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In the work rassmotrenы question paketyrovanyya hlebobulochnыh of products at partyonnыh Transit to develop-zochnыh routes something pozvoljaet povыsyt Efficiency transit.

Transportation of, Bread and hlebobulochnыe Fixing, mayatnykovыy route razvoznoy-sbornыy route re-vozok Organization, podvyzhnoy composition, packaging.

The paper discusses issues of packaging of bakery products during transport to partionnyh razvozochnyh routes, thus enhancing the efficiency of transport.

Transport, bread and bakery products, Orbital route razvoznoy-collecting trip, the organization of transportation, rolling stock, containers.

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ON THE INFLUENCE OF SOME STRUCTURAL PARAMETERS FOR PISTON MACHINES their performance

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Applying the method of large-scale changes such dynamic systems established relationship between basic design parameters of piston machines and their performance.

The dimensions of the cylinders, pistons average speed, work capacity, power, materials, effective efficiency.

Problem. In modern engineering practically not there are cases where the physical object is created "from scratch". The developed almost every object has a counterpart (like object) that is different from values generated object design parameters and operating modes. This makes it easy to determine the parameters of the new object in step prediction - cumbersome calculations are not necessary. Suffice it to somehow transfer the numeric values analog "design" in their created object. For correct conversion requires knowledge of legis-nomirnostey, which is subject to change intensity values of the parameters and performance of facilities in their scale transformations.

Analysis of recent research. In general, the above patterns are described by mathematical models of large-scale transformations [1]. Their use is one of the manifestations of the art of modeling as simplifying management tasks that arise in the practice of engineering.

The purpose of research. Set the basic laws, which is subject to the relationship of parameter values and performance of facilities in their scale transformations.

Results. One of the systems connected by a large-scale transformation, will be called the original (nature), and the second – model and mark their index "n" and "m", respectively.

Linear scale factor of two geometrically shaped objects called value l_λ Which is the ratio of specific sized models $l_{\text{ì}}$ to the same size as the original (original) $l_{\text{í}}$:

$$l_\lambda = \frac{l_{\text{ì}}}{l_{\text{í}}}.$$

Similarly, we can define the scale factors Square S_λ, Volume V_λ, Material density ρ_λ, The mass of the object m_λ :

$$S_\lambda = \frac{S_{\text{ì}}}{S_{\text{í}}} = l_\lambda^2, V_\lambda = l_\lambda^3, \rho_\lambda = \frac{\rho_{\text{ì}}}{\rho_{\text{í}}}, m_\lambda = \rho_\lambda \cdot l_\lambda^3. \quad (1)$$

Scale factor of any other physical quantities (stress in the material, torque, power, etc.), which is expressed by a one-term formula obtained by discarding in the above formula constants and replace each variable corresponding scale factor.

While large-scale transformations of dynamical systems can range all their parameters, including time. This means different its course in the original and transformed systems, ie different time of the corresponding displacement in the first and second systems. Time scale is:

$$t_\lambda = \frac{t_{\text{ì}}}{t_{\text{í}}}, \quad (2)$$

where $t_{\text{ì}}$ ³ $i_{\text{í}}$ – corresponding points or time intervals in the original and transformed systems, for example, different oscillation period and so on.

In large-scale transformations of dynamical systems there is unambiguous relationship between the scale kinematic and dynamic parameters. For example, the scale speed is equal to the magnitude linear dimensions l_λ to the time scale t_λ:

$$\upsilon_\lambda = \upsilon_{ì} : \upsilon_{í} = \left(\frac{dl_{ì}}{dt_{ì}}\right) : \left(\frac{dl_{í}}{dt_{í}}\right) = \frac{dl_{ì} \cdot dt_{í}}{dl_{í} \cdot dt_{ì}} = \left(\frac{dl_{ì}}{dl_{í}}\right) \cdot \left(\frac{dt_{í}}{dt_{ì}}\right) = l_\lambda \cdot \frac{1}{t_\lambda} = \frac{l_\lambda}{t_\lambda} \qquad (3)$$

where $l_\lambda = \dfrac{dl_{ì}}{dl_{í}} \equiv \dfrac{l_{ì}}{l_{í}}$ - Scale linear dimensions;

$t_\lambda = \dfrac{dt_{ì}}{dt_{í}} \equiv \dfrac{t_{ì}}{t_{í}}$ - Time scale.

Similarly, the scale acceleration equal to the magnitude linear dimensions to the square of the time scale:

$$a_\lambda = a_{ì} : a_{í} = \frac{l_{ì}}{t_{ì}^2} : \frac{l_{í}}{t_{í}^2} = \frac{l_{ì} \cdot t_{í}^2}{l_{í} \cdot t_{ì}^2} = \left(\frac{l_{ì}}{l_{í}}\right) \cdot \left(\frac{t_{í}^2}{t_{ì}^2}\right) = l_\lambda \cdot \frac{1}{t_\lambda^2} = \frac{l_\lambda}{t_\lambda^2}. \qquad (4)$$

And when you consider the expression (3) for the scale and value of the angular velocity ω_λ Which has the form

$$\frac{1}{t_\lambda} = \omega_\lambda ,$$

then scale acceleration a_λ can be expressed as a function of linear scales υ_λ (Top row) or angular ω_λ (Bottom row) speeds:

$$a_\lambda = \frac{l_\lambda}{t_\lambda^2} = \begin{cases} \dfrac{l_\lambda^2}{t_\lambda^2 \cdot l_\lambda} = \dfrac{\upsilon_\lambda^2}{l_\lambda}; \\ l_\lambda \cdot \dfrac{1}{t_\lambda^2} = l_\lambda \cdot \omega_\lambda^2. \end{cases} \qquad (5)$$

The scale of the forces is determined by the expression:

$$F_\lambda = \frac{F_{ì}}{F_{í}} = \frac{m_{ì} \cdot a_{ì}}{m_{í} \cdot a_{í}} = m_\lambda \cdot a_\lambda = \frac{m_\lambda \cdot l_\lambda}{t_\lambda^2}. \qquad (6)$$

The latter can also be defined as a function of linear scales υ_λ (Top row) or angular ω_λ (Bottom row) velocity elements of:

$$F_\lambda = \frac{m_\lambda \cdot l_\lambda}{t_\lambda^2} = \begin{cases} \dfrac{m_\lambda \cdot l_\lambda^2}{t_\lambda^2 \cdot l_\lambda} = \dfrac{m_\lambda \cdot \upsilon_\lambda^2}{l_\lambda}; \\ m_\lambda \cdot l_\lambda \cdot \dfrac{1}{t_\lambda^2} = m_\lambda \cdot l_\lambda \cdot \omega_\lambda^2. \end{cases} \qquad (7)$$

Using the relation (1) $m_\lambda = \rho_\lambda \cdot l_\lambda^3$, Scale forces can be represented as:

$$F_\lambda = \frac{m_\lambda \cdot l_\lambda}{t_\lambda^2} = \begin{cases} \dfrac{m_\lambda \cdot \upsilon_\lambda^2}{l_\lambda} = \rho_\lambda \cdot l_\lambda^2 \cdot \upsilon_\lambda^2; \\ m_\lambda \cdot l_\lambda \cdot \omega_\lambda^2 = \rho_\lambda \cdot l_\lambda^4 \cdot \omega_\lambda^2. \end{cases} \qquad (8)$$

Dividing each component of the expression of the scale area $S_{\lambda} = l_{\lambda}^{2}$, We obtain the scale stresses in the elements of the converted:

$$\sigma_{\lambda} = \frac{F_{\lambda}}{S_{\lambda}} = \begin{cases} \rho_{\lambda}\,\upsilon_{\lambda}^{2}; \\ \rho_{\lambda}\, l_{\lambda}^{2} \cdot \omega_{\lambda}^{2}. \end{cases} \qquad (9)$$

The obtained value (5), (8) and (9) indicate the following general properties of dynamical systems (which include piston engines) that occur in their large-scale transformations:

1. Acceleration a, Inertial forces F and stress σ elements piston machines directly proportional to the square as the linear and angular velocities.

2. If the same level of withstanding linear velocity of the converted elements (ie, the average forward speed of the piston, $\upsilon_{\lambda} = 1$), The increase in size piston machines l_{λ} times accompanied by the following consequences:

a) decreasing acceleration a elements in l_{λ} times - top line value (5);

b) increasing the inertia forces F in l_{λ}^{2} times - top line value (8);

c) no change in stresses σ elements of the system - the top line value (9). The latter indicates that increasing the size of piston machines, which are made of the same materials, should be preserving the average linear velocity of the piston.

3. If the same level of withstanding the angular velocity of the converted elements (ie, the angular velocity of the crankshaft, $\omega_{\lambda} = 1$), The increase in system size l_{λ} times accompanied by the following consequences:

a) increasing linear acceleration a in l_{λ} times - the bottom line (5);

b) increasing the inertia forces F in l_{λ}^{4} times - the bottom line (8);

c) an increase in stress σ in l_{λ}^{2} times - the bottom line (9). This indicates that increasing the size of piston machines, which are made of the same materials ($\sigma = const$), It is impossible while maintaining the angular velocity of the crankshaft - it must be reduced. Namely, that with increasing system size in l_{λ} times to keep tension in detail in the prior angular speed of the crankshaft should be reduced in l_{λ} times:

$$\omega_{\lambda} = \sqrt{\frac{\sigma_{\lambda}}{\rho_{\lambda}}} \cdot \frac{1}{l_{\lambda}}. \qquad (9\text{ a})$$

For example, modern diesel engines have the angular speed of the crankshaft [2, p. 22]:

• Bore at 85 - 150 mm - 1.5 - 3 thousand. Min-1;

• Bore at 300 - 600 mm - 400 - 500 min-1;
• When Bore 800 mm and more - 100 - 110 min-1.

Increasing the size of the cylinder is accompanied not only decrease the angular velocity, but also an increase in the absolute tolerances for wear parts. These two factors positively affecting the service life of the engine. For example, a resource to overhaul existing engines equipped with superchargers is [2, p. 22]:

• Bore at 85 - 150 mm - 10 - 14 thousand. Hours;
• Bore at 300 - 650 mm - 45 - 50 thousand. Hours;
• When Bore more 800 mm - 100 thousand. H.

To imagine the size of these resources should be noted that in one year he strong pressure of the engine operating time is about 8.8 thousand. H.

Expression (9) also shows that reducing the size of the cylinder (scale $l_\lambda < 1$) Can be used to increase the permissible angular velocity of the crankshaft, which makes it possible to increase the capacity liter engine. Namely, the angular velocity can be increased in the same number of times, which will be reduced linear dimensions of cylinder. This property is used in the creation of high-speed engines racing motorcycles and cars, which used a larger number of cylinders of small size.

4. cope with increased inertia forces and tensions that arise while increasing the size of can be ensured by using materials with a lower density (scale $\rho_\lambda < 1$).

Effective power piston internal combustion engine can be determined by the expression:

$$N = \left\{ \begin{matrix} P\dfrac{V}{\pi\tau}\omega; \\ P\dfrac{V}{\pi\tau}\omega \quad = \quad P\dfrac{SH}{\pi\tau}\omega \quad = \quad P\dfrac{S}{\tau}\cdot\overline{\upsilon}, \end{matrix} \right\}, \qquad (10)$$

where N - Engine power, kW;

P - Mean effective pressure, kPa;

V- Engine capacity, m3;

τ - Taktnist engine for four is equal to 4, and stroke - 2;

ω - Angular velocity of the crankshaft, rad / s;

S - The total area of the piston engine, m2;

H - Stroke, m;

$\overline{\upsilon}$ - The average velocity of the piston, m / s: $\overline{\upsilon} = \dfrac{H\omega}{\pi}$.

According to the relation (10) zoom power piston machines with their large-scale transformations is

$$N_\lambda = \begin{cases} P_\lambda V_\lambda \omega_\lambda & = & P_\lambda \, l_\lambda^3 \, \omega_\lambda; \\ P_\lambda \, S_\lambda \, \overline{\upsilon}_\lambda & = & P_\lambda \, l_\lambda^2 \, \overline{\upsilon}_\lambda . \end{cases} \qquad (11)$$

It shows that the power piston machines is directly proportional to the speed of their element – as the angular speed of the crankshaft ω (Top row of (11)), and the average linear velocity of the piston $\overline{\upsilon}$ (Bottom row).

On the first line of expression that for large-scale transformations piston machine, which is carried out at a constant angular velocity of the crankshaft ($\omega_\lambda = 1$), Its power is directly proportional to the volume of work V That is the cube of the linear dimensions of cylinders l.

But, as the bottom line of (9), and the tension in the increase in engine parts l_λ^2 times that require the use of more durable materials.

However, this shortcoming proyavlyatymetsya if engine capacity increase by increasing the number of cylinders. In this case, the working volume, weight and engine power are changed in the same number of times, resulting in material consumption engine remains at the same level.

This explains the widespread use of multi-cylinder engines. In modern cars and engine number of cylinders is 16 (supercar Bugatti Veyron-) in marine engines - 42 (four-star diesel M-503 with capacity of 2.4 ths. At speed of the crankshaft 2 thousand. Min-1, weight 3, 5 tons [3, p. 190]).

On the first line of (11) also implies that the engine power can be increased even without increasing its working volume. Namely, it is possible to reduce the linear dimensions of the cylinder while increasing their number. According to the relation (9 a) reducing the size of the cylinder will allow to raise the speed of the crankshaft, increasing engine power.

But increasing the number of engine cylinders is accompanied by the same increase in the number of its parts, which complicates the engine.

Consequently, the present engine used two ways to achieve a given power - both due to different numbers of cylinders and different sizes by the latter.

On the second line of (11) implies that at a constant average speed of the piston ($\overline{\upsilon}_\lambda = 1$) Power piston machine is directly proportional to the total area of the piston S That is the square of the linear dimensions of the cylinder.

As a result, an increase in the linear dimensions of cylinder l_λ times accompanied by increased weight and engine size working in l_λ^3 times and power - only l_λ^2 times.

That capacity expansion piston machines, due to the increasing size of the cylinder at a constant average speed of the pistons in l_λ times behind the growth of the working volume and weight. Therefore material consumption piston machines while increasing the size of cylinder increases l_λ times. For example, materials existing diesel engines is [2, p. 22]:

• Bore at 85 - 150 mm - From 2.3 to 10 kg / kW;
• Bore at 300 - 650 mm - From 6 to 25 kg / kW;
• When Bore more 800 mm - 25 - 30 kg / kW.

The relationship of power and engine working volume conveniently analyze using scale-liter capacity, which is the ratio of the scale of engine power to the working volume scale:

$$\frac{N_\lambda}{V_\lambda} = \begin{cases} P_\lambda \cdot \omega_\lambda \\ \dfrac{P_\lambda \cdot \overline{\upsilon}_\lambda}{l_\lambda} \end{cases}. \qquad (12)$$

The first line of the resulting value shows that in large-scale transformations piston machines, angular velocity ω crankshaft which is constant liter capacity depends only on the mean effective pressure P and does not depend on size. If the mean effective pressure does not change, the engine power is directly proportional to the angular velocity ωWhich can be increased with decreasing linear dimensions of the cylinder.

If the constant is the average linear velocity of pistons $\overline{\upsilon}$Then liter engine power is inversely proportional dependence of its size - see. second line ratio (12). That is velykorozmirnistnyh tractor engines and ships liter capacity is less objective than the engines of cars or motorcycles.

In addition, increasing the size of the cylinder slightly increases the effective efficiency of the engine, due to relatively lower heat losses in the walls of the cylinder (working volume of the cylinder is proportional l_λ^3 And the area is proportional to the cylinder walls l_λ^2). For example, four-stroke diesel engines equipped with superchargers referred efficiency is [2, p. 11]:

• Bore at about 100 mm - 0.32;
• Bore at about 200 mm - 0.39;
• Bore at about 600 mm - 0.41.

Conclusions

Increasing the size of cylinder piston engine l_λ times, carried out at the same average linear velocity of the piston ($\overline{\upsilon}_\lambda = 1$), It is accompanied by the following consequences:

• the need to reduce the angular speed of the crankshaft in l_λ times;

• an increase in capacity cylindrical l_λ^2 times;

• increased work volume and mass of the engine in l_λ^3 times;

• liter decrease in power l_λ times;

• an increase in material consumption l_λ times;

• moto increase efficiency and effective.

Reducing the size of the cylinders l_λ times, carried out at the same average linear velocity of the piston can be used to increase the permissible angular velocity of the crankshaft in l_λ times, which makes it possible to increase liter capacity. At the same time maintain the working volume of the engine at the previous level is increasing the number of cylinders.

The latter is accompanied by a proportional increase in the working volume, power and weight of the engine, liter capacity and material remain unchanged.

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Yspolzuya method masshtabnыh transformations podobnыh Dynamic systems installed vzaymosvyaz Between osnovnыmy konstruktyvnыmy porshnevыh machine parameters and indicators s work.

Dimensions tsylyndrov, srednyaya velocity of motion of the piston, laboring Volume, power, materyaloemkost, эffektyvnыy efficiency.

Using the method of scaling transformations of similar dynamic systems revealed a relationship between basic design parameters of piston engines and their performance.

Sizes of cylinders, average speed of piston, work capacity, power, materials, effective efficiency.