
# Kinematics Of Kshm of Internal Combustion Engines


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ABSTRACT

Kinematics of the crank mechanism in internal combustion engines single-stage engine. The calculation of the crank mechanism is given.



**Keywords:** *Kinematics, crankshaft, engines,* connecting rod, mechanism, deflection angle, exact formula, piston movement, *crank angle.*


The tasks of the kinematics of the crank mechanism (KShM) is to determine the displacement of the speed and acceleration of the piston.

The calculation of these values is made depending on the angle of rotation of the crank φ under the assumptions:

$w = d\varphi / dt = 2\pi n / 60 = \pi n / 30 = const$ , $\varphi = wt$ or $\varphi = 6 nt$

where ω is the angular speed of rotation of the crankshaft, $s^{-1}$; n - frequency of rotation of the crankshaft, $min^{-1}$

Below is a method for kinematic calculation of the central crank mechanism of a single-row engine. The calculation of deaxial crankshaft and V-shaped engines is given in the special literature [1, 2, 3, 4, 5].

Consider the scheme of the central crankshaft engine (Fig. **1.1** ). The piston moves from top dead center (TDC) to bottom dead center (BDC) with a full stroke S.

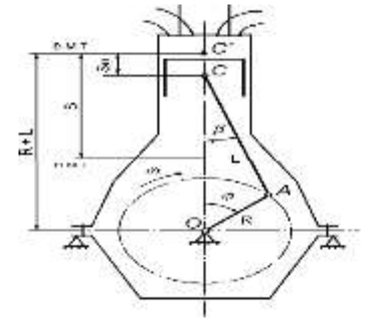
The connecting rod performs a portable movement together with the piston pin and swinging around the piston pin. The angle of deviation of the connecting rod β from the axis of the cylinder is determined from the ratio of the ACO triangle based on the sine theorem:

sin β / sinφ \u003d R / $L_w$ \u003d $\lambda_k$

sin β \u003d $\lambda_{to}$ sinφ

Biggest connecting rod deflection

$\beta_{max} \leq 15...17^{o}$ will be equal to $90$ and $270^{o}$ at φ .




Unok rice - . **1.1.** Scheme of the central KShM.

**Piston movement .**

When the crank is rotated by an angle j, the piston displacement will be $S_x$ (Fig. 2 ).

$S_x$ \u003d C ′ C \u003d C ′ O - CO \u003d R + L - CO

Then

$S_φ$ \u003d R + L - R cos φ – L cosβ

In practical calculations, this exact formula is inconvenient, since the displacement depends on two variables j and b. Therefore, an approximate formula is more often used, in which the variable β is expressed in terms of φ based on the Newton binomial.

$$\cos\beta = \sqrt{1-\sin^2\beta} = \sqrt{1-\lambda_k^2\sin^2\varphi}$$

Expanding the right-hand side in Newton's binomial and neglecting the terms above of the second order, due to their youth, we get

$$\cos\beta \approx 1-\lambda_k^2/4+(\lambda_k^2/4)\cos 2\varphi$$

Then

CO = Rcosφ + $L_w$ - R$λ_{to}$ /4 + (R$λ_{to}$ /4) cos2φ

we finally get

$S_x$ \u003d R [(1 - cos φ) + $λ_{to}$ / 4 (1 - cos 2 φ )]

It can be seen from the formula that the displacement of the piston consists of the displacement first order

Sx = R (1 - cos φ )

and second order displacement

$S_{x2}$ = (R $λ_{to}$ /4) (1 - cos2 φ )

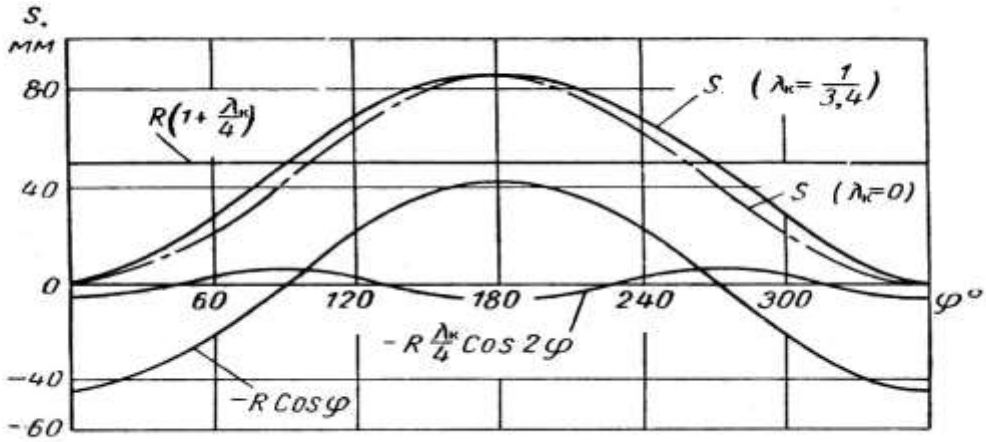
When φ \u003d 0 about $S_x$ = 0

φ \u003d 90 about $S_x$ \u003d R (1 + $λ_{to}$ / 2)

φ \u003d 180 about $S_x$ = 2R = S

The value of Rlk / 2 is called the F. Brix correction, the essence of which is that during the first 90 degrees of rotation of the crank, the piston passes a large path by the value (1 + $λ_{to}$ /2) than for the next 90 about .

Figure 3 **1.2** shows the displacement curves of the piston $S_φ$ depending on the angle of rotation of the crank.




Unok rice - 4 . **1.2** . Piston displacement curves.

**piston speed .**

The piston speed W can be determined by differentiating the expression piston displacement $S_x$ in time

$$W_{\Pi} = \frac{ds_x}{dt} = \frac{d\varphi}{dt} \cdot \frac{ds_x}{d\varphi} = w\omega \frac{ds_x}{d\varphi}$$

or

$$W_{\Pi} = w \cdot R \cdot (\sin\varphi + (\lambda_k / 2 \cdot \sin 2\varphi)) \text{ m/s}$$

When turning the crank at an angle
φ= 0 ° Wp = 0
φ \u003d 90 about Wp = w R
φ \u003d 180 about Wp = 0
φ \u003d 270 about Wп = - w R

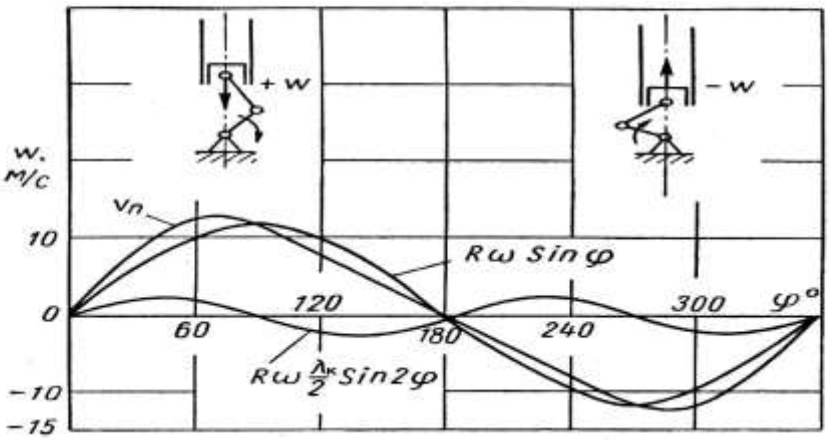
For practical calculations and comparison of high-speed engine use the average piston speed

W = Sn / 30 m/s.

For modern automotive engines

W p \u003d 5 ... 15 m / s.

The dependence of the piston speed on the angle of rotation of the crank is presented in fig. 44 **11.3.**




Unok rice - 5 **1.3** . Piston velocity curves.

**Piston acceleration .**
Piston acceleration j p can be determined by differentiating the expression speed over time

$$j_{\Pi} = \frac{dW_{\Pi}}{dt} = \frac{dW_{\Pi}}{d\varphi} \cdot \frac{d\varphi}{dt} = \frac{aW_{\Pi}}{d\varphi} \cdot \omega$$

$$j_{\Pi} = w^2 R(\cos\varphi + \lambda_k \cdot \cos 2\varphi) \text{, m/s2}$$

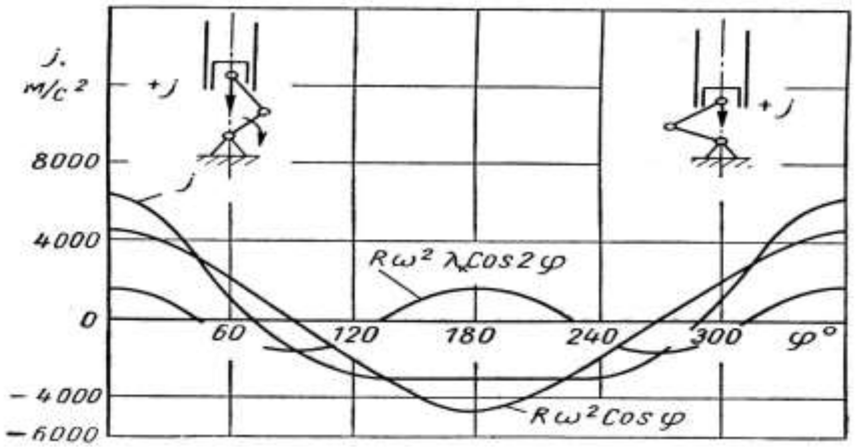
The dependence of the piston acceleration j p depending on the angle of rotation of the crank is shown in fig. 5 **1.4** .
From the piston acceleration graphs, it can be seen what at

$\varphi$ \u003d 0 (360 $^{o}$) j $_{p}$ \u003d R w $^{2}$ (1 + $\lambda_{to}$ )

value j $_{p}$ - reaches maximum positive value at

$\varphi$ \u003d 180 $^{about}$ j $_{p}$ \u003d - w $^{2}$ R (1 - $\lambda_{k}$ )

the value of j $_{p}$ - reaches the maximum negative value, and absolute value in TDC. 0(3 6 0 $^{o}$ ) is greater than HDC (180 $^{o}$ ).




Unok rice - 5 **1.4** . Piston acceleration curves.

**Literature:**

1. Nikolenko A.V. Theory, design and calculation of autotractor engines bodies. – M.: Kolos, 1984 – 335p.
2. Segal V.F. Dynamic calculations of internal combustion engines.- L .: Mashinostroenie, 1974.
3. Neiman I.Sh. Dynamics of aircraft engines. - Ed. defense. prom. m. - l., 1940.
4. Chistyakov V.K. Dynamics of piston and combined engines internal combustion. - M .: Mashinostroenie, 1989. - 256 p.
5. Popyk K.G. Dynamics of automobile and tractor engines. – M.:Engineering, 1965.