Japan, and the United Kingdom. In the USA, the development of FORJs for instrumentation is one of the top priorities.

A considerable contribution to this field has been made at the Institute of Semiconductor Physics of the NASU [1-3]. It was developed a unique method of signal transmission between objects, which move relative to each other, by means of step-by-step compensation of velocities and directions of light beams (Invention certificate No 1832395, 1992). The developed method opens up the possibility to create multipass FORJs for dozens of optical fibers of different modifications. In addition, multipass FORJ on the basis of a graded-index optical compensator with unique characteristics has been designed (not less than 500 MHz bandwidth; not more than 2.5 dB insertion width; not more than 0.5 dB actual rotational variation; up to 10 channels; not more than 5...7 cm overall dimensions; less than 250... 300 grams weight).

A great bandwidth of a FORJ's channel, which is thousand times greater than that for an electrical channel, compactness and low weight, reliability and long service life, as well as no need for adjustment for several years are the principal advantages, which exactly meet the requirements to space equipment.

The most promising trends for the FORJ's usage onboard of a space vehicle are the following: space robotics, radar antennas, remotely operated vehicles, cranes and turrets, telemetry of rotary objects, and other fields, where there is a necessity to transmit information to and from the rotating equipment. The designed multipass FORJs and preliminary research allow us to confirm the applicability of the devices for the above purposes.

It is, however, necessary to study the influence of space emissions, high vacuum, as well as low temperatures on optical and operating characteristics of FORJs for their direct usage onboard the space vehicles. Investigation of these factors permits selection of the materials needed and development of special designs of FORJs for operation in a space environment.

References

1. Svechnikov G., Shapar V. // OE/FIBERS'91. SPIE International Symp.: Proc. SPIE.—Boston, Massachusetts, USA, Sept..—1991.—N 1589.—P. 24—31.
2. Svechnikov G., Shapar V. // OE/FIBERS'91. SPIE International Symp.: Proc. SPIE.—Boston, Massachusetts, USA, Sept..—1991.—N 1589.—P. 391—394.
3. Kyryluk L., Konyukhov S., Oleinik I., Shapar V. // Int. Sci. &Tech. Conf. «Advanced Radiolocation». — Kyiv: Sci. Research Inst. «Kvant», 1994.—P. 42.

«Factor» Experiment

PROSPECTS FOR STUDY OF STRENGTH OF STRUCTURAL MATERIALS AT THE OSS

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The near-earth space factors (NESF) adversely affect the strength of metal structural materials for space industry. These factors are classified into the following groups: vacuum, chemical composition of the atmosphere, corpuscular radiation, electromagnetic radiation, meteors and cosmic dust, and temperature. The NESF effect on structural materials is primarily exerted through their surface layers and also through the mechanisms of radiation damage. The simulation of the aforementioned set of NESF and its long-term confinement under the laboratory conditions is, in essence, an unsolvable problem. For this reason, there is a necessity to carry out mechanical tests directly in raw space using special equipment mounted on the outer surface of the OSS.

The goals of the experiment are as follows:

- qualitative and quantitative assessment of the NESF effect on the load-carrying capacity of structural elements during their long-term operation;
- development of specifications for design of load-carrying structures operating under space conditions for a long time;

- issuing recommendations for selection of structural materials to ensure the reliability of structures under space conditions taking into account the modes of mechanical loading and service life;
- development of the necessary industrial standards.

Integrated certification of such structural materials should include various procedures and testing equipment. Analysis of the actual methods for materials testing allowed us to select the method, which meets the basic requirements to experiments in space materials science. These requirements include some principal items: low power consumption during loading; larger surface area of experimental specimens exposed to the impact of destructive NESF; simulation of the most dangerous modes of loading of the actual structures; minimal overall dimensions and weight of experimental multi-specimen loading device; independent power supply source for this device; automatic control means.

In our opinion, the tests for cyclic alternating bending by specifying the kinematic displacement of the force application point, i. e. the strain-controlled loading, satisfy these requirements exactly. The low-cycle fatigue is a characteristic, which is very sensitive to short-term and long-term effects of NESF.

The Figure 5 illustrates the functional block diagram of the experimental unit being created. The experimental unit consists of loading device (LD) A, and of solar energy converter (SEC) B, which are mounted on the outer surface of the OSS, and of a system of automatic control and recording of experimental data (ACS) C, which is inside the station. The LD has holder 4 with circularly positioned specimens (about 24 pieces).

Each of the specimens is prepared in the form of a cantilever beam. It has equal resistance to bending and interacts with a ram, which reciprocates by loading rollers 3 during the holder revolution. In one revolution of the holder, each of the specimens is deformed according to a single symmetrical cycle composed of two half-cycles shifted in time. Being in the position between the rollers, the specimens are in the unloaded state. Special gauges 2 and 6 record their residual bending in a half-cycle, as well as the number of the holder revolutions. Taking into account the maximal loads and losses, the power of engine 1 for the holder revolution at the speed of 3 r.p.m. should be up to 30 W with the torque at the holder shaft of 100 N·m. The Stirling heat engine (external combustion engine) 8 with solar energy concentrator 7 in a hot zone of the engine and with emitter-radiator 9 in a cold zone, is used as a solar energy converter (SEC). Electric generator 10 generates power supplied to engine 1. The automatic control system includes transducers of signals from displacement pickups, holder revolution transducers, temperature gauges, generator current sensors, timer, and experimental data recording unit constructed on the basis of a microcomputer. In testing of one holder (24 specimens), the approximate number of the data recorded do not exceed 104, which requires up to 100 Kbytes of memory capacity.

In order to use the test unit in an independent power drive, a detailed design of the Stirling heat engine model has been developed. It has the following main rated characteristics: power at the pressure of the working medium of 105 Pa is equal to 20 W; power at the pressure of the working medium of $5\cdot10^5$ Pa is equal to 100 W; working medium is the air; temperature range of the thermal dynamic cycle is equal to 350...650 K; frequency is equal to

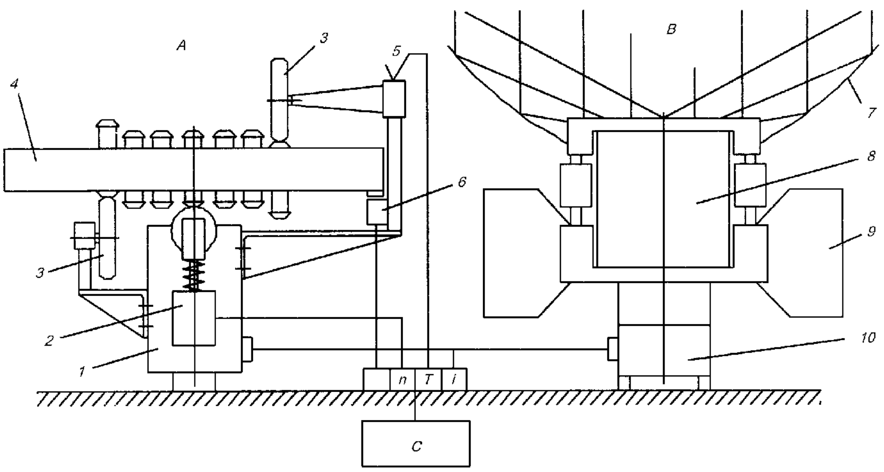

Fig. 5. Functional black diagram