Найдем отношение амплитуд A и B из (1, 2) /3/

$$n_1 = \frac{A_1}{B_1} = \frac{b}{k_1^2 - a}$$
$$n_2 = \frac{A_2}{B_2} = \frac{b}{k_2^2 - a} \qquad (6)$$

Тогда общее аналитическое решение дифференциальных уравнений будет иметь законченный вид:

$$\begin{cases} z = n_1 B_1 sin(k_1 t + \varepsilon_1) + n_2 B_2 sin(k_2 t + \varepsilon_2), \\ \varphi = B_1 sin(k_1 t + \varepsilon_1) + B_2 sin(k_2 t + \varepsilon_2)\,. \end{cases} \qquad (7)$$

Выводы: Таким образом, получено возможность аналитического расчета динамики формного вала из его физических характеристик и эксплуатационных условий.

Данное решение для пружин одинаковой жесткости физически и конструктивно справедливы, тогда запись решений на много упрощается.

Список литературы

4. Ллойд Деджидас, Томас Дистри. Листовая офсетная печатная машина. – М.: Принтмедиацентр, 2007. – 490 с.

5. Бухгольц Н.В. Основы теоретической механики. Т.2. – М.: Высшая школа, 2002. – 450 с.

6. Курманалиев К., Султангазиева А.К. Распространение упругих волн в протяженных цилиндрических системах // Известия КГТУ № 17. – Б., 2009. С.385-386.

References

1. Lloyd Dedzhidas Thomas distro . Sheetfed offset press . - M .: Printmediatsentr , 2007. - 490 p.
2. Buchholz NV Basics of theoretical mechanics . V.2 . - M .: Higher School , 2002. - 450 p.
3. Kurmanaliev K. Sultangazieva AK Propagation of elastic waves in a long cylindrical systems // Proceedings of KSTU № 17. - B. , 2009. S.385-386 .

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EXPERIMENTAL SURVEY ON COOLING WATER PUMPS USED IN ENGINES

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The purpose of this article is to cooling water pumps used in the vehicle engines are open vane type pumps. One important difference of the open vane type pumps from the other pumps as its gp losses are high. Because; in these kinds of pumps, the gap flow that pass through the horizontal gap on the open side of the gear distorts the main flow and causes performance losses.

In this study; the performance characteristics and gap losses of the open-geared radial pumps, that are used to pump the cooling water in engines, have been analysed in an experimental way.

In order to define the behaviour of open gear under zero gap range; the closed manifactured model of the same gear has been tested. The findings indicate that as the gap range increases, gap losses increase as well. On the other hand; an optimum gap range has been observed as well.

Keywords: pumps, cooling water pumps, radial pumps, open gear

ИЗУЧЕНИЕ ИСПОЛЬЗУЕМЫХ В МОТОРАХ НАСОСОВ ХОЛОДНОЙ ВОДЫ НА ОПЫТАХ

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Насосы с открытой лопастью – это насосы охлаждающей воды, используемые в переносных моторах, охлаждающиеся холодной водой

Отличающая часть насосов с открытой лопастью от других насосов это высокое образование потерь отверстий. Потому что в насосах такого типа промежуточное течение, проходящее через поперечную полость в открытой части колеса, приводит к порче основного течения и является причиной потери эффективности.

В этом исследовании при помощи тестов были изучены потери отверстий и харастеристики производительности радиальных насосов с открытой лопастью, используемых для качки охлаждаемой воды в переносных моторах.

Чтобы определить поведение открытого колеса при нуливом отверстии была изучена модель этого же колеса, произведенного без промежутков. На основе полученных данных было отмечено увеличение ширины

отверстия паралельно увеличению потери промежутков.

Ключевые слова: насосы, насосы с открытой лопастью, радиальных насосов, открытого колеса

Introduction

The operation point of an open vane type radial pump has a significant impact on the gap range that must be left between gear and body . (Figure 1)

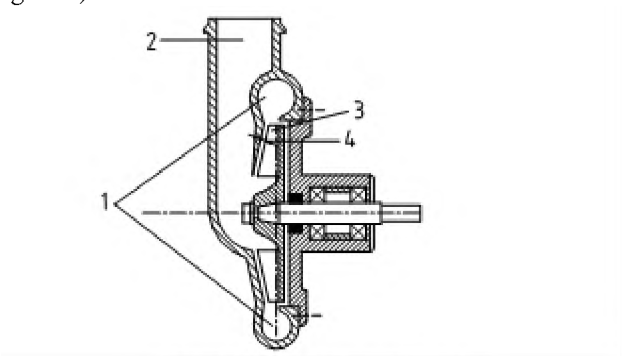


Figure 1. Experiment pump

1) Pump output ; 2) Spiral casing ;3) Gear ; 4) Pump body

Also; as the gap range planned is not exactly the same at the end of manufacturing; it leads to different values than the planned under the working conditions.

Despite that there are several studies about the impacts of gap range and the issue has been searched for a long time; it has not possible to calculate these impacts theorically yet. But; some important studies on the subject has drawn a roadmap for the designers[1.2.3].

1. Experiment Mechanism

An experiment mechanism has been designed and manufactured in order to the conduct experimental studies on the cooling water pump used in the engines of the vehicles. The schematic display of the experiment mechanism can be seen in Figure 2. The pump tested in the experiment has been driven by an electrical motor with the power of 0,55 kW. A frequency meter is connected to the electricity motor and the rotation speed of the pump is read from the digital display of the frequency meter. Pump shaft power has been obtained by measuring the moment of electricity motor shaft. In this measurement method; electricity motor is run on idle mode when there is no water in the pump; and in this way the power spent by the pump to rotate the shaft is identified, and then the pump is provided with water and it is run with water. The initial value is deducted from the latest obtained value and in this way pump output hydroulic power is calculated. The amount of the water pushed by the experiment pump is mesaured by means of rotameter assembled to the outlet line.

The pressure difference between the inlet and output flashes has been measured by using the pressure difference transmitter which is equipped with (0-4 bar) pressure measurement range and (24 V.) DC feding voltage (4-20 mA) that gives analogue output signal.

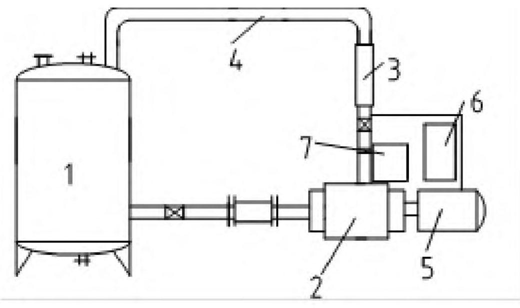


Figure 2.Schematic display of experiment mechanism

1)Experiment pump; 2)Electrical engine ; 3)Pump connection frame ;4) Current rectifier 5) Flow meter, 6) Electricity plug; 7) Transformator distribution cables

2.Experiment Mechanism Pump

The experiment pump given in Figure 3 is composed of five different parts and twenty parts.

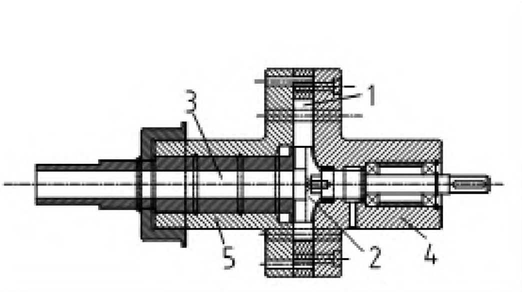


Figure 3. Cross section of test pump

1) Bedding system; 2) Transfer system; 3) Spiral casing ;4) Vane ; 5) Absorption pipe

Pump has been designed in a way to allow sensitive arrangement of the gap width and easy Exchange of different gears during the experiment.

Bedding part of the pump has been connected to the spiral casing with four nuts; and it is the part which helps bedding and arrangement of absorption pipe.. Transfer part is also connected to the spiral casing with four nuts. Transfer system embodies rotating gear and shaft. Shaft transfers the energy it receives from driving engine to the gear. This part is desşgned in a way to ensure easy assembly and disassembly of the gears.

It is similar to spiral in shape. Spiral casing is manufactures in a way to minimiza hydraulic losses and optimize the efficiency of the pump. Spiral casing used in the experiment is produced from steel plate by metal cutting method as seen in Figure 4

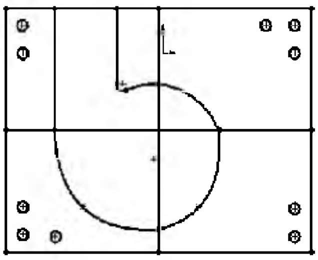


Figure 4. Appearance of the spiral casing from the front side

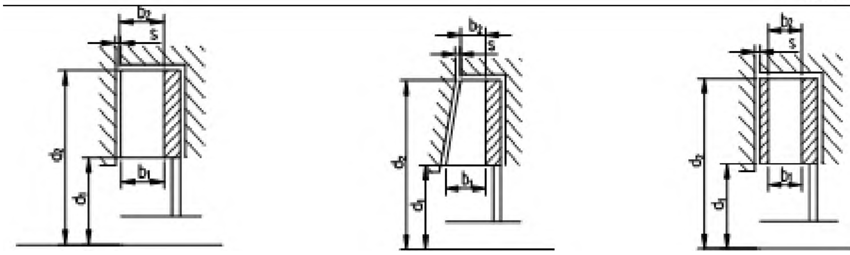
3.Tested Gears

The gears used in experiments are designed as: open plane vane, open plane conic vane and closed plane vane. The vanes of the designed gears are produced from aluminium. Aluminium is preferres as it is economic, and its casting and workmanship is easy. The diameters, number of vanes, vane thicknss and shaft sizes of the gears can be seen in Table 1.

Gear tyoe	**Vane angle**		**Gear diameter**			**Vane thickness**		**Number of vanes**	$\mathbf{b_1/b_2}$
	β_1	β_2	D_1	d_2	$\mathbf{d_1/d_2}$	b_1	B_2		
AD	**90**	**90**	**34.4**	**68.8**	**0.5**	**10.5**	**10.5**	**11**	**1**
AK	**90**	**90**	**34.4**	**68.8**	**0.5**	**10.5**	**6.9**	**11**	**0.60**
KD	**90**	**90**	**34.4**	**68.8**	**0.5**	**10.5**	**10.5**	**11**	**1**

Table 1. Tested gears

Firstly; the models of the tested gears seen in Figure 5 have been prepared. Then they are poured into moulds and manufactured



Open Plane Vane(AD) Open Plane Conic Vane(ADK) Closed Plane Vane(KD)

Figure 5. Cross section of the gears

4. Experimental Results

In the cooling water pump, which has been tested in the experiment mechanism, three different types of gears have been tried. During the experiment, test pump has been operated in 1500 d/d, 2000 d/d and 2500 d/d . Pump gap width for each rottion and gear has been arranged as follows: 0,5 mm, 1 mm. 1,5 mm, 2 mm.

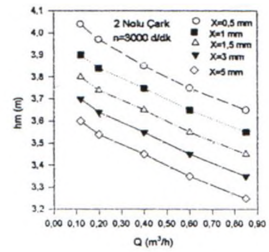
All of the gears have been operated under the rotation and gap widths stated above; and the pressure difference in pump inlet and output and shaft moment have been measured under different flow rates. Performance characteristics of the tested gears can be seen in Figure 6-7-8.

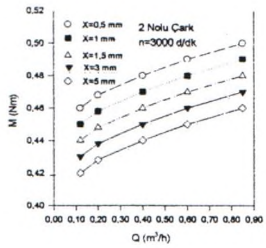
5.Conclusion

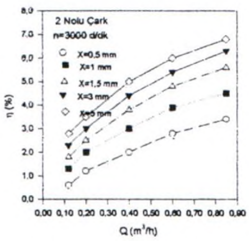
The values obtained in these studies by testing the designed cooling water pumps and gears have been compated with the desired values. The gap width in closed gear had no effect on the selected criteri.

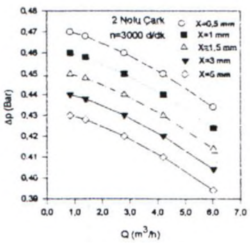
As it is seen from the characteristic curves of the tested open conic plane vane gear; depending on the gap width and rotaton speed, it has not been efficient enough.

The values obtained in open plane vaned pump fit the defined parameters. On the other side; it is indicated that over 3000/ minute rotation speeds; it can be more efficient.









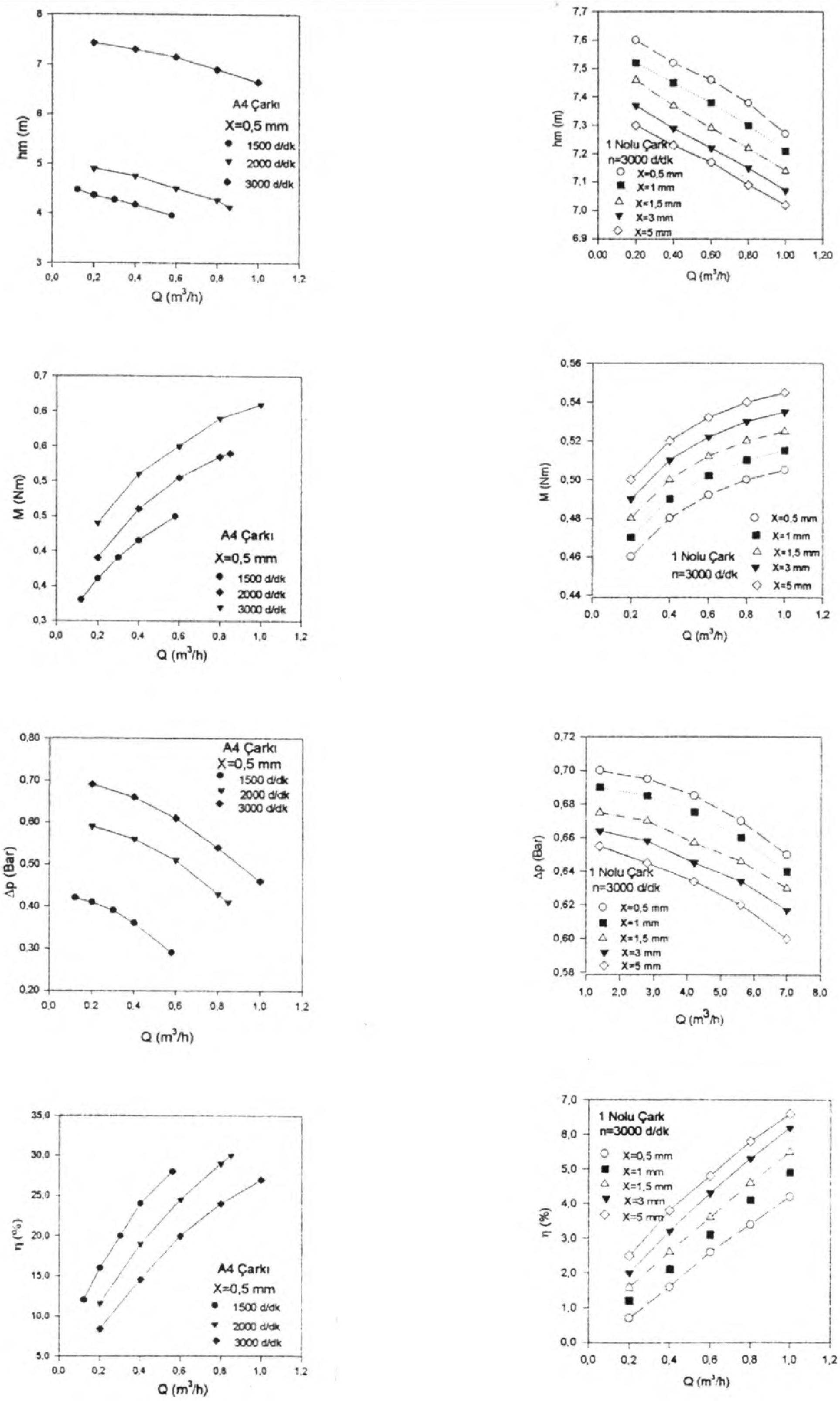


Figure.8 Characteristic curves of the open plane conic vane

SYMBOLS

AD = Open plane vane
AK = Open plane conic vane.
KD = Closed plane vane.
b_1 = Vane height / (mm).
b_2 = Vane height / (mm).
d_1 = Internal diameter of the gear / (mm).
d_2 = Internal diameter of the gear / (mm).
X = Gap width / (mm).
Z = Number of vanes.
B1 = Vane inlet angle / (^{0}).
B2 = Vane outlet angle / (^{0}).
Q = Flow rate /(m^3 / h).
Hm = Pump head / (m).
n = Efficiency / (%).
M = Moment / (Nm).
▲p = Pressure difference

References

1. Senoo Y, Ihsida, M, Deterioration of Compressör performance due to tip clearance of centrifugar impeller. Trans of the ASME, J of Turbo machinery vol 109,1987.
2. Lauer J, 1 Tip clearance Sensitivitiy of centrifugal pumps with semi-open impellers. ASME Fluids Engn. Dıv. Summer Meeting FRDSM'97,1997.
3. YigitS. Theoric and experimental review on the gap losses of the open vane pumps used in the enginesi. Kocaeli University 1994.
4. Canbazoglu S. Polat M, Selection of optimum pump system and their adaptation to new working conditions.Erciyes University kayseri 1998.

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УПРАВЛЕНИЕ ДЕФОРМАЦИЕЙ КАК ИНСТРУМЕНТ ОБЕСПЕЧЕНИЯ ЗАДАННЫХ СТРУТУРЫ И СВОЙСТВ КОМПРЕССОРНЫХ ЛОПАТОК ИЗ ТИТАНОВЫХ СПЛАВОВ

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В статье путем компьютерного моделирования технологического процесса протяжки в плоских бойках и на радиально-ковочной машине, осадки в выпуклых бойках, а также изотермической штамповки определены рациональные режимы деформирования заготовок, позволяющие получить компрессорные лопатки с мелкозернистой структурой.

Ключевые слова: протяжка, осадка, бойки, заготовка, поковка, штамповка, лопатка.

The article by computer simulation of the process in drawing flat die and radial forging machine, rainfall convex Boyko, as well as isothermal forging a rational modes of deformation of billets, you always get the compressor blades with fine-grained structure.

Keywords: rolling, sediment, strikers, billet, forging, stamping, paddle.

Введение

В компрессорах высокого давления одной из основных деталей являются компрессорные лопатки. Как правило, они изготовляются из титановых сплавов.

В настоящее время на машиностроительных заводах применяются следующие способы штамповки компрессорных лопаток [1]:

• Штамповка в один переход или с предварительной осадкой.
• С предварительной высадкой заготовок на горизонтально-ковочных машинах (ГКМ).
• Штамповка с предварительной высадкой заготовок на электровысадочных машинах.
• Штамповка с предварительной вальцовкой заготовок.