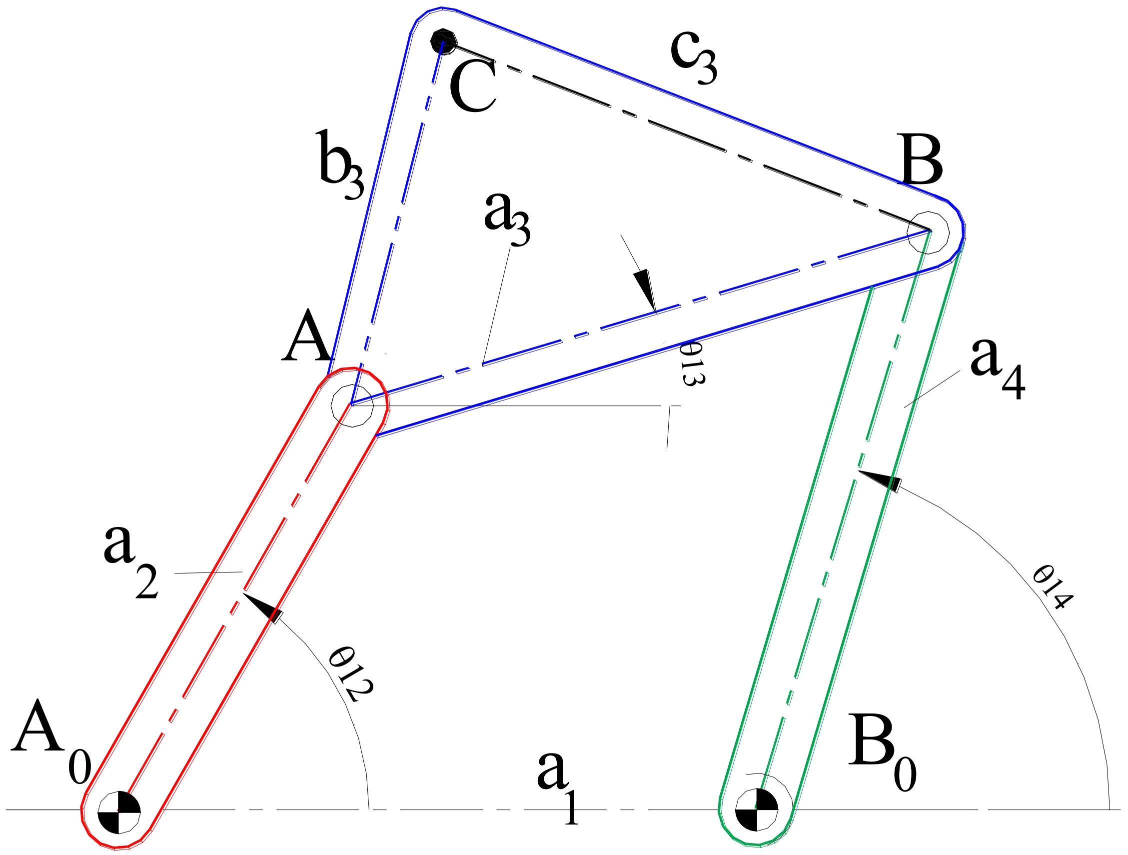
Geogebra and Excel

https://www.youtube.com/channel/UCELZzjZ-m4E0nbqD_P5Vpew

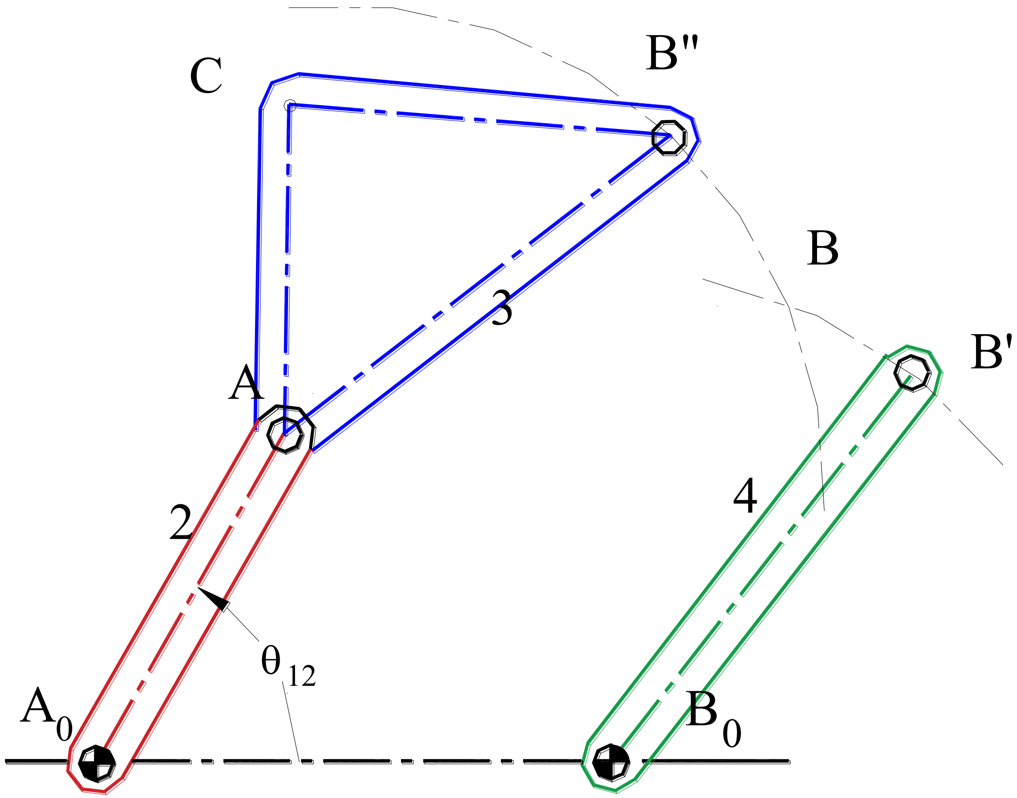


a_1=150, a_2=100, a_3=130, a_4=145, b_3=80, c_3=120

Given: A four bar mechanism (all link dimensions are given), crank angle, θ_{12}. and constant angular velocity of link 2, ω_{12}

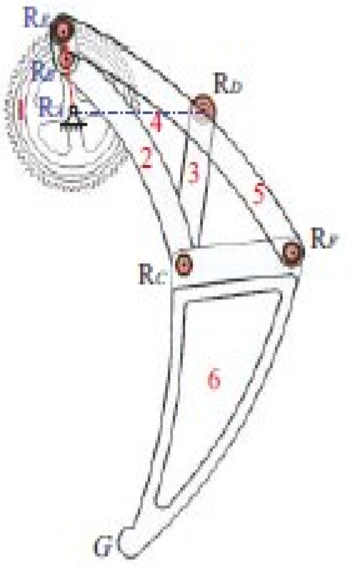
Find: θ_{14}, coordinates of point C, angular velocity of link 4, ω_{14} and the angular velocity of point C

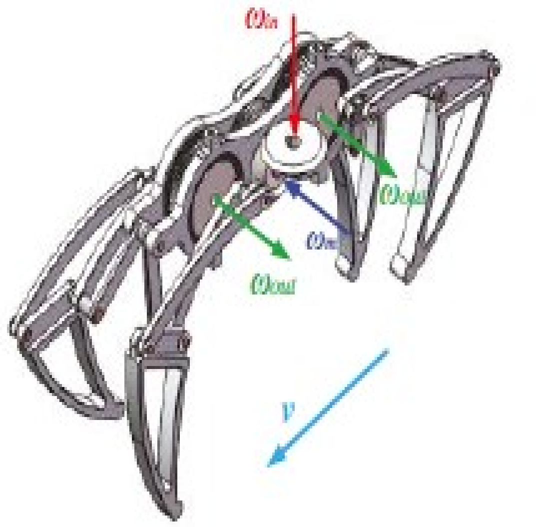
Geometrical Solution



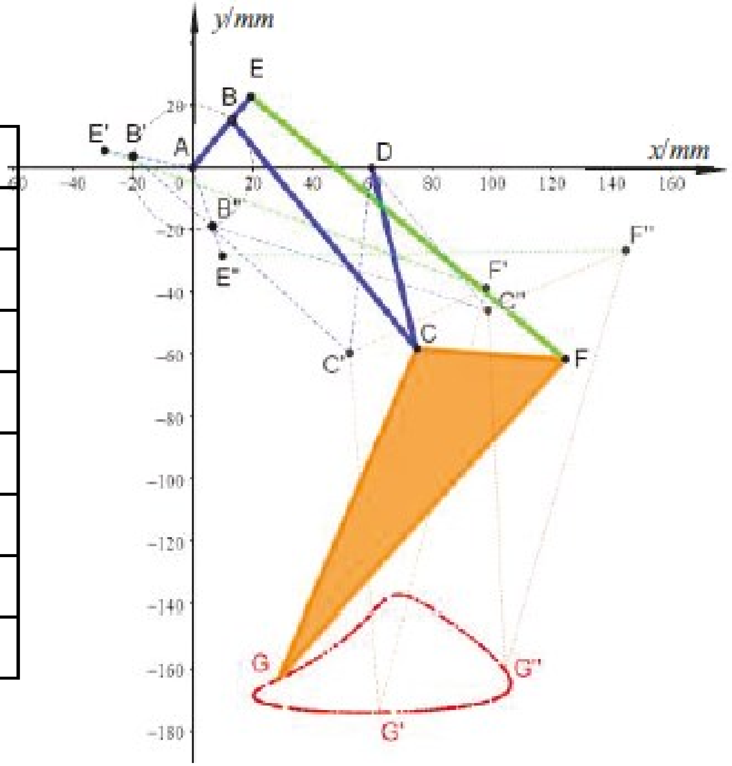
Geogebra

Walking leg of a robot.

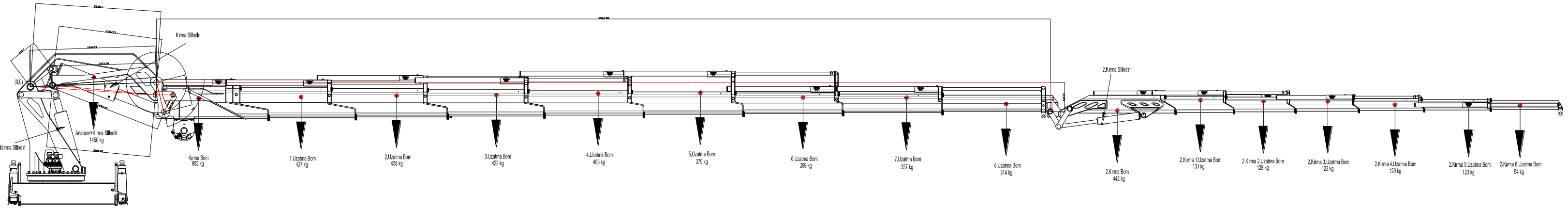


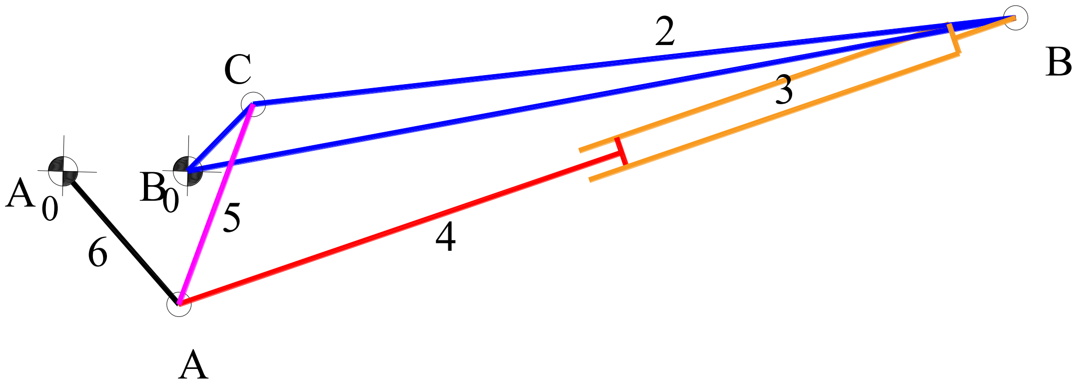


AB	20
BC	96
CD	60
AD	60
AE	30
EF	135
FG	140
CF	50
CG	115



by Xu, Lui, Zhu and Song *"**Six Bar Bionic Leg",***
Mechanisms and Machine Science, 2019, pp:13-21.





A_0B_0	a_1	250
A_0A	a_6	360
AC	a_5	435
B_0C	c_2	196
CB	b_2	1568
B_0B	a_2	1724

$< CBB_0 = \beta = \mathrm{acos}((b_2^2 + a_2^2 - c_2^2)/(2 * b_2\ a_2))$

$< B_0A_0A = \theta_{16} = -\mathrm{acos}((a_6^2 + a_1^2 - s^2)/(2 * a_6\ a_1))$

$< CBA = \quad = \mathrm{acos}((b_2^2 + s_{34}^2 - a_5^2)/(2 * b_2\ s_{34}))$

$B_0A = s = \sqrt{[a_2^2 + s_{34}^2 - 2 * a_2 s_{34} \cos(\phi - \beta)]}$

or

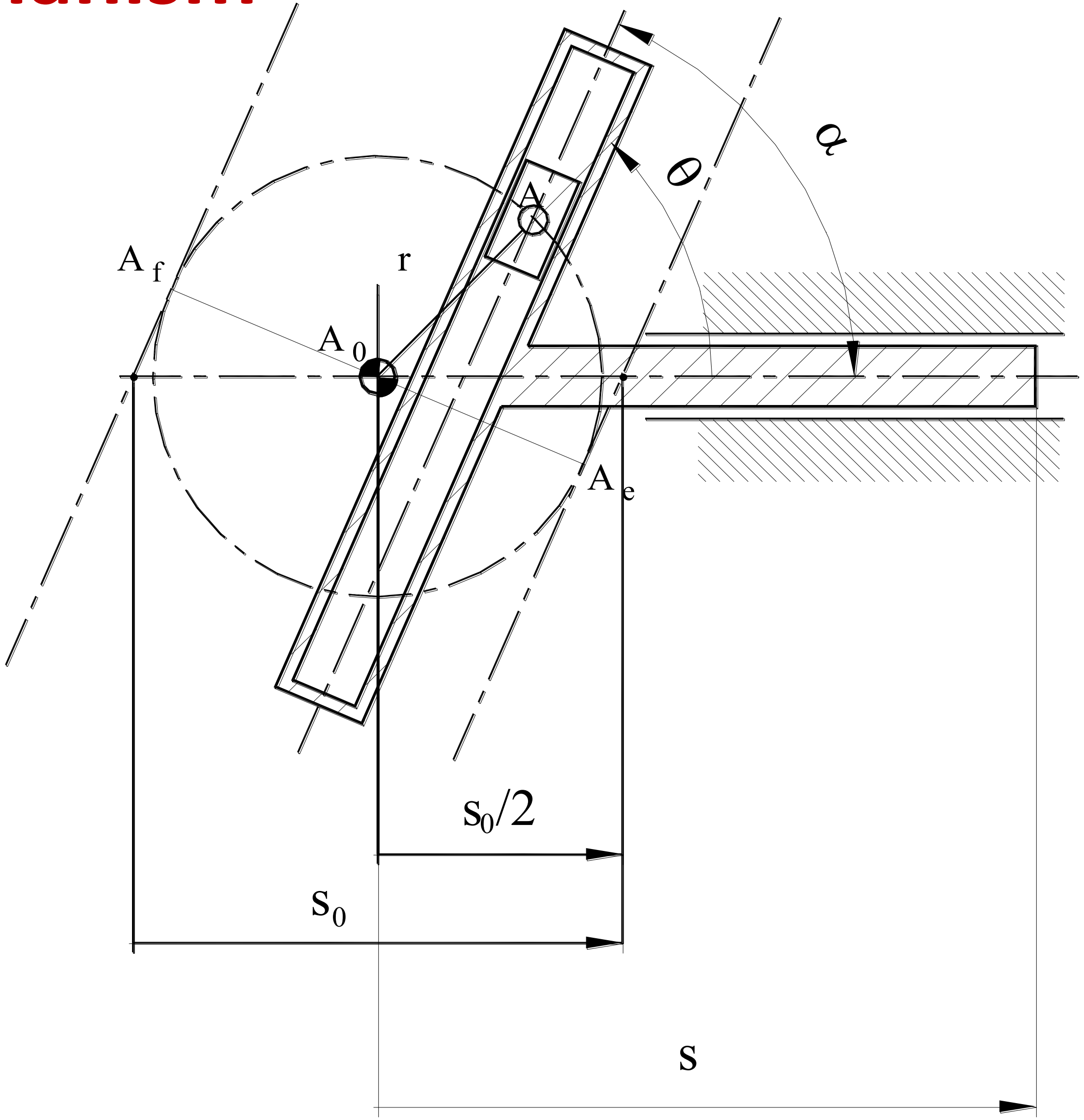
$< BCB_0 = \beta' = \mathrm{acos}((b_2^2 + c_2^2 - a_2^2)/(2 * b_2\ c_2))$

$B_0A = s = \sqrt{[c_2^2 + a_5^2 - 2 * c_2 a_5 \cos(\beta' - \phi')]}$

$< ACB = \ ' = \mathrm{acos}((b_2^2 + s_{34}^2 - a_5^2)/(2 * b_2\ s_{34}))$

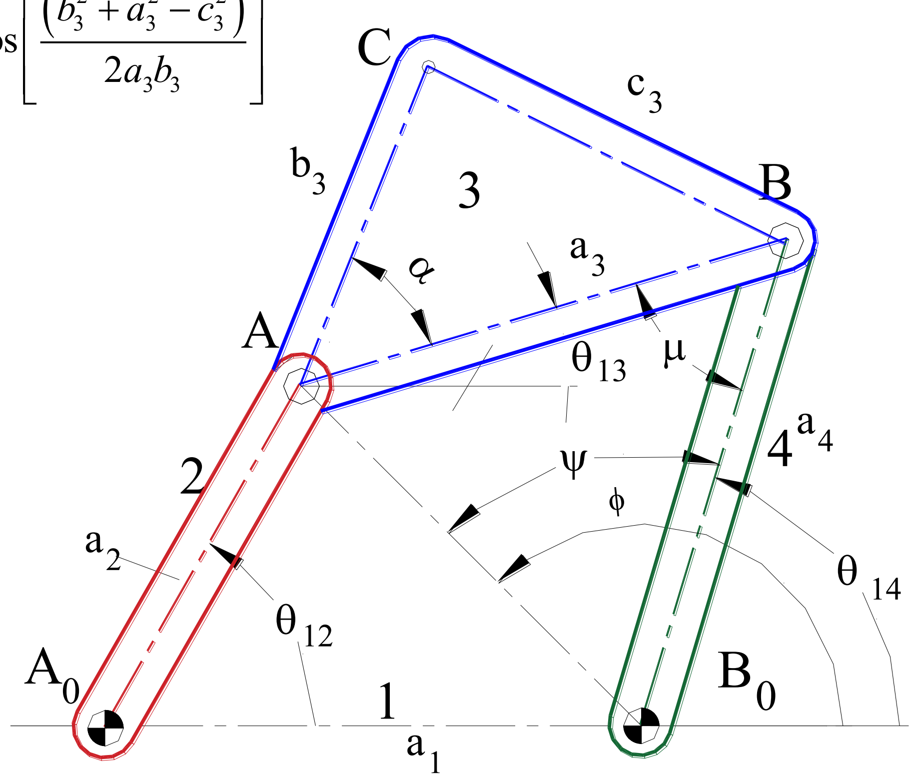
»Scotch Yoke Mechanism»

In most cases the slider axes are perpendicular to each other and the stroke is twice the crank length. Let the crank length $r=A_0A$, The angle α Can have values between 0^0 and 90^0, Using geogebra model this mechanism.



Analytical Solution:

$$\alpha = \mathrm{acos}\left[\frac{\left(b_3^2 + a_3^2 - c_3^2\right)}{2a_3 b_3}\right]$$



a_1=150, a_2=100, a_3=130, a_4=145, b_3=80, c_3=120

$$B_0A = s_x + is_y = se^{i\phi}$$

$$B_0A = (-a_1 + a_2\cos\theta_{12}) + i(a_2\sin\theta_{12})$$

$$s_x = -a_1 + a_2\cos\theta_{12}$$

$$s_y = a_2\sin\theta_{12}$$

$$s = \sqrt{\left(s_x^2 + s_y^2\right)}$$

$$\phi = a\tan 2(s_x; s_y)$$

$$\psi = \mathrm{acos}\left[\frac{\left(s^2 + a_4^2 - a_3^2\right)}{2sa_4}\right]$$

$$\mu = \mathrm{acos}\left[\frac{\left(a_3^2 + a_4^2 - s^2\right)}{2a_3a_4}\right]$$

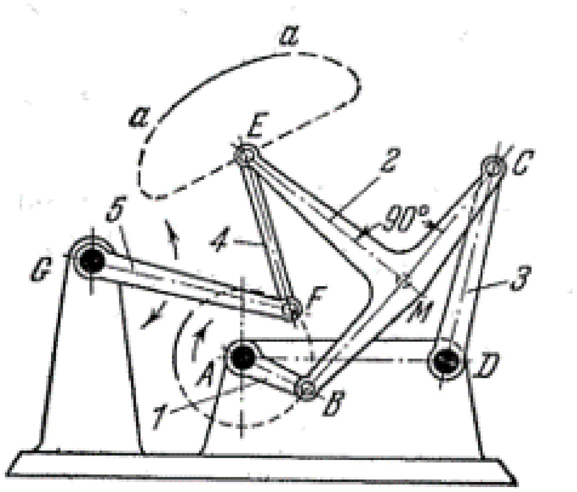
$$\theta_{14} = \phi - \psi$$

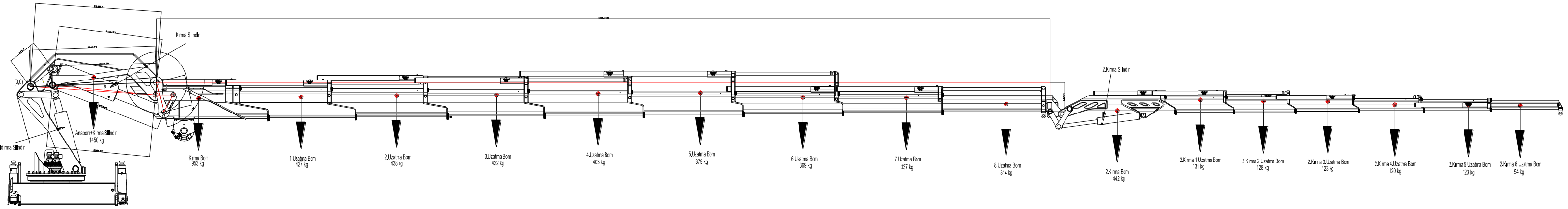
$$\theta_{13} = \theta_{14} - \mu$$

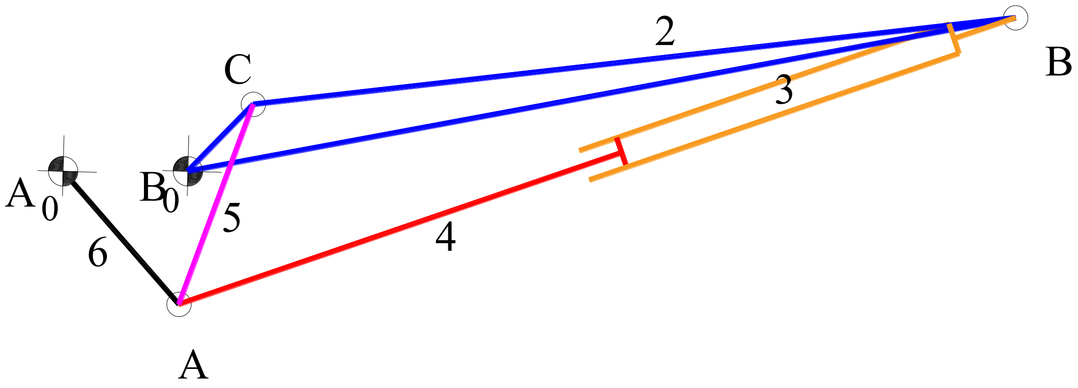
$$x_C = a_2\cos\theta_{12} + b_3\cos(\theta_{13} + \alpha)$$

$$y_C = a_2\sin\theta_{12} + b_3\sin(\theta_{13} + \alpha)$$

$|BC| = 4.22\ |AB|$, $|DC| = |GF| = |EM| = 3|AB|$, $|EF| = 2.33\ |AB|$,
$|AD| = 3\ |AB|$, $|GD| = 5.44\ |AB|$, $|BM| = |MC|$ and $|AG| = 2.4\ |AB|$







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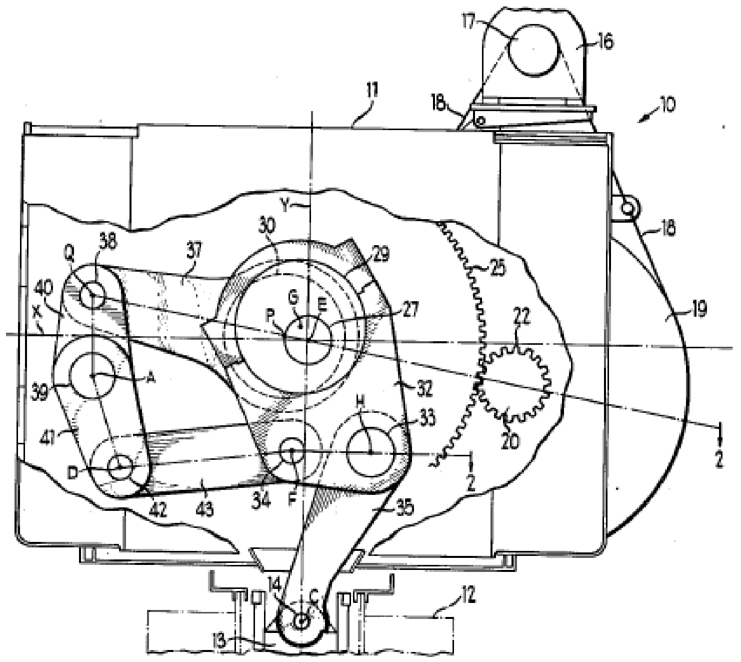
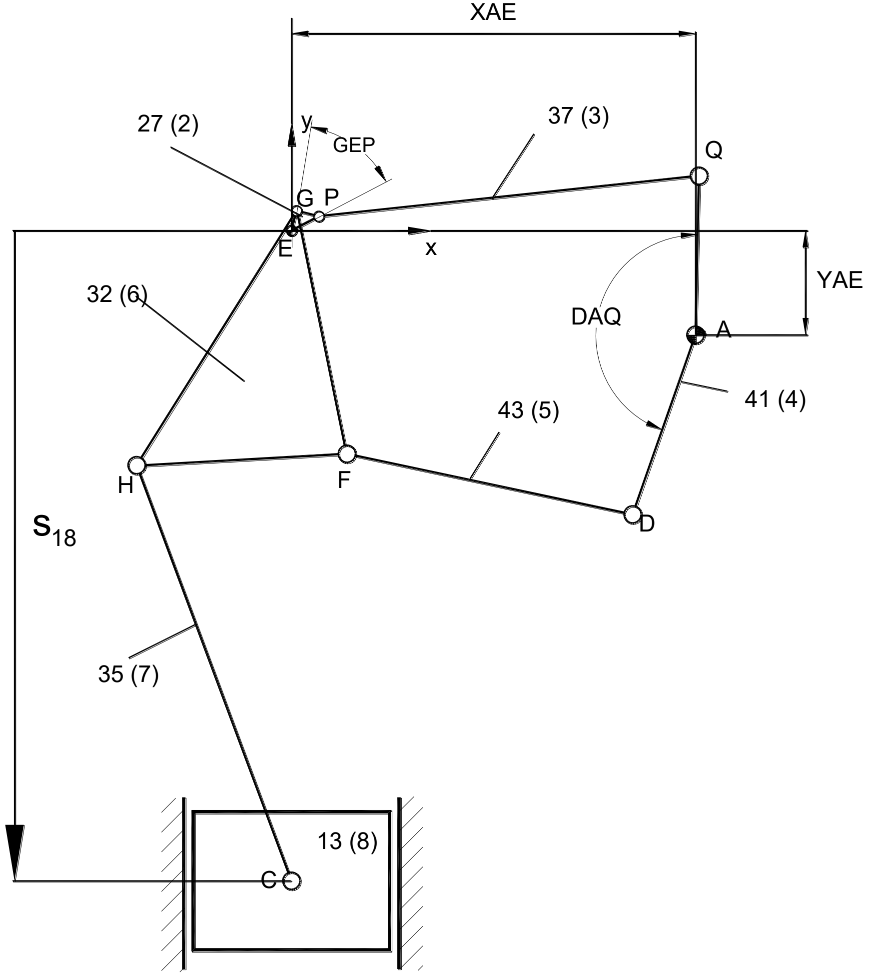
$B_0A = s = \sqrt{[c_2^2 + a_5^2 - 2 * c_2 a_5 \cos(\beta' - \phi')]}$

$< ACB = \quad ' = \mathrm{acos}((b_2^2 + s_{34}^2 - a_5^2)/(2 * b_2\, s_{34}))$

US4138904
Link drive Mechanism for mechanical Press
Tsuruo Otsuka, Jacob J. Zeilengu
20 Temmuz 1977

Example.





Elements	Fig. 3
(X)AE	43.000″
(Y)AE	− 8.000
(Y)CE	−56.000
EP	4.750
EG	3.000
GH	28.750
FG	24.750
FH	16.000
CH	36.500
PQ	39.250
AQ	16.000
AD	19.000
DF	34.500
< GEX	58.797775°
< PEX	10.472730°
<GEP	48.325044°
<DAQ	162.396480°