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(54) **Large-size sandwich wall panel of fibrolite and method for fabrication thereof**

(57) Described in the application is a shop-prefabricated wall panel, which is intended to use as a support element for outer and inner walls in low-rise buildings construction.

A large-size wall panel having width equal to the storey height is made having many parallel layers of fibrolite, altering with low and high density along the width, wherein one or more high-density fibrolite layers are disposed between the low-density layers, bearing the structural design compressive load, whilst the low-density layers of fibrolite provide thin layers of high-density fibrolite with stability under compression, bearing load of elastic deformation of entire panel, also providing heat and noise insulation.

The high-density fibrolite slabs are laid with gaps between their adjacent sides in order to provide air change between the low-density layers.

The panel is fabricated by compacting fibrolite pulp layer by layer and compacting each layer, wherein high-density fibrolite slabs fabricated using in-line system are placed between the layers. It is possible to fabricate the sandwich panel without high-density fibrolite slabs.

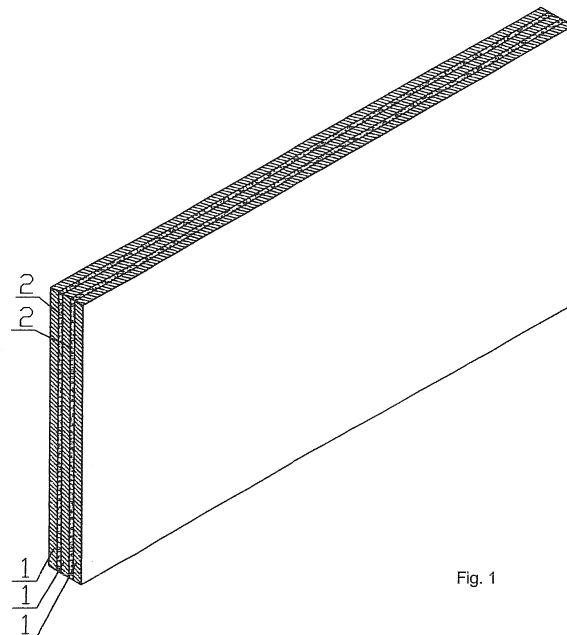


Fig. 1

Description

Field of invention

[0001] The invention generally relates to the field of low-rise large-panel building construction. Panel disclosed herein is prefabricated and is used as a structural element of inner and outer walls in low-rise construction.

Background of invention

[0002] Various designs of wall panels using cement bonded wood chip and wood wool materials, hereafter referred to as fibrolite, are currently in use in construction industry. Set forth in this application is system and method for fabrication of prefabricated large-size load-bearing sandwich wall panels of fibrolite materials.

[0003] Fibrolite is fabricated in the world starting from the beginning of the last century and is made of mineralized wood chips (wool) and of cement or magnesite binding material. Fibrolite slabs have high grade of fire protection, biological protection, they are ecologically clean and durable.

[0004] Low-density fibrolite, serving the purpose of heat insulation is fabricated having density from 200kg/m³. The density of constructional fibrolite reaches the quantity of 1200kg/m³, wherein the maximum thickness of fabricated slabs is not more, than 25mm [1]. This thick constructional slabs having length equal to their height, cannot independently provide stability under compressive vertical loads.

[0005] In most cases when fibrolite materials are used, concrete, wooden or metal elements [2],[3],[4],[5] perform functions of support members of the wall carrying frame. In these structures the carrying capacity of wood chip materials is not utilized, the materials are used only to provide thermal and noise insulation. Thereby it is noted, that the frame elements deteriorate thermal and noise insulation properties of wall panels. The use of wooden frame results in decreasing fire resistance and biological resistance of the structure. Metal frames have low resistance to corrosion. Concrete frame members are typically formed in the process of erection thus expanding construction time.

[0006] Cast in situ sandwich wall panels, formed in moulds at construction site, comprise support layer of heavy or light concrete, heat insulation layer of wood-cement material of uniform density and concrete or sand-cement outer protective layer[6]. Noted is the resulting low process efficiency, increased man-hours and dependence on weather conditions. Compaction of the fresh fibrolite mass is performed with hand vibrators, which does not provide uniformity of panel properties throughout its volume.

[0007] The closest analogue of the claimed invention is a full-size monolayer wall panel of cement fibrolite, having density from 200 to 300 kg/m³, patented by Ydre Traullsvaggar AB, Sweden [7]. Panels of this type are

fabricated and set in moulds in shop till they achieve the required strength. Their mechanical properties are uniform throughout the entire volume. The monolayer wall panels have high thermal and noise insulation characteristics. However the carrying capacity and deformability of the panels is limited with the volume of working vertical load. Particularly this is shown at points, where concentric loads are applied, for example loads from roof beams and trusses. This problem is resolved in situ by casting the reinforced concrete band at the upper face of the panels and by fabricating vertical concrete posts between the panels. Stiffening of concrete band increases construction time.

Disclosure of the invention

[0008] The object of this invention is to arrange for flexible variations of thermophysical properties and carrying capacity of the panel as well as to minimize operations on site, thus enabling to accelerate construction operations and to achieve high quality of construction. This is achieved by the way of factory prefabrication of the sandwich wall panel, which is configured for uniform distribution of the vertical compressive force carrying capacity along the length and the width of the panel made with alternating the parallel layers of fibrolite, having density from 200kg/m³ to 1200kg/m³ along the height of the panel. Therefore one or more layers of high-density fibrolite are located between the low-density layers to bear the structural design compressive load. The low-density layers of fibrolite provide for the compressive stability of the high-density layers of fibrolite, carrying the load resulting from elastic deformation of the entire panel and providing thermal and noise insulation. High-density layers may be made either along the entire length of the panel or at the load concentration points (in the zones of ceiling beams, window and door openings). Thickness of panel number and thickness of layers and their arrangement is specified by requirements to heat insulation and load. Uniformity of materials used and technique of fabrication employed provide good bond of layers in the panel and the required physical and mechanical properties of the final product.

[0009] The wall panel is fabricated in mould having sized like the panel. Fibrolite pulp is placed in the mould and compacted layer by layer until it reaches the predetermined density. High-density fibrolite slabs prefabricated on in-line system are then laid on the compacted layer.

[0010] To provide air change the high-density fibrolite slabs are laid with vertical gaps, the gaps are to be filled with low-density fibrolite when the next layer of high-density fibrolite is placed.

[0011] To improve maintenance of the panel, its outer surface is protected with high-density fiberboards, or layers of plaster are applied.

[0012] In order to achieve the maximum level of prefabrication, the outer surface of the panel maybe fabricated using decorative coating made of high-density fibrolite slabs. Setting of cement binding material during

the first day takes place in closed mold.

Brief description of the drawings

[0013]

Figure 1 shows the structural design of a large-size load-carrying wall panel, including 3 layers of low-density fibrolite 1 encompassing therebetween 2 layers of high-density fibrolite 2. Prefabricated fibrolite slabs 2 are laid with vertical gaps between them to be filled with low-density fibrolite pulp when the following layer of low-density fibrolite 1 is formed. Therein air exchange channels are formed between the layers 1. To improve bending strength of the panel, the slabs of higher density are laid displaced in consequent layers. Each layer of low-density fibrolite pulp is compacted to achieve the designed density. Besides heat and noise insulation the layers of low-density fibrolite provide stability under vertical compressive load to high-density fibrolite panels 2.

Figure 2 shows embodiment of a 2-layer wall panel made of fibrolite layers 1 of low-density and fibrolite layers 3 of high density. The layers are fabricated with use of consequent compacting till they achieve the required density. More than two layers may be used.

Figure 3 shows wall panel coated with protective or decorative panels, for example thin fibrolite slabs, used for interior 4 or exterior 5 wall finishing.

low-density layers of fibrolite provide thin layers of high-density fibrolite with stability under compression, bearing load of elastic deformation of entire panel, also providing heat and noise insulation.

2. A panel as claimed in claim 1 **characterized in that** the high-density fibrolite slabs are laid with gaps between their adjacent sides in order to provide air change between the low-density layers.
3. A panel as claimed in claim 1 or 2 **characterized in that** the inner and the outer surfaces of the panel are coated with decorative or protective slabs.
4. A method for fabrication of a large-size wall panel, **characterized in that** the panel is cast in mould with placing and compacting the fibrolite (of low-density fibrolite) pulp layer by layer, wherein the high-density fibrolite slabs are placed between the low-density fibrolite slabs, wherein the slabs are prefabricated using in-line system.
5. A method for fabrication as claimed in claim 4, **characterized in that** the panel is fabricated by placing fibrolite pulp layer by layer, and compacting each layer till it reaches the density required.

Sources of information

[0014]

1. Patent WO 2004 005,643 A1, 15.01.2004
2. Patent US 5,034,085 A, 23.07.1991
3. Patent WO 9821422 A1, 22.05.1998
4. Patent GB 2,346,626 A, 16.08.2000
5. B.N.Kauffman et.al. Cement Fibrolite. -M.:Stroyizdat, 1961, article 4.
6. V.I.Zaprudnov Three-layer structures with fibrolite thermal insulation layers: monograph rev.2, -M.: MGUL, 2006, articles 4-5.
7. Patent WO 2006 106,844 A1, 16.02.2006

Claims

1. A large-size wall panel of fibrolite having width equal to the storey height, **characterized in that** in order to straighten the carrying capacity along its length and width, the panel is configured to have many parallel layers of fibrolite, altering with low and high density along the width, wherein one or more high-density fibrolite layers are disposed between the low-density layers, wherein the former layers are bearing the structural design compressive load, whilst the

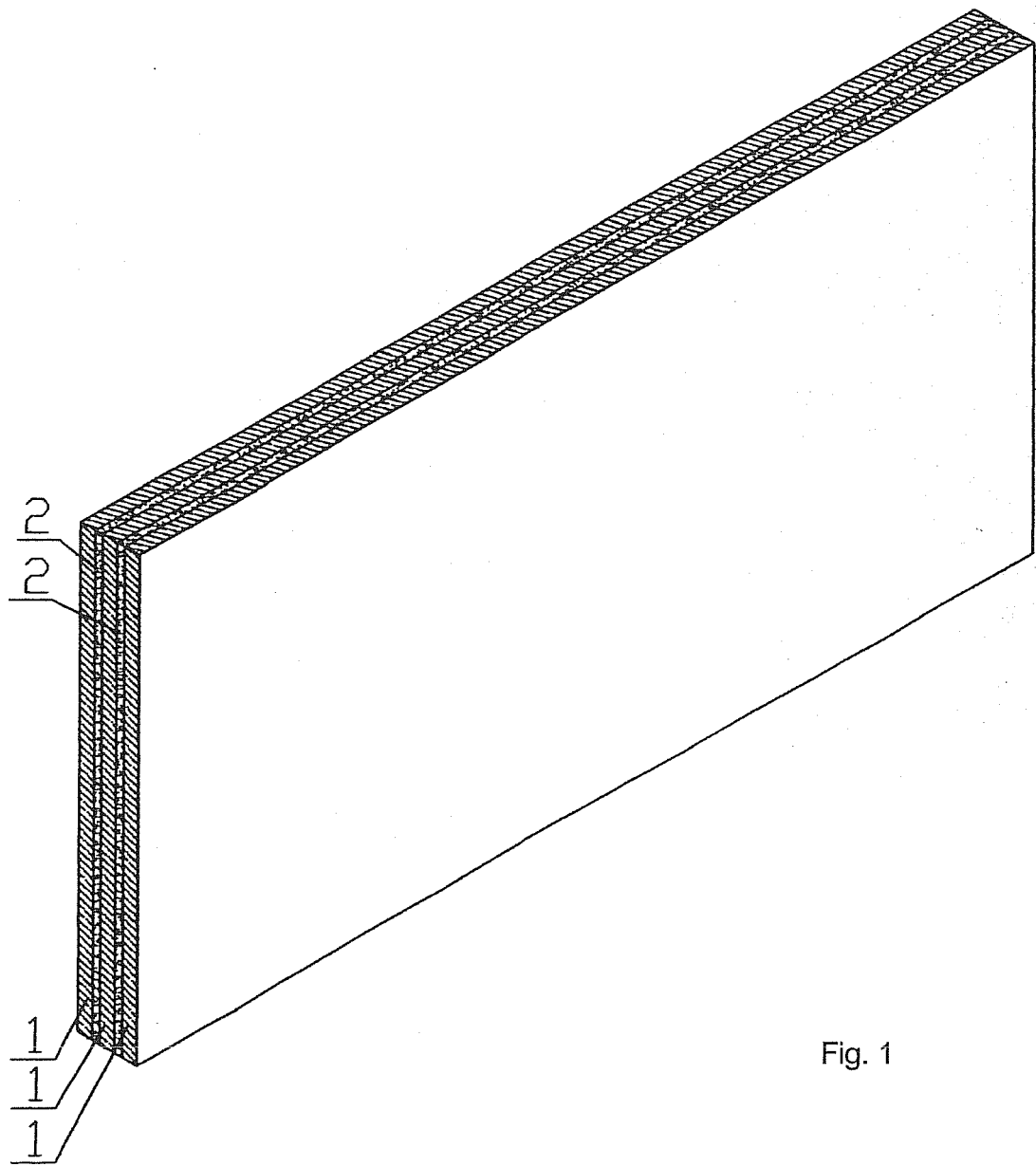


Fig. 1

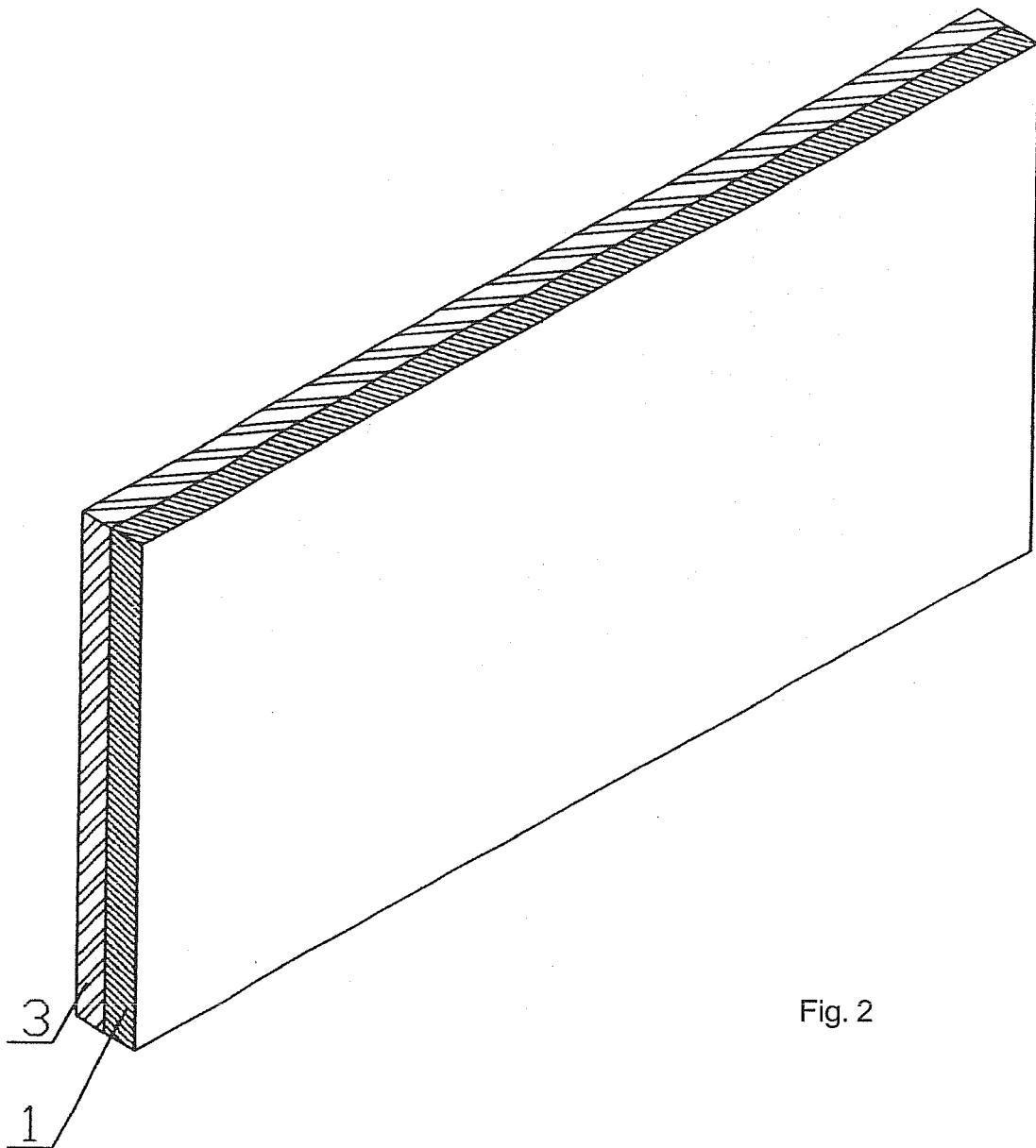


Fig. 2

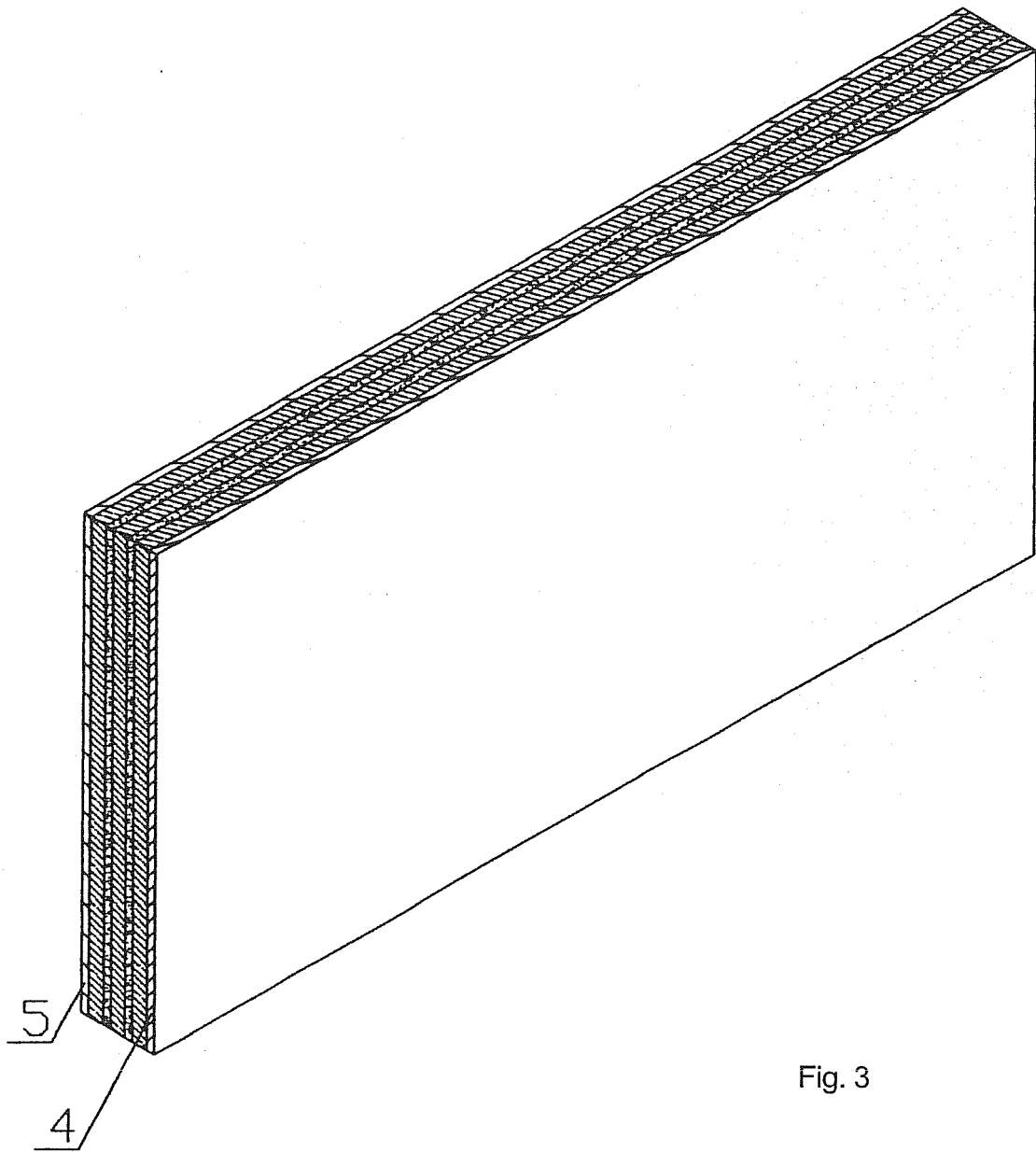


Fig. 3



EUROPEAN SEARCH REPORT

Application Number
EP 08 16 2217

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	GB 1 440 201 A (OKUTANI) 23 June 1976 (1976-06-23) * page 1, line 13 - page 2, line 82; figures 5,7 *	1-5	INV. E04C2/16
Y	US 5 188 889 A (NAGATOMI ET AL.) 23 February 1993 (1993-02-23) * column 5, line 23 - line 44 *	1-5	
A	DE 74 13 718 U (DEUTSCHE NOVOPAN GMBH) 20 April 1974 (1974-04-20) * claim 1 *	1,4	
			TECHNICAL FIELDS SEARCHED (IPC)
			E04C B32B
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 17 November 2008	Examiner Mysliwetz, Wolfgang
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 08 16 2217

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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17-11-2008

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- WO 2004005643 A1 [0014]
- US 5034085 A [0014]
- WO 9821422 A1 [0014]
- GB 2346626 A [0014]
- WO 2006106844 A1 [0014]

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- **B.N.KAUFFMAN.** *Cement Fibrolite.* -M.:Stroyizdat, 1961 [0014]
- **V.I.ZAPRUDNOV.** *Three-layer structures with fibrolite thermal insulation layers: monograph rev.2,* -M.: MGUL, 2006 [0014]