# POLARIZED FIBER SENSOR

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Actually is paid a great attention to dispersed phases, especially to magneto-reologic liquids (MRL) [1]. Thus the growing role of MRL for production of optical circuits and fibers, based on those liquids properties to change reversibly their reological parameters (viscosity, fluidity limit) under magnetic fields influence, is obvious.

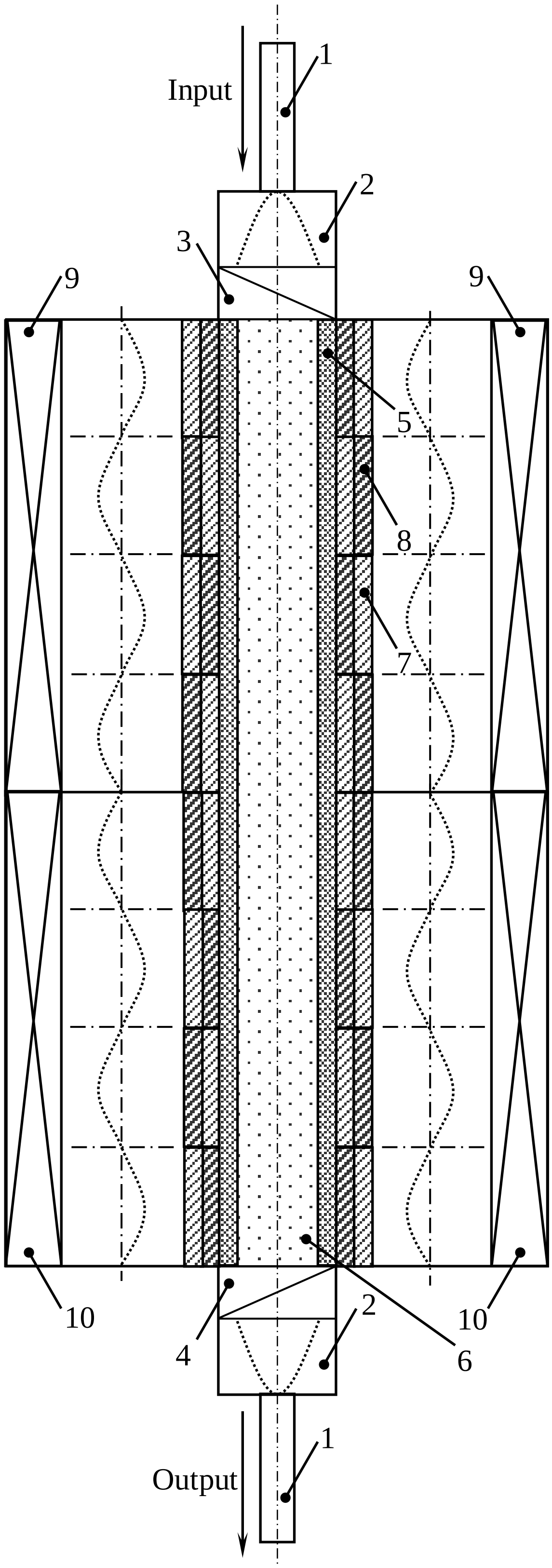
The liquid magnetoreologic is represented a colloidal suspension of magnetic powder with particles diameter ~ 100 $\overset{o}{A}$, suspended in oil. As an oil polyethylsilloxan liquid with ε = 2,4... 2,5, for deriving a magnetic dust was used $Y_3Fe_5O_{12}$.

***Keywords***: optic, fiber sensor, polarized, magnetoreologic.

## 1. INTRODUCTION

Information processing system enhancement is connected with the necessity to develop elemental depot based upon new phenomena and material characteristics.

Recently dispersion medium has been increasingly popular, and namely magnetic and rheological liquid (MRL) [2]. At the same time there are trends to more frequent usage of MRL in production of various optical devices, functionality of which is based upon MRL qualities to reversibly change its rheological characteristics (viscosity, yield point) upon the influence of external magnetic field. Any information processing system can fulfill its task subject to exact perception and conversion of the information on the phenomenon studied. For the conversion of the information on physical phenomenon in the information processing systems fiber sensors (FS) [3] has been widely used.




*Pic.1. Polarized fiber sensor*

In this work we have developed the polarized fiber sensor (PFS) based upon the contemporaneous Faraday Effect and MRL characteristics.

## 2. POLARIZED FIBER SENSOR (EXPERIMENTAL)

The developed construction of the polarized fiber sensor is shown on pic.1 and consists of fiber (1), quarter-space rod gradient lenses (2), polarizer (3), analyzer (4), fiber segment composed of polymeric casing (5) and core (4), of magnetic and rheological liquid based on yttrium iron garnet powder $Y_3Fe_5O_{12}$ and polyethylene and siloxane oil, sectioned bi-magnetostrictive coating of Ni (5) and 45% Ni/55% Fe (6) alloy, and magnetizing coil (7).

For the sensor efficiency and compactness enhancement it was decided to use sectioned bi-magnetostrictive coating with the interchange of passive (7) and active (8) strata (see pic. 1).

The mode of functioning of bi-magnetostrictive elements is based on the difference in values of magnetostriction index of the magnetic medium $\lambda_m=\Delta l/l$, being the bases for the bimetal striation production.

The stratum of metal or alloy with positive value of magnetostriction index we call active, and with negative – passive correspondingly. The active layer consists of 45% Ni/55% Fe with $\lambda_m=27\cdot10^{-6}$ alloy, and passive – of Ni with $\lambda_m=-37\cdot10^{-6}$ [4]. During the process of magnetizing sectioned bi-magnetostrictive coating bends in such a way that the stratum with positive magnetostriction value turns up to be on external (convex) side, and the stratum with negative magnetostriction value – on internal (concave) side. As a result the coating fluctuates almost according to the harmonic principle as is dotted on the pic.1, which is transmitted onto the sensitive core of magnetic and rheological liquid by means of polymeric coating.

The operation principle of the polarized fiber sensor consists in the following: the input fiber signal comes onto the fiber segment with the core of magnetic and rheological liquid as linearly polarized light, with polarization angle been determined by polarizer. After the fiber segment with the core of magnetic and rheological liquid optical signal polarization plane turns at a certain angle. Thus if at the output we put analyzer with polarization plane coinciding with the polarization plane of the optical signal, the whole device will become utterly transparent for the optical signal.

Besides the magnetic field influence on the optical signal distribution character via fiber segment with the core of magnetic and rheological liquid important effect gives sectioned bi-magnetostrictive coating, which along side with magnetic field influences the index profile distribution, which changes the rotation angle of the optical signal polarization plane.

There is a case of particular interest when the current via inductive coils moves in opposite directions and the corresponding sectioned bi-magnetostrictive coatings fluctuate in the antiphase.

To measure the parameters of polarized fiber sensor we used the Г5-72 surge injector unit, sending optoelectronic modules ИЛПН – 206 ($\lambda$=763μm), accepted power optical wattmeter

OMK3-79, and receiving optoelectronic module ФПМ-140 connected to the oscillograph C1-116. The measurements have shown that direct sensor backoff do not exceed 1 decibel, and isolation from entrance to exit come to approximately 30decibels.

## 3. CONCLUSIONS

Polarized fiber sensor can register direct external magnetic field changes as well as all the changes in the state, processes and parameters connected with the magnetic field change. PFS can also act as a sensory unit, optical radiation modulator, measuring or protecting device.

## 4. REFERENCES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