sound or light signals and are to be subjected to more careful examination with a repeated scanning of the hazardous zone.

The eddy-current flaw detector, in addition to a linear scanning image on the screen, provides the mode of a two-dimensional imaging of defective regions. In this mode, the point on the screen, which represents the end of a vector of a complex output voltage of the transducer, describes complex closed trajectories during the transducer movement with respect to the object of examination. The trajectory is memorized for a time required for analysis, which is set by the operator. The phase characteristics of the signal are determined from the trajectory position in a complex plane, while the defect can be identified from the trajectory.

The computer memory stores coded information on the typical internal and external defects that allows the classification analysis of defects to be made from the recorded scanning signals.

«Transformable Shells» Experiment

WELDED METAL TRANSFORMABLE SHELLS

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Progress in space science and technology, practical exploration of space, which has been started in the 60^s of the XX century, opened for the scientists and engineers the complicated, but challenging prospects of study and exploration of near-earth space and the nearest planets. Stations, which are equipped for an integrated study of the natural conditions, will enable the use of the resources of these planets for the benefit of mankind. The presence of scientific expeditions on the planets implies provision of comfortable conditions for work and rest of the crew. For this purpose, it is necessary to create living quarters, laboratories and production shops, stores, shelters, etc. Such constructions naturally have large volumes and their transportation from the Earth will be problematic, as there are contradictions between the required dimensions of structures and limited sizes of transport containers of rocket carriers.

Engineering thought has produced a number of approaches to overcome this contradiction, for example, folding of structures made from air-tight fabric and films, modular assembly, etc. The many-year practice showed that the use of metals is the most rational way to create space objects, but transformation of the overall constructions into compact packs is extremely difficult, the more so since

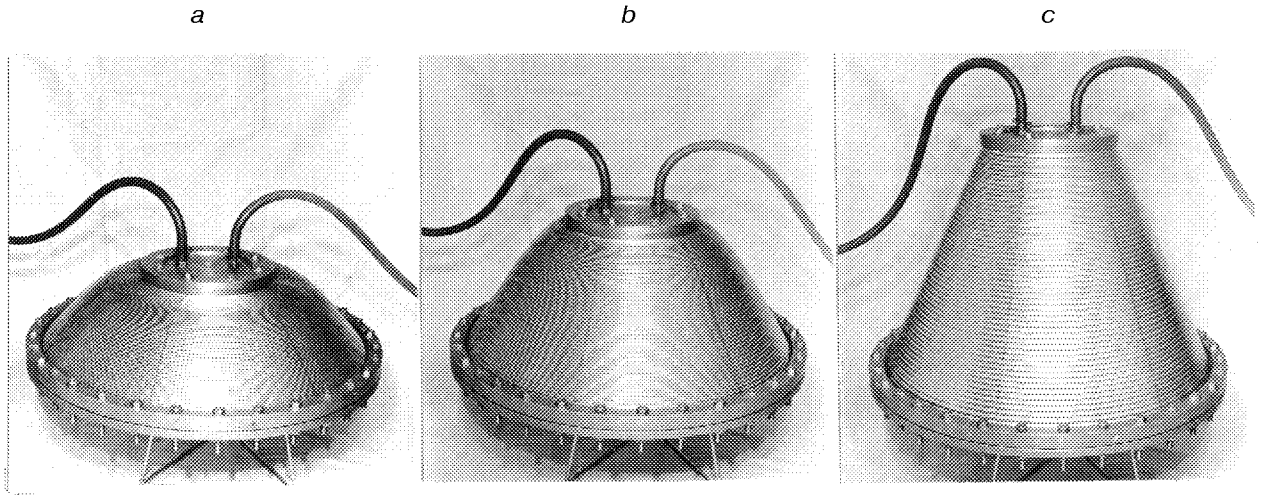

Fig. 10. Transformation of a corrugated disk into a conical shell at the initial (a), intermediate (b) and final (c) phases

the metal shell structures, which are to be transformed, should meet the following requirements:

— complete readiness for operation;
— air-tightness;
— minimum possible dimensions for transportation;
— simplicity of mounting after delivery;
— transformation pressure should be on the level of operating pressure in service.

Theoretical and laboratory analysis allowed to make a selection from a large number of variants, namely, the concept which is the most readily adaptable to fabrication is the transformation of a conical surface into a corrugated disk with circular corrugations. A theoretical model of transformation of closed surfaces is based on the principles of the theory of isometric bending and mirror reflection. The use of these principles allows the height of the cone to be decreased in the process of transformation of the shape within a very wide range (from 10 to 40 times).

Research carried out at the E. O. Paton Electric Welding Institute resulted in a unique, yet simple technology of transforming real metal shells with a conical surface into a corrugated disk. Investigations were performed on shells of 0.1 to 0.3 mm wall thickness and 400 mm diameter, made of titanium alloy VT1-1 and stainless steel Kh18N10T. Testing demonstrated good repeatability of the shell shape transformation, simplicity of the required equipment and a comparatively low cost. Transformation of a corrugated disk into a conical shell is shown in Figure 10 (a, b and c).

Joining the required number of corrugated elements into a single structure, which acquires the necessary dimensions and volume after transformation, provides a construction of a specified configuration and architecture.

Figure 11 shows a model of a 400 mm diameter structure with 65 mm height in a transportation state and with 2000 mm height in the operational state.

The proposed structures allow manufacturing a wide range of space constructions, such as docking modules, modules for enlargement of the useful volume of the space vehicles and long-term stations, transition tunnels, multichannel rod aerials, rods for extending instrument modules, etc.

Designing a standardized module of transformable shell structures, which can be used as the basic one for creation of volumes of planetary stations, is also interesting in our opinion. The proposed structures can be used on the Earth for storage of liquid and bulky products, as water towers, fuel stores and granaries, etc. Within the scope of the project, it is intended to design and manufacture the transformable lock chamber and to perform an experiment on its deployment under the space conditions.

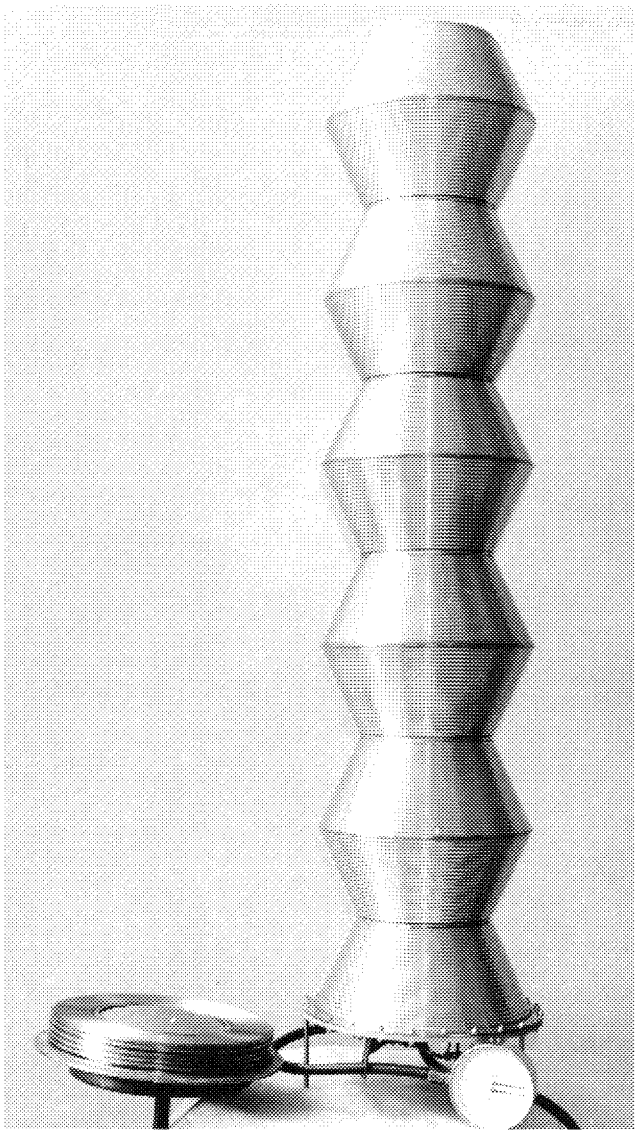

Fig. 11. Model of a 400 mm diameter structure in the transportation and operating states