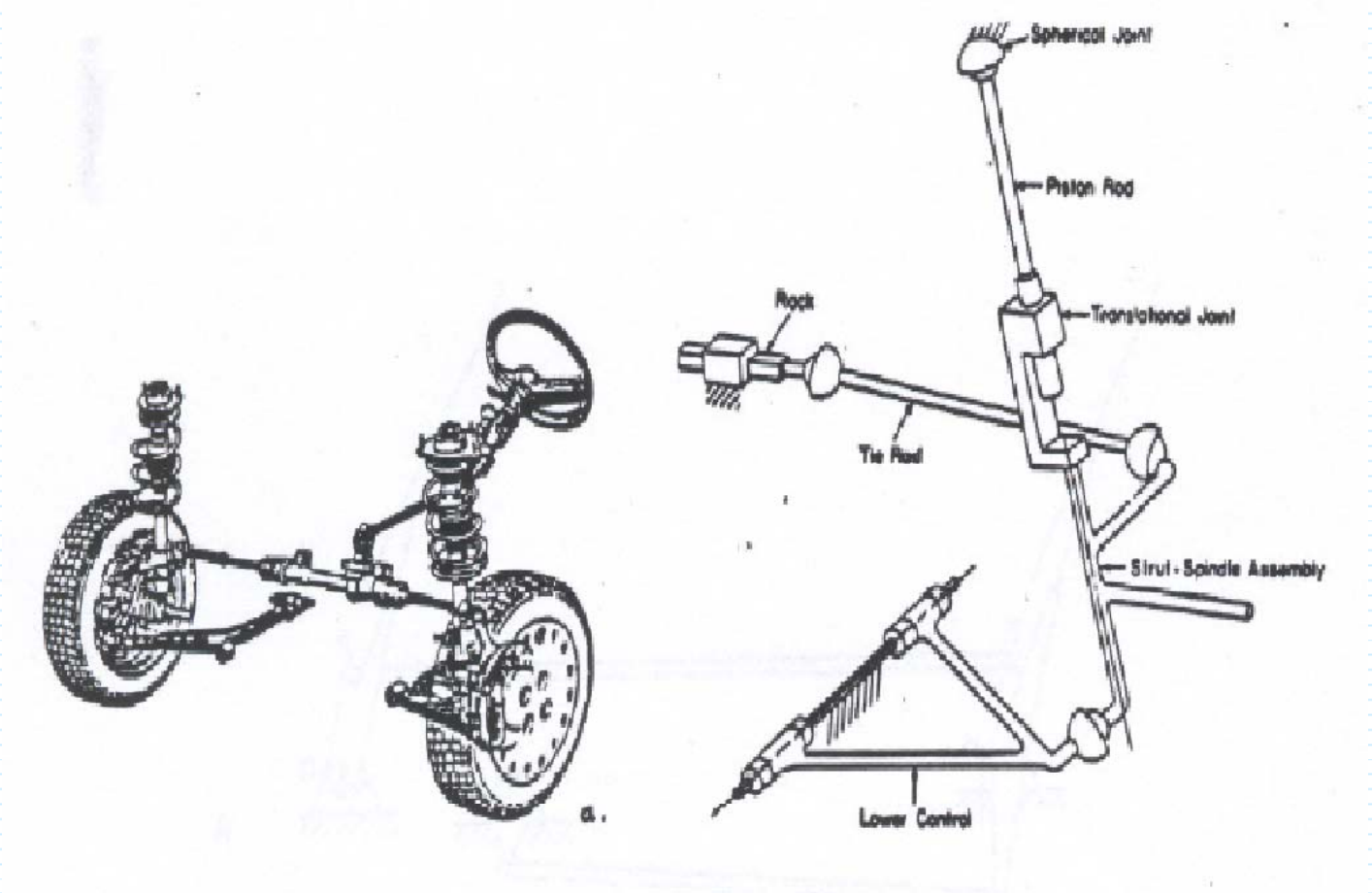
114
Planar

FIG. 2A

Example Car Suspension



Example:
Some spatial mechanisms