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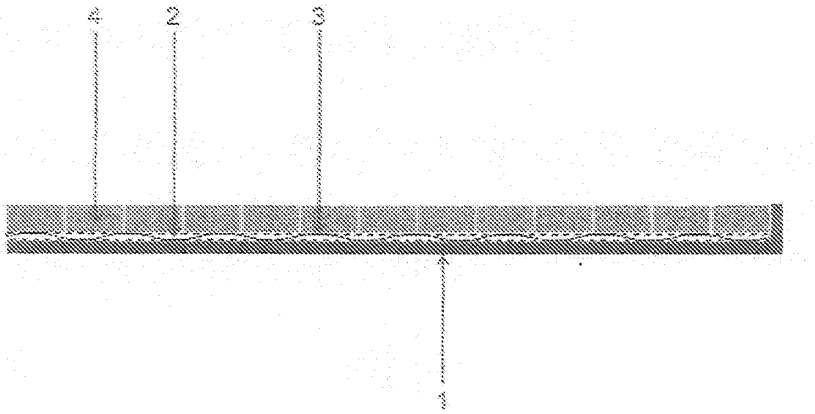
(54) METHOD FOR MANUFACTURING HYBRID ABRASION-RESISTANT BASALT PLATES

(57) **Summary**

The Manufacturing Process of Hybrid Anti-Abrasive Basaltic Plates is a basalt coating manufacturing process that will be applied to elements that come into contact with highly abrasive products for increased abrasion resistance, resulting in the increased useful life and the consequent significant reduction in the shutdown of industrial processes and therefore significantly increasing productivity, with applications in industries such as mining, steel, chutes, stock houses, silos, machinery and transportation systems, storage and handling subject to the action of abrasion by contact between the input or product with the surface of movement and or storage thereof, therefore it will be composed of a steel plate SAC 50 (1); special cement glue (2); a steel screen (3); basalt plates (4) and screws (5) forming a basaltic coated hybrid plate that is resistant to traction and corrosion.

FIG 02



EP 3 392 407 A1

Description

[0001] The present patent is for the invention of a process for the manufacture of hybrid anti-abrasive basaltic plates, more precisely the manufacture of plates with a cast basalt coating for improved resistance to abrasion for places requiring such efficiency, as well as in transportation systems, storage and handling of raw materials or abrasive products in industry, mining, transport carriers and cargo lifts.

[0002] Numerous types of plates are used and replaced in areas subject to abrasion wear, plates which are also manufactured by the forging of steel sheets or even ingots; parts that despite their apparent resistance, when installed in areas subject to abrasion, suffer constant wear, and at an advanced stage of wear are then necessarily replaced which causes a consequent stop in production to be able to perform this task.

[0003] It is known that the bulk transportation of materials in many industries, steel making, mining and coal-fired power plants is associated with high component wear. In addition to the loss of investment from the original equipment, the combination of plant shutdowns and production losses, destroys the company's capital base. This is unacceptable to today's competitive markets.

[0004] The solution to this problem is the use of reliable anti-wear protection. The choice of the right material is of vital importance as well as its correct application. Since it was developed the cast basalt serves to promote the reduction of wear and maintenance costs.

[0005] Existing solutions do not use the concept of product creation with the application of different materials for optimization and maximum use of its functional characteristics.

[0006] With the intent to proceed with the use of basalt for the coating of bulk material transport equipment in various industries and coal-based thermoelectric plants, considering its anti-abrasive properties, the Process for the Manufacture of Hybrid Anti-Abrasive Basaltic Plates that will allow through the aggregation of some materials as well as the consecutive arrangement of each component, evidencing an increase in the useful life due to the high resistance to abrasion, that is, the wear of the plate, consequently a significant reduction in the industrial process stoppages with an expressive increase in productivity.

[0007] Another great advantage of the utilization of the hybrid plates claimed here is that they allow for a minimum duration of 5 (five years) with guarantee of resistance to abrasion, just with this advantage the reduction of costs due to the stops and shutdowns are 5 times more than those used in the market currently, considering that today plate exchanges are carried out in intervals of no more than 1 (one year).

[0008] The process of manufacturing hybrid anti-abrasive basaltic plates may be better understood through the detailed description in accordance with the following attached figures, where:

Figure 01 presents a perspective view of the hybrid plate from the manufacturing process of the hybrid basaltic anti-abrasive plates with a folded edge.

Figure 02 presents a side view of the hybrid plate from the manufacturing process of the hybrid basaltic anti-abrasive plates with a folded edge.

Figure 03 presents a front view of the manufacturing process of the hybrid basaltic anti-abrasive plates with a folded edge.

Figure 04 presents a top view of the manufacturing process of the hybrid basaltic anti-abrasive plates with a folded edge.

Figure 05 presents a exploded perspective view of the manufacturing process of the hybrid basaltic anti-abrasive plates with screws.

Figure 06 presents a perspective view of the manufacturing process of the hybrid basaltic anti-abrasive plates with screws.

Figure 07 presents a top view of the manufacturing process of the hybrid basaltic anti-abrasive plates with screws.

Figure 08 presents a back view of the manufacturing process of the hybrid basaltic anti-abrasive plates with screws.

Figure 09 presents a close-up perspective view of the manufacturing process of the hybrid basaltic anti-abrasive plates with screws.

[0009] With reference to these figures it can be seen that the manufacturing process of hybrid anti-abrasive basaltic

plates produces a product that will be offered to mining industries, steel mills and any others that have their facilities subject to high levels of abrasion.

[0010] The basaltic plate described herein refers to a hybrid plate, composed of a steel plate SAC 50 (1) in its various gauges, which will be the base for supporting the plate; then a special cement glue (2) will be added together with a steel screen (3); and finally the basalt plates (4) will be fixed, thus making up the face of the plate to be used for abrasion resistance.

[0011] The SAC 50 steel plate (1) may contain DIN standard screws (5) in their various gauges, allowing the hybrid plates to be attached to the surfaces to which they will be implanted. Or also, in situations where the screws (5) can not be used, they can then be secured by anchoring.

[0012] The special cement glue (2) is a blend which will surround the steel screen (3) in such a way that this assembly will allow for an impact damper property, as well as that of joining the steel plate SAC 50 (1) to the basalt plates (4). As it is a mixture that will result in an alloy, it will also allow for a flexing, compression and compacting functionality.

[0013] These hybrid plates may also receive a galvanizing treatment in order to further ensure protection against corrosion.

Characteristics of the inputs:

[0014]

- Basalt: Physical characteristics of cast basalt.

Category	Attribute
Density	3g/cm^3
Compressive strength	300 MPa
Flexural strength	≥60 MPa
Impact Strength	1,76 KJ/m^2
Resistance to abrasion	0.07 g/cm^2
Vickers hardness test	≥720 kg/mm^2
Module of Elasticity	1.67 x 10 MPa
Expansion Coefficient	8.92 x 10^2
Resistance to chemical attack	
95% - 98% H2SO4	≥98%
20% H2SO4	≥94%
20% NaOH	≥98%
Characteristics of SAC 50 Steel	

General characteristics of thick plates:

Current generation	Previous generation	Yield point (Mpa)	Resistance to Atmospheric Corrosion	Resistance to Fire
USI-CIVIL-300	ASTM-A36MGM	Min 300		
USI-CIVIL-350	ASTM-A572-50-1	Min 350		
USI-SAC-300	USI-SAC-41-MG	σ Min 300		
USI-SAC-350	USI-SAC-50	min 350		

(continued)

Current generation	Previous generation	Yield point (Mpa)	Resistance to Atmospheric Corrosion	Resistance to Fire
USI-FIRE-350	USI-FIRE-490	Min 325 (Ambient Temp.) Min 217 (600°C)		
* Key: - low, σ - medium, - high				

Similarity of thick plates:

Quality	**Similar Standards**				
	ASTM	**EN**	**JIS**	**NBR**	**Mercosur**
USI-CIVIL-300	ASTM-A-36	10025-S235J0	G3101-SS400	6650-CF26	02-131-ED24
USI-CIVIL-350	ASTM-A572-50-1	10025-S355J0	G3101-SS490	5000 5004	02-102-MCF=345 02-101-MCG-360
USI-SAC-41	A709W-GR36	10155-S235J0	G3114-SMA400	5921-CFR-400 5008-CGR-400	02-103-GRAU-400
USI-SAC-41MG	A709W-GR50	-	-	5921-CFR-400 5008-CGR-400	NM-140-98-GRAU-400
USI-SAC-50	A588 (CG) A606-2 (TQ)	10155-S355JOW	G3114-SMA490	5921-CFR-500 5008-CGR-500	NM-140-98-GRAU-500
USI-SAC-350	A242-1 (CG) A606-4 (TQ)	10155-S355J0WP	G3125-SPA-H	-	-

Characterization of steels in relation to their chemical system:

Application	**Nomenclature**	**Chemical System**
Structural	ASTM-A-36-MG	C and Mn
	ASTM-A-36	
	ASTM-A572-50-1	
	USI-CIVIL-300	
	USI-CIVIL-350	
Corrosion Resistant	USI-SAC-300	Si, P, Cu and Cr
	USI-SAC-350	
Fire Resistant	USI-FIRE-300	Mo and Cu
	USI-FIRE-350	

Specified Chemical Composition (% by mass) - Thick Plate:

Steel	Thickness	C	Mn	Si	P	S	Nb
ASTM-A36-MG	60 to 75.00	0.26	0.80 to 1.35	0.15 to 0.30	0.04	0.05	
ASTM-A36	6.0 to 19.1	0.25	-	0.4 max			
	19.1 to 38.1	-	0.80 to 1.20	015 to 0.4			
	38.1 to 63.5	0.26					
	63.5 to 101.6	0.27					
ASTM-A572-50-1	Up to 9.53	0.23	0.50 to 1.35	0.4 max			0.005 to 0.050
	9.53 to 38.10	0.2	0.80 to 1.50	0.15 to 0.40			
	38.1 to 50.00	-	-				

Specified mechanical properties:

Steel	Traction (Transverse)					Folding (1) (longitudinal)	
	LE (MPa)	LR (MPa)	Stretching (2)				
			Thickness (min)	BM (min)	% (min)	Thickness (min)	Diameter
ASTM-A36-MG	Min 300	Min	6.00 to 75.00	50 200	18 0.18	Below 19.05	0.5E
						19.05 to 25.40	1.0E
						25.40 to 38.10	1.5E
						38.10 to 50.80	2.5E
						Above 50.80	3.0E
ASTM-A36	Min 250	400 to 550	6.00 to 70.00	200	20	Below 19.05	0.5E
						19.05 to 25.40	1.0E
						25.40 to 38.10	1.5E
			70.00 to 101.6	50	23	38.10 to 50.80	2.5E
						Above 50.80	3.0E
ASTM-A572-50-1	Min 345	Min 450	< 50.00	200	16	Below 19.05	1.0E
						19.05 to 25.40	1.5E
						25.40 to 38.10	2.5E
1 - Performed when requested by the client; 2 - The stretching values should be reduced according to the following table;							

General Purpose Quality:

Specification SAE)	Thickness Range (mm)	Chemical composition (%)				
		C (Max.)	Mn (Max.)	Si (Max.)	P (Max.)	S (Max.)
1010	5.0< and ≤ 152.4	0.08 - 0.13.	0.30 - 0.60	0.35	0.04	0.05
1020		0.17 - 0.23				
1045		0.42 - 0.50	0.60 - 0.90	0.10 - 0.35		

Equipment Required for Fabrication

[0015]

- Plasma cutting equipment for sheet steel and screens;
- Mig welding equipment;
- Bending equipment for sheet steel;
- Special tables for cutting the cast Basalt;
- Press for casting of steel and basalt plates;

Stages of the Productive Process:

[0016]

- Preparation of the cast basalt parts: in this step the cutting, the cutting out of the coupling grooves and the finishing of the cast basalt plates is carried out according to the dimensions of the steel sheet to be coated;
- Electrolytic galvanizing of the steel plates: galvanizing the plates according to the specified measurements; (When the plates are subjected to humidity and / or environmental oxidation conditions)
- Folding of the sheets: the folding of the sheet is performed along its largest dimension, creating a cross-section in an L shape;
- Cutting: plasma cutting and drilling of the USI SAC 350 steel plates (former SAC 50);
- Cutting of the steel screens: Cutting of the galvanized steel screens 14 is carried out, which will be embedded in the cement glue between the steel plate and the basalt coating;
- Special Cement Glue Preparation: mortar is mixed with a special cement made up of ARI (initial high strength) + granular elements + ground basalt;
- Joining of the plates with the use of the hydraulic press: the basalt pieces are applied to the plates, set to each other and glued with the special cement glue;
- Painting, Finishing and coding of the final product: the final finishing procedure is carried out, serial numbering with bar code for batch identification and date of manufacture is applied.

[0017] Components and product characteristics (steel, electrolytic galvanizing, screen, cast basalt, special cement, screws, welds, cuts): Product typology.

- Standard plates;
- Hybrid plates;
- Shaped plates;
- Duct linings;
- Customized plates.

[0018] Advantages found with the use of the manufacturing process of anti-abrasive basaltic plates;

- Increased useful life;
- Operation without maintenance;
- Operation without interruption;

- Eliminates production losses;
- There is no contamination of the product resulting from abrasion, mixing or oxidation;
- Physiologically harmless, so it is recommended for the food industry;
- Smooth contact area, which promotes good flow and prevents accumulation of material;
- Reduces pressure loss and consequently decreases energy consumption.

[0019] Here are some areas where you can apply the process:

- Cement factories;
- Breweries, malt houses;
- Chemical industry.
- Gas plants;
- Foundries;
- Glass factories;
- Steel mills and rolling mills;
- Lime, sand and potassium plants;
- Mineral extraction and coal;
- Coke plants;
- Waste incineration plants and recycling plants;
- Paper manufacture plants.

[0020] The disadvantage observed in the use of this process is only in the restriction of the temperature of the environment that should not exceed 350 degrees Celsius and the limitation of direct Impacts and of sharp edged loads acting directly on the surface of the plates, in a certain way, it is the only disadvantage of the material due to its crystalline structure.

[0021] As seen above, the preferred embodiments given to the dimensioning of the hybrid plates are through the thickness, shapes and folds of the steel plates, so that the application of the process of coating transport equipment described herein is a viable alternative, in addition all references to anti-abrasive hybrid plates follow in a manner that do not tend to limit the present invention, there may be constructive variations which are equivalent without, however, departing from the scope of protection of the invention.

Claims

1. The manufacturing process of the Hybrid Anti-Abrasive Basaltic Plates enables the production of a hybrid plate which will has anti-abrasive characteristics, that is it has abrasion, stress and corrosion resistive properties, it is composed of a steel plate SAC 50 (1) which makes up the first layer of the plate, then a special cement glue (2) is applied that will surround the steel screen (3) in such a way that this assembly will allow the joining of the steel plate SAC 50 (1) to the cast basalt plates (4); the SAC 50 (1) steel plate can be fixed using DIN standard screws (5) in their various gauges, which will allow the hybrid plate to be attached to the equipment where it will be applied, or the SAC 50 (1) steel plate can come without these screws (5) and can be secured by anchoring, forming a basaltic coating covering on the elements that come into contact with highly abrasive products.

FIG 01

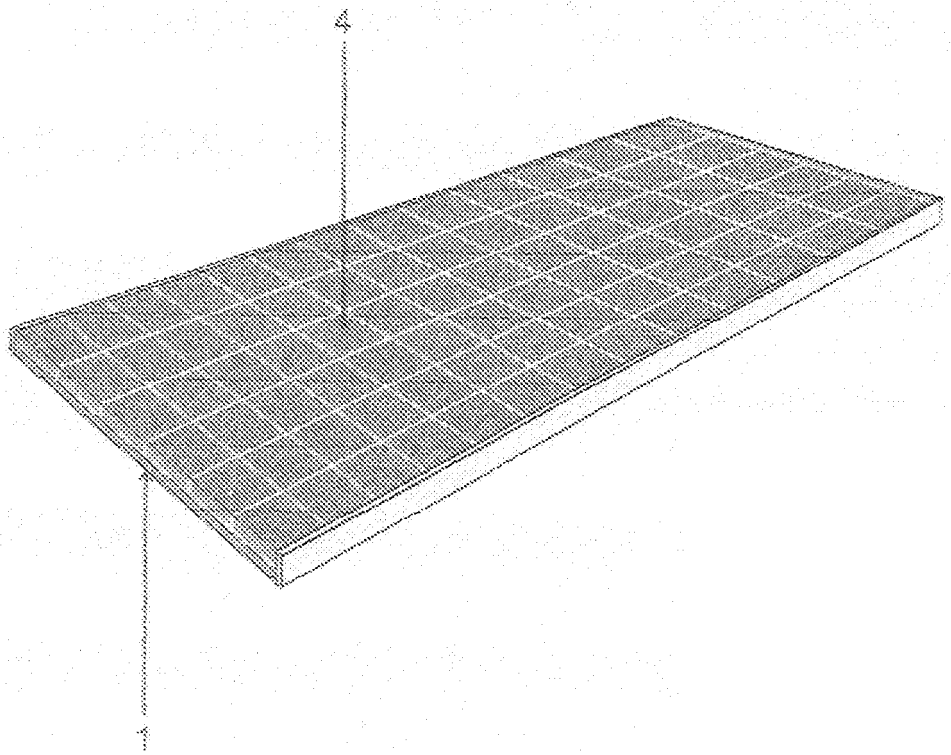


FIG 02

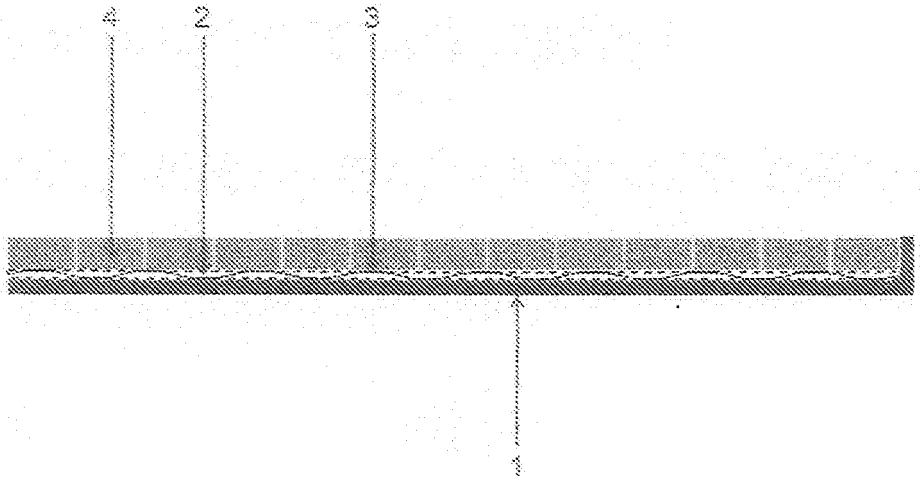


FIG 03

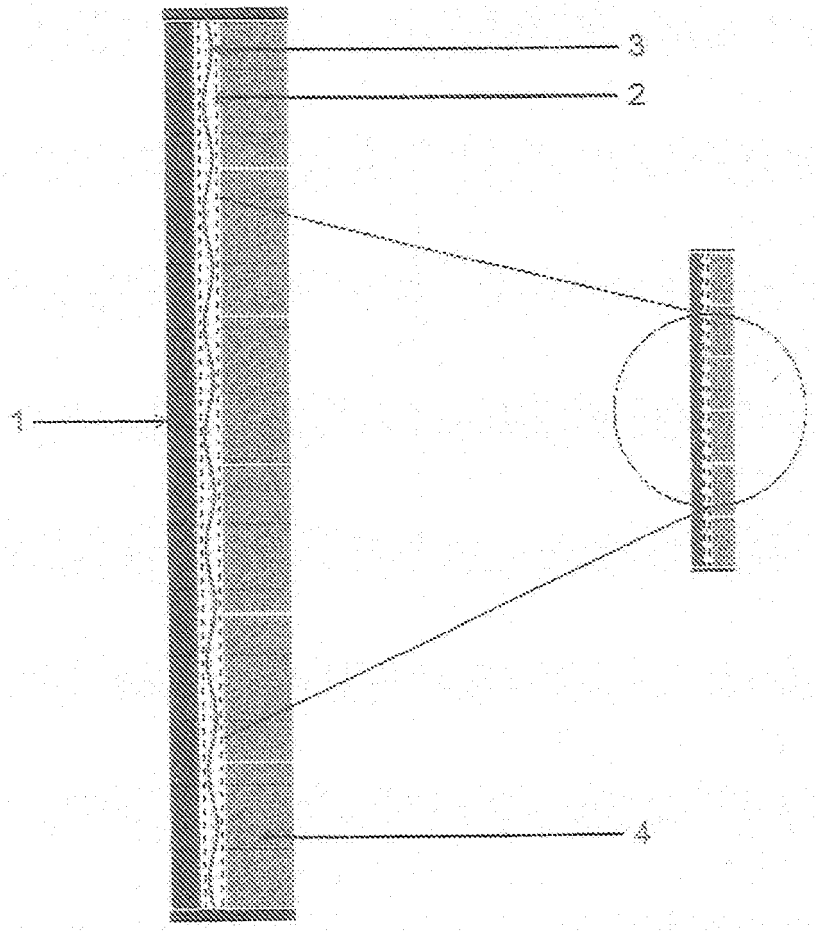


FIG 04

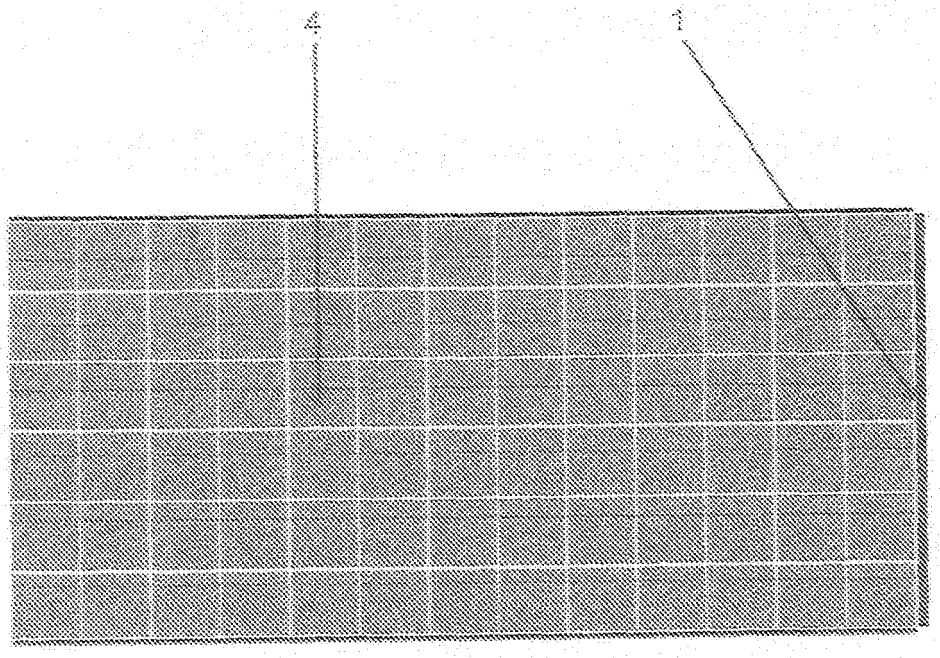


FIG 05

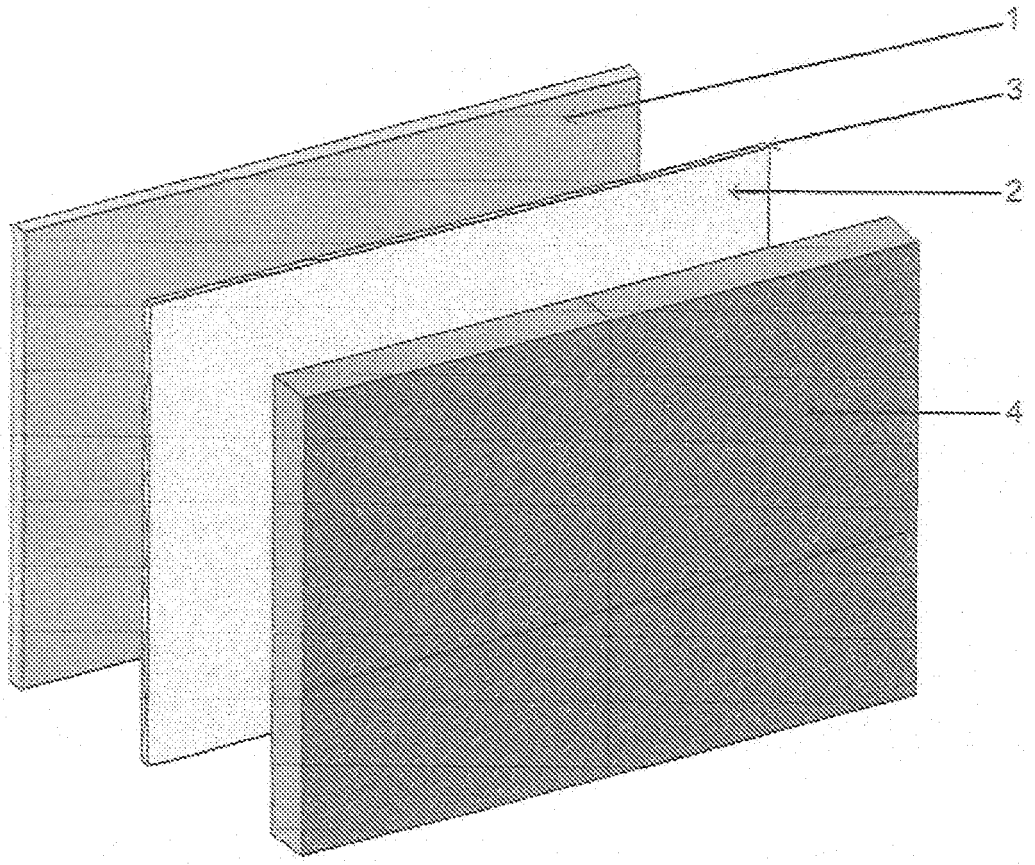


FIG 06

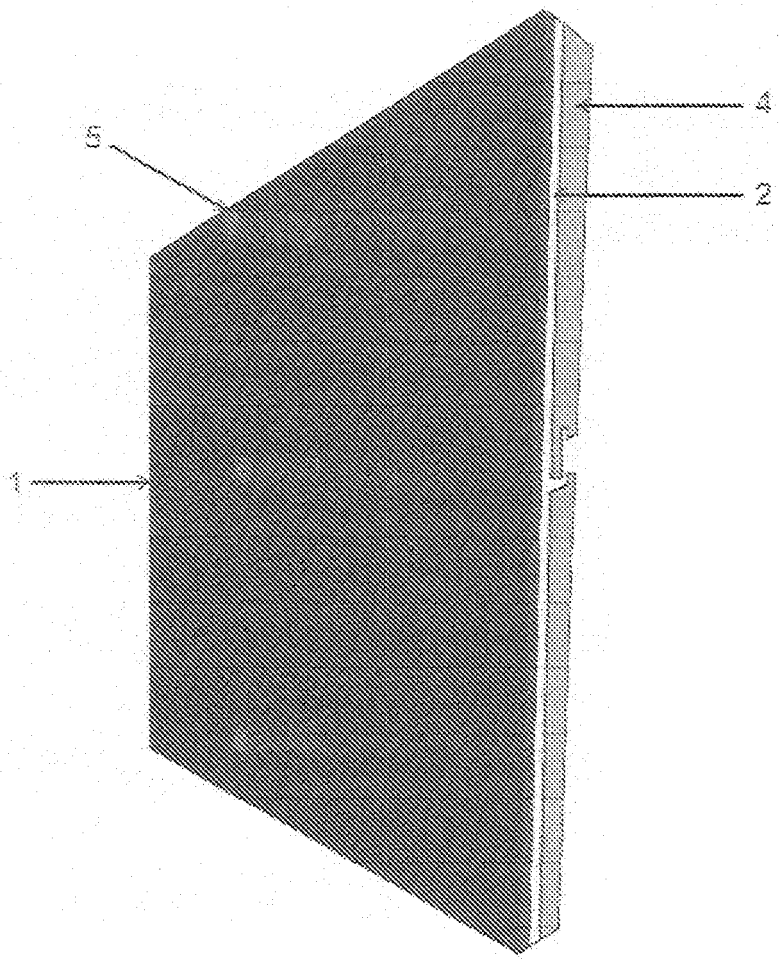


FIG 17

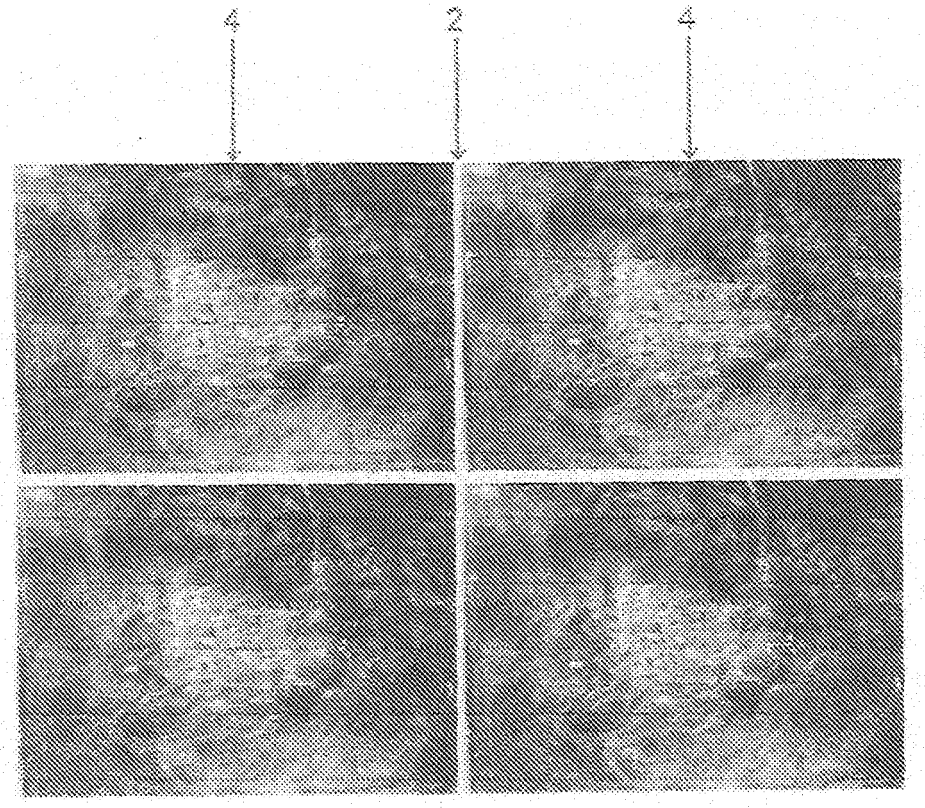


FIG 08

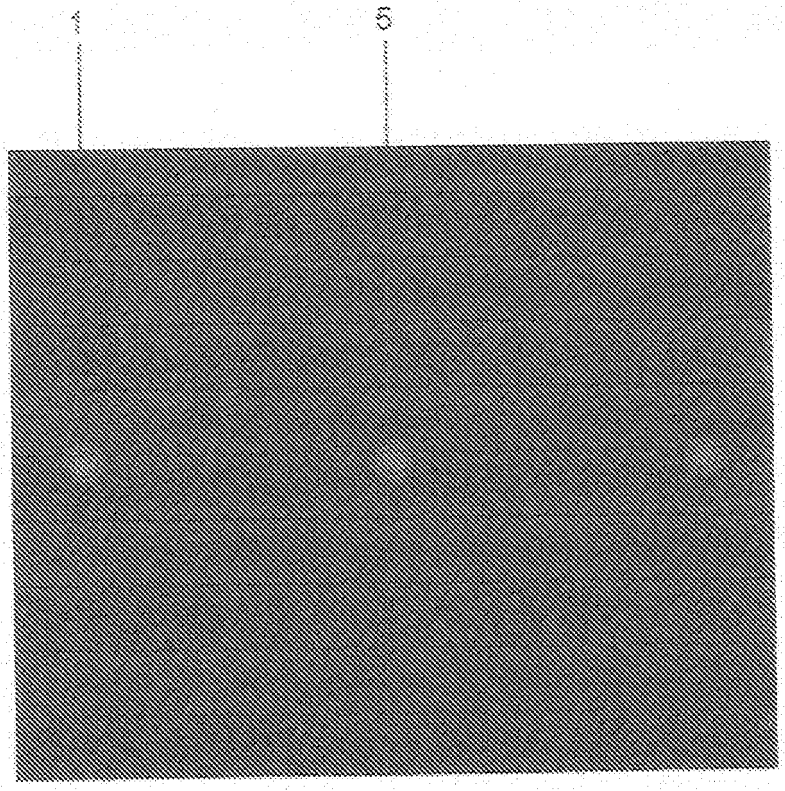
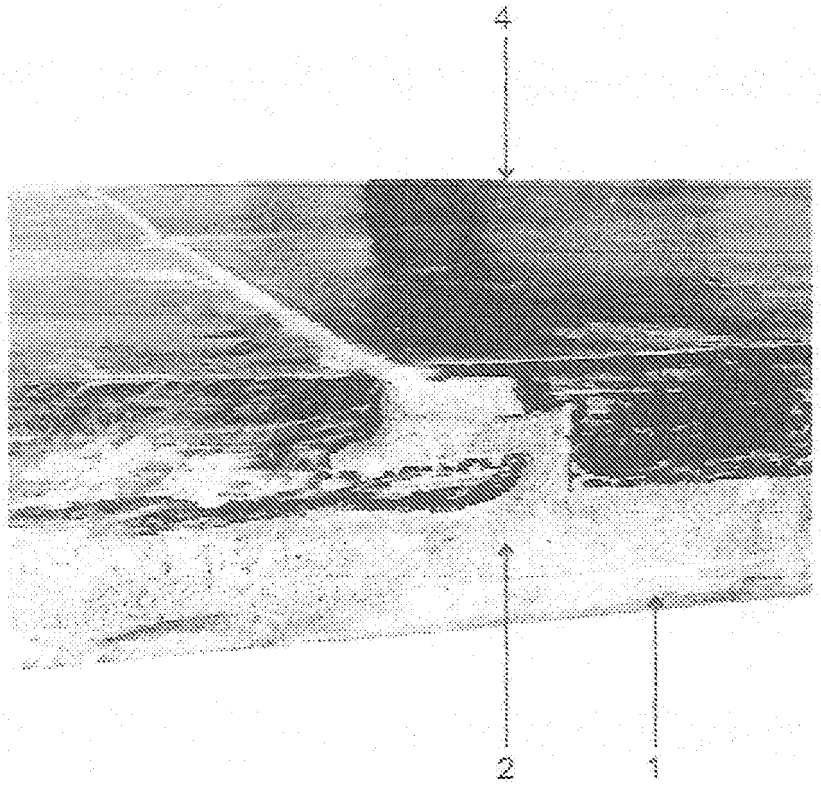


FIG 09



INTERNATIONAL SEARCH REPORT

International application No.
PCT/BR2016/000160

A. CLASSIFICATION OF SUBJECT MATTER

IPC: E01C 5/22 (2006.01), E04F 15/00 (2006.01), E04C 2/28 (2006.01), E04B 1/62 (2006.01), E04B 5/44 (2006.01), B32B 15/04 (2006.01)
CPC: E01C 5/223, E04F 15/00, E04C 2/28, E04B 1/62, E04B 5/44, B32B 5/44

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

E01C; E04F; E04C; E04B; B32B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	**CN 201433345 Y (UNIV SOUTH CHINA TECH) 31 March 2010 (2010-03-31) (Abstract; figure 1)**	1
Y	**KR 100749368 BI (HUH NAM JUNG [KR]) 08 August 2007 (2007-08-08) (Abstract)**	1
A	**CH 574882 A5 (ZUEBLIN ED CIE AG) 30 April 1976 (1976-04-30) The whole document**	
A	**JP 4511620 BI (TOMOE JIKO KK) 28 July 2010 (2010-07-28) The whole document**	

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13/03/2017	**22/03/2017**

Name and mailing address of the ISA /	Authorized officer
INPI INSTITUTO NACIONAL DA PROPRIEDADE INDUSTRIAL Rua Sao Bento nº 1, 17º andar cep: 20090-010, Centro - Rio de Janeiro/RJ Facsimile No. +55 21 3037-3663	**Rogerio Barbosa dos Reis** Telephone No. +55 21 3037-3493/3742

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/BR2016/000160

CN 201433345 Y	2010-03-31	None	
KR 100749368 B1	2007-08-08	None	
CH 574882 A5	1976-04-30	None	
JP 4511620 B1	2010-07-28	JP 2010189875 A	2010-09-02