Table 1.2 – The results of the research

| $\upsilon_2$ | $L_1$, м$^3$/с | $V_T$ | $\alpha_{\acute{\imath}}$ | $Q_{PG}$, Вт | $\Delta t_{in}$ | $\Delta t_{out}$ | $\ln\frac{\Delta t_{in}}{\Delta t_{out}}$ | $\Delta t_{in}-\Delta t_{out}$ | $\frac{\Delta t_{in}}{\Delta t_{out}}$ | $t^{\hat{o}}_{3,8}$ | $\Delta t_{\tilde{n}\eth}$ | К | Re |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 30 | 31 |
| 2,0 | 0,0067 | 0,22 | 14,9 | 82,4 | 8,3 | 5,7 | 0,375 | 2,6 | 1,456 | 27,9 | 6,92 | 15,7 | 8070 |
| 2,2 | 0,0071 | 0,24 | 15,0 | 67,5 | 10,4 | 1,0 | 2,340 | 9,4 | 10,4 | 31,5 | 4,02 | 21,25 | 8877 |
| 2,1 | 0,006 | 0,2 | 14,7 | 58,1 | 9,0 | 1,0 | 2,200 | 8,0 | 9,0 | 32,5 | 3,64 | 20,2 | 8473 |
| 2,7 | 0,0074 | 0,25 | 15,1 | 75,2 | 12,0 | 0,6 | 3,000 | 11,4 | 20,0 | 35,0 | 3,8 | 25,05 | 10895 |
| 2,7 | 0,008 | 0,27 | 15,2 | 108,7 | 15,0 | 3,0 | 1,610 | 12,0 | 5,0 | 36,25 | 7,45 | 18,5 | 10895 |
| 2,8 | 0,0085 | 0,28 | 15,3 | 111,8 | 16,5 | 2,0 | 2,110 | 14,5 | 8,25 | 37,25 | 6,87 | 20,6 | 11298 |
| 2,9 | 0,0087 | 0,29 | 15,4 | 149,0 | 20,0 | 4,5 | 1,490 | 15,5 | 4,44 | 38,75 | 10,4 | 18,14 | 11702 |

According to the data above, we developed the method and obtained the experimental results for updating regularities of changing intensities of a direct flow of heat exchanger productivity for the purpose of using it in the systems of energy-efficient buildings.

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## MATHEMATICAL MODELS FOR CHECKING LEAKAGE IN THE COMBUSTION CHAMBER OF AN INTERNAL COMBUSTION ENGINE

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*We propose a mathematical model to present changes in the pressure within the above-piston space of an internal combustion engine depending on the temperature within the compression chamber. The model takes into account leakage through the piston ring-liner sealing.*

Investigations referring combustion engine failures show that 31 % of combustion engines failed due to faults in the cylinder piston group, whereas 45 % of failures are due to the faults in fuel system [1]. Wear and tear of the engine may cause leakage of the working fluid through the piston rings or intake valves. The main leakage of the working fluid from the cylinder body occurs through the piston ring joints. These findings result from the numerous measurements conducted for the leakage of the working fluid down the piston rings [2]. With successful break-in of unworn set of piston rings, 80 % of leakage is due to expansion gaps in the piston rings [3]. The flow of the working fluid down the piston ring joints is at 250-300 m/sec. Thus, the contact time between the working fluid and piston ring sides is minimal, and the gas flow process may be regarded as adiabatic.

The given mathematical model was developed for internal combustion engines and can be used to simulate the engine performance and engine output modes. Therefore, it is significant for defining mechanical conditions of the cylinder-piston group and monitoring the overall performance of the engine.

Meanwhile, it should be noted that mathematical models proposed by Prof. V.G. Dyachenko are best applied to simulating complex physical processes within the combustion chamber of a diesel engine, and can be utilized for the processes of mass and heat transfer in the above-piston space. In the cases of compression travel, changes in the pressure can be determined using the following formula:

$$dp=\frac{kp}{V}\cdot\left[-\frac{1}{p}\cdot dM_{УТ}+\frac{(k-1)}{k}\cdot\frac{(\pm dQ_T)}{p}-dV_{П}\right] \quad (1)$$

where $dM_{УТ}$ = the decrease of the working fluid mass in the above-piston space caused by the leak of the working fluid down the valves, $d\tau$ = piston rings over the computed period, ; $k$ = adiabatic exponent of the real working fluid under temperature values as of the initial computed time interval; $dQ_T$ = loss of heat energy of the piston walls surface to and from the working fluid within the computed time interval; $dV_{П}$ = volume changes of the above-piston space caused by the piston transfer over the computed time interval; P и V = respectively pressure and volume of the mixture at the start of computed time interval.

On the other hand, the model used to measure gas pressure between the rings of an engine cylinder is described in the works by Prof. R. Petrichenko by the following formula:

$$\frac{dM_i}{d\phi}=\frac{1}{6n}\cdot(\pm G_{i-1}\pm G_i), \tag{2}$$

where $G_{i-1}, G_i$ = working fluid flow through the piston ring joints.

Taking into account transformations to models (1) and (2), as well as assessment data for leakage devoid of the working mixture fire, the processes under investigation are given by

$$dp=\frac{kp}{V}\cdot\ [-\frac{1}{p}\cdot(\frac{dM_i}{d\phi})+\frac{k-1}{k}\cdot\frac{(\pm dQ_T\ )}{p}-dV_\Pi \tag{3}$$

Therefore, the final value for the calculated interval $\Delta\tau$ (final value for the crank angle is given by $\Delta\phi=1-5^\circ$), pressure, volume, mass and temperature of the working fluid, as well as the amount of heat from the walls to the working fluid, and back from the working fluid to the walls of the above-piston space at the end of the calculated interval, can be determined by the following formulas:

$$p_{i+1}=p_i+\Delta p_i; \tag{4}$$

$$T_{i+1}=\frac{p_{i+1}\ \cdot V_{i+1}}{M_{i+1}\cdot R}; \tag{5}$$

$$M_{(i+1)}=M'_V; \tag{6}$$

$$V_{(i+1)}=V_V+\Delta V_\Pi; \tag{7}$$

$$Q_{T(i+1)}=Q_{Ti}\pm\Delta Q_{Ti}, \tag{8}$$

where $p_i, p_{i+1}$ = pressure values at the start or end of the calculated time interval; $R$ = a universal gas constant per 1 kg of the working fluid; $M'_V$ and $V_V$ = mass and volume of the working fluid at the start of the calculated time period.

With the final value of the calculated time period $\Delta\tau_i$ (crank angle $\Delta\phi_i$), the formula for the compression travel will be as follows [5]:

$$\Delta p_i=[\pm\frac{k_i-1}{k_i}\cdot\ \ \frac{\Delta Q_{Ti}}{p_i}\ -\Delta V_{\Pi i}\ ]. \tag{9}$$

The values for the eat interchange $\Delta Q_{Ti}$ from the surface of the above-piston walls to the working fluid within the calculated time period are given by [5]:

$$dQ_T=\sum_{j=1}^{j}\alpha_{T.j}\cdot\ (T-T_{CT.j}\ )\ \cdot F_j\ d\tau, \tag{10}$$

where $\alpha_{T.j}$ = gas side heat transfer coefficient for the wall surface of the working body «j» characterized for physical properties in terms of convective heat transfer; $T$ = current values for gas temperature in the above-piston space; $T_{CT.j}$ = average surface element temperature «j»; $F_j$ = surface area for the above-piston space walls.

Thus the above equation can be used for changes in the pressure at the end of the compression stroke (within the calculated time period $d\tau$) taking into account leakage of the working fluid through the engine cylinder with misfiring, which is important to diagnose engine problems. The conducted experiments proved analytical calculations. Application of the above dependences will produce the resources for proper assessment of the engine sealing, and determine optimum intervals for diagnosis of the cylinder piston group.

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## IMPROVING PERFORMANCE OF SHAFT SURFACE PLASTIC DEFORMATION

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*In this work one of ways of a naplavka is considered at restoration of shaft by superficial plastic deformation, on completion of work the result about influence of superficial plastic deformation on endurance and intensity of wear of a cranked shaft was summed up.*

The main causes that explain the need for repair of machines, are fraying and fatigue destruction of parts operating in conditions of exposure periodic loads. Typical load detail, requiring increased wear resistance and fatigue strength are the crankshafts of internal combustion engines. If there is a loss of efficiency, there is a need for crankshafts of their recovery, as they are steel-intensive and expensive parts, replacement of new products economically impractical. To restore the crankshafts are widely used various ways of surfacing. Hard-facing of wear resistant surfacing materials allows you to restore the geometry and coating with high wear resistance, fatigue strength of remanufactured shafts are reduced by 25-30%.

Negative effect of welding on the fatigue strength of these parts can be significantly reduced by applying the technology of repair of surface hardening plastic processing methods-surface plastic deformation (SPD) [1].

The aim of this work is to improve the performance properties of shafts of the restored building-introduction to technology repairs SPD.

As a material for manufacturing samples used worn crankshafts, constructed of steel 45 with a given chemical composition for obtaining the required technological strength, but prone to hardening structures and, as a result, cracks [2]. Fatigue tests were carried out on the car the UKI-10 m on samples manufactured in accordance with GOST 25.502-79. The tests were conducted to complete destruction of the samples. Wear rate was determined according to the scheme "disc-pad" (paper liners bearings AO20-1) by car friction SMC-2 by defining mass intensity of wear, in kg · cm-2 for 1000 m friction GOST 17364. As your welding material used wire 1.6 N-08X13.

Using wire 1.6 N-08X13 to prevent the formation of cracks due to minimize the transition zone.

Hardness of coatings obtained by welding wire Mw-08X13-HRC 30-33. One of the indicators of the properties of deposited metal is the firmness with which sometimes equate durability, but when evaluating durability must be taken into account and the structure of coatings: matrix hardness, presence of carbides and their dimensions, consolidation of carbides in matrix. Microstructure of coatings obtained by welding wire 08X13 is a solid solution with chromium carbides. Alloys of similar structure, with low carbon content has the ability to significantly increases the hardness, toughness and wear resistance as a result of testing (with plastic deformation with a considerable degree of deformation). As a result of the SPD in the surface layer of deposited coating is formed texture with high concentration of lattice defects that inhibit the sliding plane, making it difficult for their further spread. Just after the TTD cover arise internal residual compressive stress, which block the disclosure of the fatigue cracks, turning them into a wide range of stresses in unspreadable.

Introduction to the technology of repair when welding wire shafts 1.6 N-08X13 operation of surface plastic deformation increases the fatigue limit of the recovered shafts on 25-30%, and the wear rate is reduced by 15-20%.

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