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International Journal of Fluid Power is dedicated entirely to the full range of science and technology associated with hydraulics and pneumatics. The objective of the journal is to provide the engineering community with high quality information about advances in research, design and application of fluid power technology. Special emphasis will be placed on presenting papers concerned with component and system development, analysis, modelling and control of components and systems, monitoring, computer aided engineering methods and dynamic analysis of fluid power systems.

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CONTENTS

S. Oshima, T. Leino, M. Linjama, K. T. Koskinen., M. Vilenius

EFFECT OF CAVITATION IN WATER HYDRAULIC POPPET VALVES

J. Lim, P. R. Jackson, Q. Yang, B. E. Jones

OPTICALLY POWERED HYDRAULIC PILOT VALVE USING PIEZO-ELECTRIC MULTILAYER ACTUATOR

P. Pennacchi, G. Mimmi, L. Frosini

REDUCTION OF QUASI-IMPULSIVE FORCES AND NOISE EMISSION IN THREE-SCREW PUMP ROTORS

M. Tahmeen, H. Yamada, T. Muto

THE DYNAMIC CHARACTERISTICS OF TAPERED FLUID LINES WITH VISCOELASTIC PIPE WALLS (TRANSFER MATRIX AND FREQUENCY RESPONSE)

F. Daerden, D. Lefeber

THE CONCEPT AND DESIGN OF PLEATED PNEUMATIC ARTIFICIAL MUSCLES

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EFFECT OF CAVITATION IN WATER HYDRAULIC POPPET VALVES

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Abstract

In this paper, cavitation in water hydraulic poppet valves is investigated by an experimental method with a half cut test model. The situation of cavitation appearance, the effects of cavitation on the characteristics of flow rate, noise level, pressure distributions and the boundary of inception of the cavitation are investigated. Comparison between a poppet valve with sharp edged seat and another, which has a length on the seat, is made. The effects of change in the shape of the seat are discussed as well as the effect of cavitation appearance. As a result, it is revealed that the sharp edged seat valve is less influenced by the cavitation on its characteristics.

Keywords: hydraulics, water, cavitation, poppet valve, shape of valve seat, half cut model, experimental study

OPTICALLY POWERED HYDRAULIC PILOT VALVE USING PIEZOELECTRIC MULTILAYER ACTUATOR

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Abstract

A normally-closed 2/2 hydraulic pilot valve has been developed for a power- by-light system which is being applied in aerospace fuelling systems and oil-well applications. This system offers unique advantages such as good immunity from electromagnetic interference, intrinsic safety, and low attenuation for long distance.

The valve employs a piezoelectric multilayer bender actuator (Pz29) with an elastomer blocking plate and a nozzle as the valve mechanism. The valve system is operated by 86 mW optical power which is transmitted via a multimode optical fibre (core diameter 62.5 μm) from a laser diode light source. The optical power is converted to electrical power by a photovoltaic cell, to drive the pilot valve, which requires, 8 mW electrical power to operate. The valve output flow-rate of 28 cm^3/s has been achieved at an operating pressure of 1000 kPa, which is adequate for the applications. However, the maximum operating pressure up to 2000 kPa has already been tested. For the valve dynamic response, 18 ms average opening time and 1.5 seconds controllable smooth shut-off time have been observed. There was no valve operation failure during vibration testing up to 196 m/s^2 . The pilot valve is now used to operate an aircraft refuelling valve system that provides aviation fuel flow-rate up to 680 l/min. It can also be used for other hazardous environments and noisy applications.

Keywords: Hydraulic pilot valve, Piezoelectric actuator, Power-by-light system, Optical power, Flapper valve, Fibre optic, Hazardous environment

REDUCTION OF QUASI-IMPULSIVE FORCES AND NOISE EMISSION IN THREE-SCREW PUMP ROTORS

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Abstract

In this paper a theoretical study is presented about the possibility of reducing the quasi-impulsive load components, which act on the rotors of the three-screw pumps in the rotational axial direction. These forces can be related, on the basis of previous experimental and analytical studies by the same authors, to the noise emission of the pump.

The analysis is carried out by the systematic variation of one of the design parameters of the rotors, i.e. the semi-amplitude of the threaded zone of the screws, by using the analytical tools previously set-up for the study of the dynamic loads on the standard rotors.

Finally, it is shown that a suitable choice of this design parameter on one hand allows to cancel the quasi-impulsive load, on the other hand has a positive effect on the loads on the cross section.

Keywords: three-screw pumps, noise reduction, rotor design, optimization

**THE DYNAMIC CHARACTERISTICS OF TAPERED FLUID LINES WITH VISCOELASTIC PIPE WALLS
(TRANSFER MATRIX AND FREQUENCY RESPONSE)**

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Abstract

For convenience in investigating the dynamic responses of a liquid-filled tapered line with a viscoelastic pipe wall, a transfer matrix equation, relating pressure to volumetric flow, is derived. In this derivation, it was assumed that the rate of divergence (or convergence) of the line is comparatively small. The fluid line model employed in the analysis is one of an unsteady viscous flow; that is, the frequency-dependent effect of viscosity is taken into consideration. The viscoelastic pipe wall model is a modified version of the Voigt mechanical model, and it is distributed along the pipeline. The frequency response curves are calculated from the matrix, and the accuracy of the curves is evaluated by comparing them with the response curves obtained without assuming the small taper angle. The results verify that the transfer matrix is accurate enough for practical applications.

Keywords : fluid power systems, tapered fluid lines, transfer matrix equation, viscoelastic pipe wall, frequency response

THE CONCEPT AND DESIGN OF PLEATED PNEUMATIC ARTIFICIAL MUSCLES

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Abstract

This paper describes the design of a new type of Pneumatic Artificial Muscle (PAM), namely the Pleated Pneumatic Artificial Muscle (PPAM). It was developed as an improvement with regard to existing types of PAM, e.g. the McKibben muscle. Its principle characteristic is its pleated membrane. It can inflate without material stretching and friction and has practically no stress in the direction perpendicular to its axis of symmetry. Besides these it is extremely strong and yet very lightweight and it has a large stroke compared to most other designs. A general introduction on PAMs is given together with a short discussion and motivation for this new design. The concept of the PPAM is explained and a mathematical model is derived. This model proves its principle of operation. From the model, several characteristics, such as developed force, maximum contraction, diameter, volume and membrane tensile stress, are obtained. Material choices and dimensions of a typical PPAM are next discussed and its measured values of static force and diameter are compared to the model predicted values. The agreement between both is found to be very good.

Keywords: pleated pneumatic artificial muscle, PAM, PPAM, McKibben muscle, pneumatic, actuator, lightweight, compliance.
