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(12) # EUROPEAN PATENT APPLICATION

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(54) **Heated chambers provided with sealing means for openings therein and method of sealing them.**

(57) A heated chamber having at least one opening; closure means for closing said at least one opening, said closure means having at least a closed and open position; said closure means and said opening having surfaces (16,14) disposed for coming into proximity of one another in said closed position, said surfaces forming a primary sealing means for said heated chamber in said closed position, there being a substance (110) applied to at least one of said proximate surfaces, said substance having a property of expanding upon the application of heat thereby forming a secondary sealing means between said proximate surfaces in said closed position.

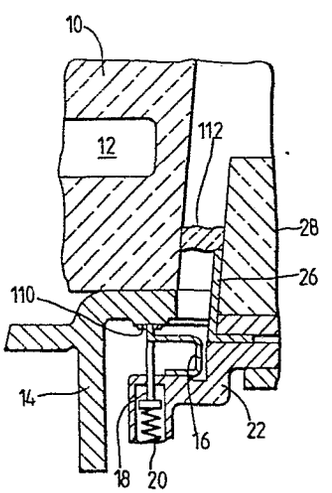

Fig. 2

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TITLE MODIFIED
see front page

SEALING OF HEATED CHAMBERS

This invention relates to the sealing of heated chambers. More particularly, the invention relates to a heated chamber provided with improved sealing means, and to a method of sealing a heated chamber.

It is well known especially from Environmental Reports and the news media that the sealing of ovens which produce noxious fumes, smoke, dust, etc., is a difficult art. Only recently the coke industry in the major steel producing area of the United States has been threatened with a complete shutdown because of its inability to comply with the new Environmental Regulations of the Environmental Protection Agency of the United States of America and the Department of Environmental Resources of the Commonwealth of Pennsylvania.

An example of a coke oven which presently has sealing problems, is a coke oven with a so-called Koppers Door. The coke oven with the Koppers Door utilizes an S-shaped seal for sealing the door against the jamb of the oven. Because of irregularities in the jamb and seal, gases from within the coke oven readily leak past the jamb. In cases where the seal has been damaged by loading and unloading of coal and coke, gouges occur therein, which greatly increase the flow of noxious gases and fumes from the coke oven to the surrounding air. This leakage from damaged ovens is especially undesirable since the degree of pollution caused

thereby is many times that of an oven in an undamaged condition. However, during long use, coke ovens are damaged by the constant loading and unloading and seal cleaning. Therefore, a larger and larger percentage of the ovens leak at ever increasing rates.

Another door widely used in the coke industry is the Wilputte Door. The Wilputte Door has a diaphragam seal and a jamb with an adjustable screw for making contact more readily between the jamb and the door. The Wilputte Door also suffers from the same sort of problems as does the Koppers Door. A great need is also felt for an improved sealing arrangement therein.

Recent tests have shown that many of these doors in present operation in their present configurations do not permit operation within the guidelines set by the Department of Environmental Resources and the Environmental Protection Agency. The fact of the lack of capability of meeting these requirements is well known and has threatened to shut down the steel industry for lack of coke. Therefore, a great need is felt for an improved door sealing arrangement which would permit operation within the guidelines of the Environmental Protection Agency or the Department of Environmental Resources.

There are a great number of other applications where leakage from ovens and other heated chambers can be cured by the use

of the present invention such as soaking pits, used for the soaking of iron ingots during the manufacture of iron and steel, furnaces and other examples which are too numerous to mention herein.

A means of attempting to seal a coke oven is disclosed in U.S. Patent No. 3,875,018 in which a collodial mixture is injected into a passage from which it leaks out in such a way that during the coking cycle the mixture becomes gummy and sticky, so as to seal crevices between the door and the jamb. The mixture dehydrates and develops non-wetting and non-adhering properties by hardening into a strong solid mass. This method requires a special door design which incorporates channels for receiving the mixture. Problems have been discovered in the injection of the mixture into the channel because the mixture has a tendency to leak out of the channel and past the seal before it has an opportunity to harden sufficiently.

A novelty search conducted prior to the preparation of this application revealed U.S. Patent No, 2,279,791, which does not form the prior art but only teaches the application of a material which expands when subjected to elevated temperatures. This material is used to coat the individual wires of a fire screen. The fire screen thus coated, when exposed to elevated temperatures causes the material to expand. The expansion closes the openings between the individual wires of the screen, thereby restricting the flow

of air at these elevated temperatures through the fire screen.

Another result of the mentioned novelty search is U.S. Patent No. 3,814,613 which discloses the use of a refractory composition for patching the walls of a coke oven. This refractory composition comprises siliceous aggregate, plastic clay, a chemical binder such a sodium silicate, chromic acid, boric acid, sodium sulfate, magnesium sulfate, sodium phosphate and organic binders and finally, a source of manganese dioxide. The patching material may be applied by troweling or plastering over a cracked area in the wall of the coke oven or by pumping or injecting the material into cracks in the wall or by pneumatically gunning. U.S. Patent No. 3,814,613 has the object of providing a patching material for coke ovens which has a long lasting bond with used silica brick.

The present invention relates to the sealing of heated chambers from which gases, fumes and other noxious materials may escape. These chambers have at least one opening therein for receiving contents to be processed therein in some manner. This opening has preferably some sort of closing element for the gross sealing thereof from the surrounding atmosphere. This element may be a door. This door has a primary seal for making at least a rudimentary seal between the door and the jamb which reduces the leakage of gases, fumes and other noxious materials from the chamber

to the surrounding environment. In addition to the primary seal, a secondary seal is provided which is placed or disposed in such a way as to enhance the sealing function of the primary seal. In addition, this secondary seal is made from a material which changes dimensions such as to expand when exposed to heat and preferably expands to complement or surround the primary seal, thereby greatly improving the ability of the primary seal to contain the gases, fumes and other noxious materials.

This secondary sealing means is preferably applied in a liquid state and is comprised of a material such as liquid sodium silicate which provides a sealing capability which improves as the temperature rises because of its property to expand when heated. Other intumescent materials, that is materials which expand upon the application of heat, are within the scope of this invention.

The sealing mixture or medium is formed by mixing preferably an intumescent material such as sodium silicate to a desired viscosity which when applied at temperatures before the chamber is heated will permit an accumulation thick enough to surround the primary seal when making a seal against the jamb, upon the closing of the oven door.

Reference will now be made to the accompanying drawings which are given by way of example and in which:-

Figure 1 is a cross-sectional view of a Koppers oven door having an S shaped seal and a jamb according to the prior art.

Figure 2 illustrates the invention applied to the Koppers oven door of Figure 1.

Figure 3 is a cross-sectional view of a Wilputte door according to the prior art.

Figure 4 illustrates the invention applied to the Wilputte door of Figure 3.

Figure 5 is a three dimensional view of a segment of an S shaped seal showing gas leakage gaps as in the prior art.

Figure 6 illustrates the present invention applied in Figure 5.

Referring now to Figure 1, oven walls 10 are shown with flues 12 therein. Abutting the walls are jambs 14. Making contact with the jambs 14 are S shaped seals.

Plungers 18 have springs 20 for urging the S shaped seals 16 against the jambs 14. The opposite ends of the S shaped seals 16, not making contact with the jambs 14, abut a door frame 22 which has a latch 24 for opening, closing, and locking the door. Also attached to the door frame 22 are

retainers 26 which hold a plug 28 therebetween. A brickstay 30 abuts the jambs 14 on the sides opposite the oven walls 10.

Referring now to Figure 2, a partial cross section of the Koppers door of Figure 1 is shown, having one of the S shaped seals 16, one of the door jambs 14 and the plug 28. In the area of the jamb 14 onto which the S shaped seal 16 abuts, an intumescent material 110 is applied. The intumescent material expands upon exposure to the elevated temperature during the making of coke. This expansion provides a gas-tight seal between the jamb 14 and the S shaped seal 16.

As an alternative embodiment also shown in Figure 2 between the plug 28 and the oven wall 10 a mass of intumescent material 112 is applied. This mass of intumescent material 112 has the same function as the intumescent material 110, and will expand upon exposure to elevated temperatures.

If there are any gouges or cracks or other irregularities in the jamb 14 or as in the alternative embodiment as shown in this same Figure 2 in the oven wall 10, the intumescent material either 110 or 112, as the case may be, will fill these gouges, cracks, or other irregularities both upon application and subsequent thereto, during expansion in the heating process and form an extremely efficient seal even under these adverse conditions where the primary seal, the S

shaped seal 16 is not operative satisfactorily.

Figure 3 is similar to Figure 1, in that it shows a prior art Wilputte door instead of a Koppers door. Moreover, it has a similar jamb 214 with a diaphragm seal 216 which makes contact with the jamb 214. The Wilputte door has a plug 218 similar to the Koppers door of Figure 1.

Figure 4 shows the placement of an intumescent material 310 with the diaphragm seal 216 and the jamb 214 as shown in Figure 3.

Also in Figure 4 an alternative embodiment of the Wilputte door according to the present invention is shown, that is, between the oven wall 10 and the plug 218 another body of intumescent material 312 is placed for the sealing of the opening there between.

The intumescent material may be a pulverant cellulatable glass such as ground glass with a high carbon content mixed with silicate and a clay. The clay is preferably ball clay or china clay which are used because of their fine texture.

Another formulation of intumescent material which has been shown to be satisfactory is liquid sodium silicate having a viscosity of 400 centipoise when blended. The liquid sodium silicate is preferably applied directly to the horizontal surfaces with a pressurized spray gun which produces a fine

atomized discharge, such as a portable pressurized sprayer. The material sprayed on the horizontal surfaces may also be sprayed with a pressurized spray gun which produces a finely atomized discharge and is permitted to coat these surfaces to a thickness of about ten-thousandths of an inch in one pass or, yet more preferably, in two passes to a thickness of twenty-thousandths of an inch. It has been shown that there is little or no running of the material when applied in this manner. The sodium silicate adheres to the oven and will produce a seal upon the application of heat to the intumescent material which has the property in its present form of enlarging or expanding upon being heated thereby making a good seal. On vertical surfaces the liquid sodium silicate is preferably blended to a viscosity of approximately 950 centipoise or combined with granular sodium silicate to achieve higher viscosities and thixatropic behaviour and applied to a heated surface at or above 100 degrees C. In certain applications other materials may be added to the liquid sodium silicate such that it will more readily adhere to vertical surfaces and inhibit the tendency to run thereon.

The applicant has found that a viscosity of between 400 to 950 centipoise is adequate for the applications that he has investigated. However, even lower viscosities may be adequate and can be determined by experimentation. The applicant also believes that mixtures having viscosity which decrease as the shear rate increases will reduce the

tendency of the sealer to run off the surface after it has been applied thereto. Other methods of applying the liquid sodium silicate or other materials having intumescent substances may be by the formation of a gasket, the application of the mixture with a brush or any other applicable method, even aerosol sprays may be useful under certain sets of circumstances and conditions. The applicant has additionally found that mixture may be applied to the goose neck portion of a coke oven to effectively seal it as well as a door.

CLAIMS:

1. A heated chamber having at least one opening; closure means for closing said at least one opening, said closure means having at least a closed and open position; said closure means and said opening having surfaces disposed for coming into proximity of one another in said closed position, said surfaces forming a primary sealing means for said heated chamber in said closed position, there being a substance applied to at least one of said proximate surfaces, said substance having a property of expanding upon the application of heat thereby forming a secondary sealing means between said proximate surfaces in said closed position.

2. A heated chamber according to claim 1, wherein said substance comprises an intumescent mixture.

3. A heated chamber according to claim 1, wherein said intumescent mixture comprises sodium silicate and glass.

4. A heated chamber according to claim 1, 2 or 3, wherein said primary sealing means has voids therein permitting gases to leak therethrough, the substance forming the secondary sealing means having properties of adhering to at least one surface of said at least one opening or said closure means, said secondary sealing means being disposed in relationship with said primary sealing means such that

upon application of heat, said secondary sealing means expands and at least partially fills a portion of said voids in said primary sealing means whereby sealing of said heated chamber is enhanced.

5. A heated chamber according to claim 4, wherein said primary sealing means includes an S shaped seal.

6. A heated chamber according to claim 4 or 5, wherein said heated chamber comprises a coke oven.

7. A heated chamber according to claim 4 or 5, wherein said heated chamber comprises a coke oven with at least one Koppers or Wilputte door.

8. A method of sealing a heated chamber having at least one opening with closure means therefor, comprising the steps of: applying a substance, which expands upon heating, to at least one surface between said at least one opening and said closure means.

9. The method of claim 8, wherein said applying is accomplished by spraying or trowelling the substance onto said at least one surface.

10. The method of claim 8 or 9, wherein said substance is applied as a mixture comprised of sodium silicate and glass at approximately 400 centipoise.

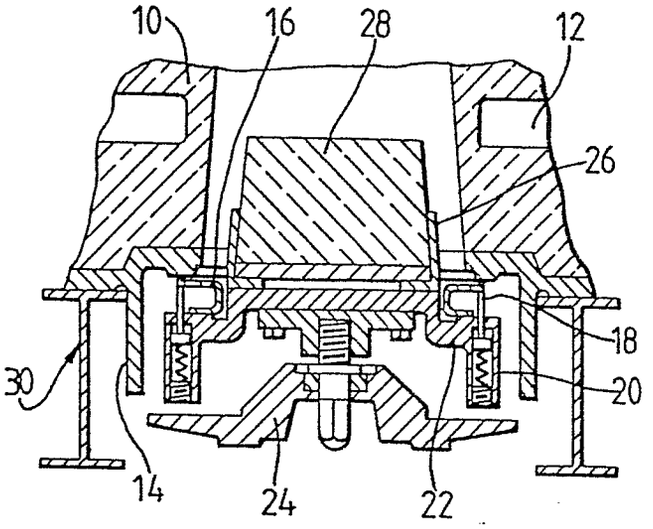

Fig. 1

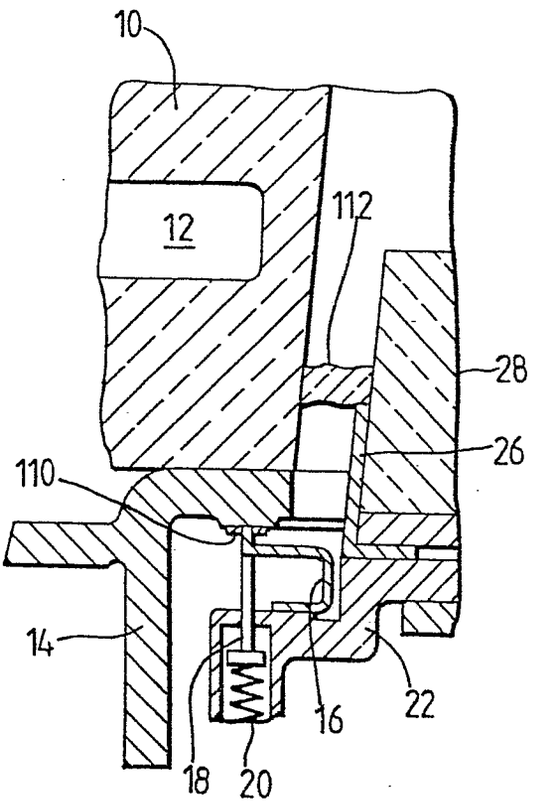

Fig. 2

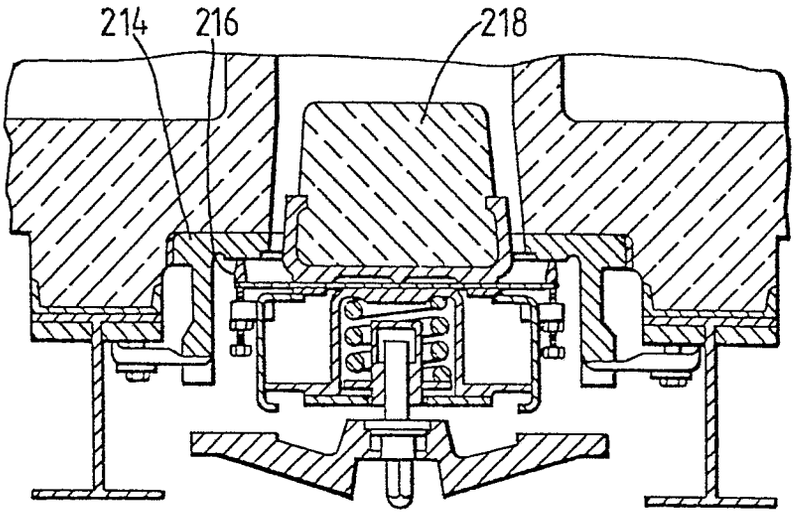

Fig. 3

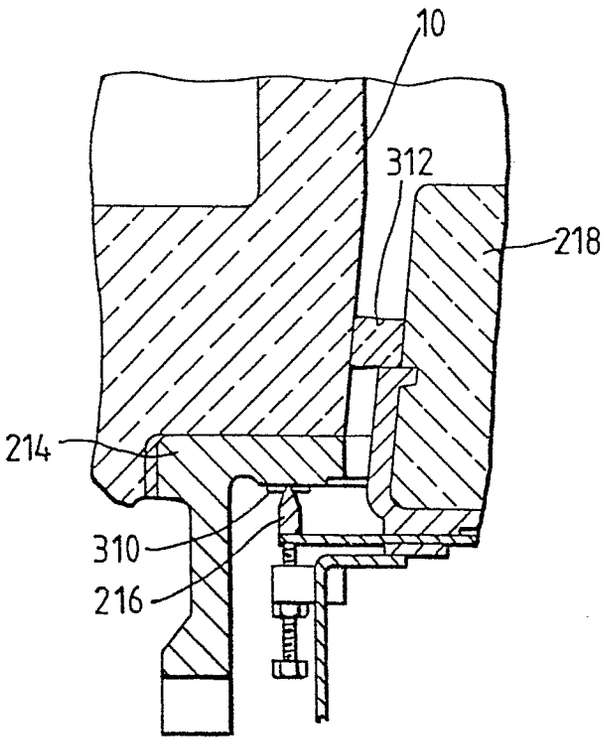

Fig. 4

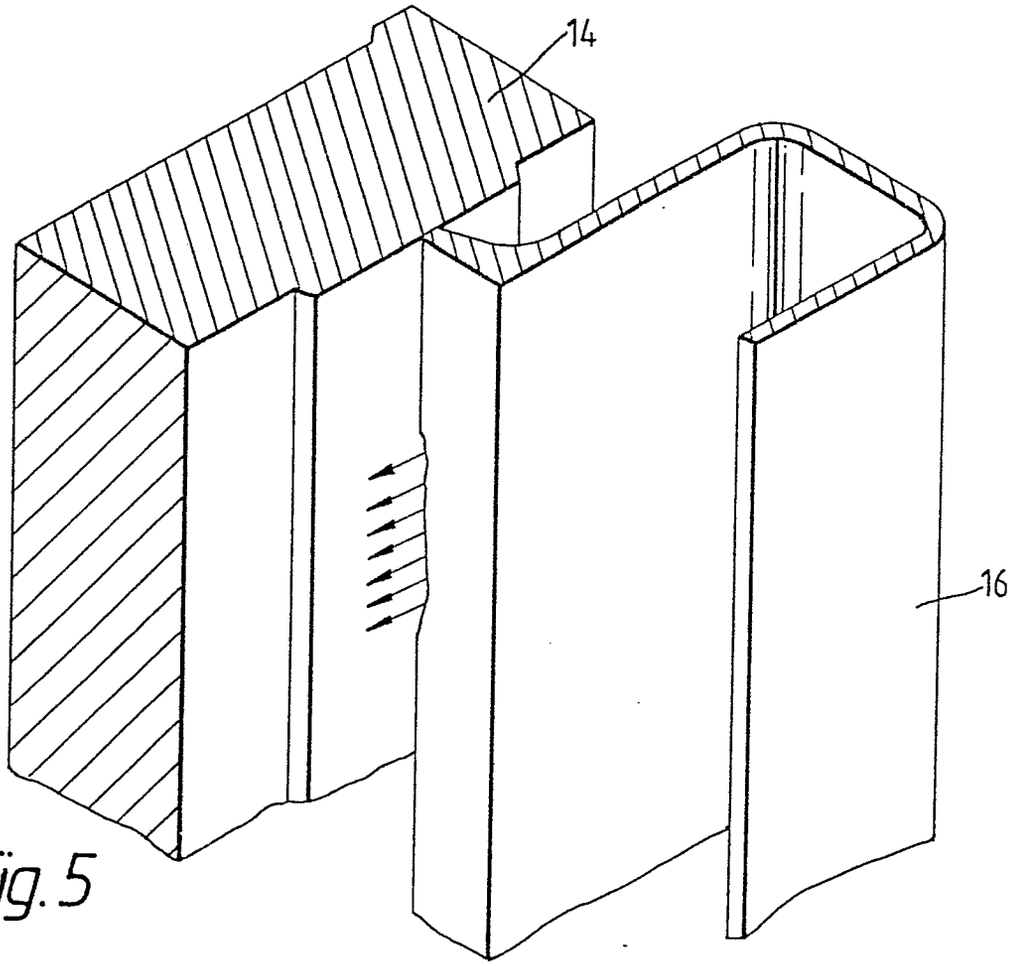

Fig. 5

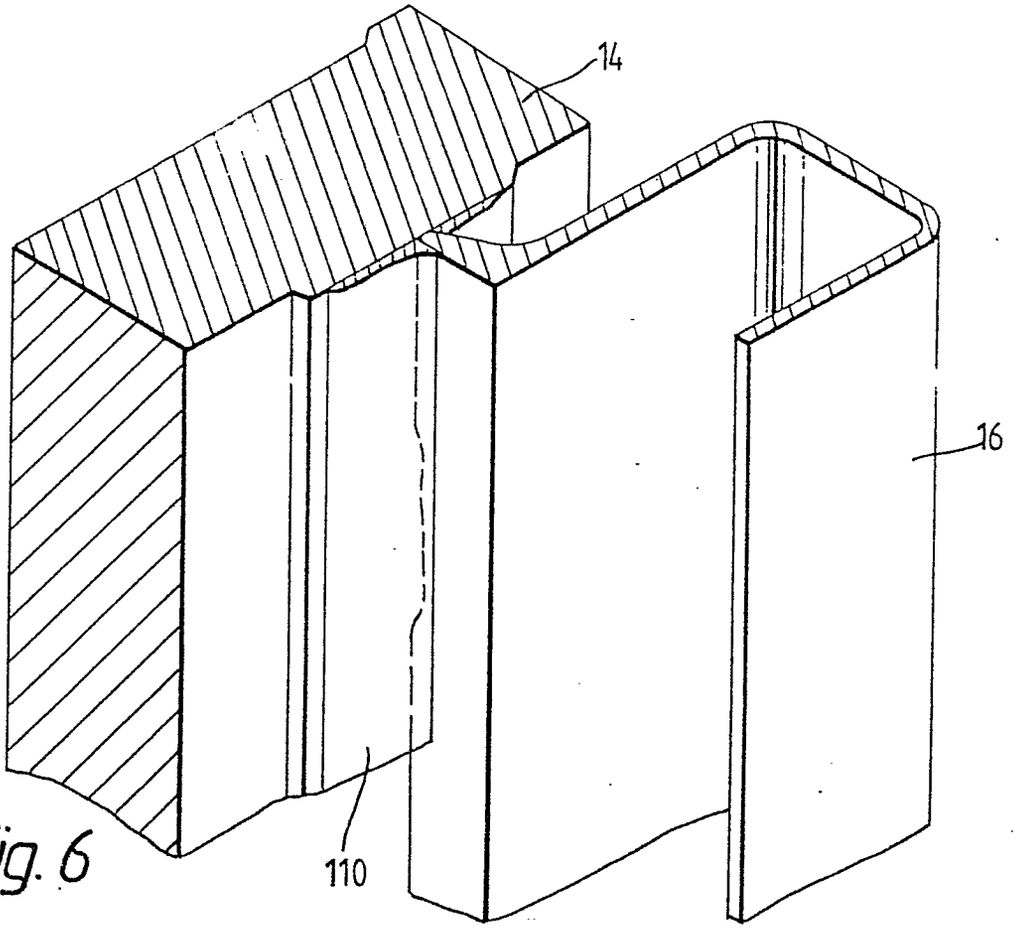

Fig. 6

European Patent Office

EUROPEAN SEARCH REPORT

Application number EP 80 30 0975

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
	US - A - 4 111 709 (PRICE et al) * Claim 1 *	1,2,4-9
AD	US - A - 3 875 018 (CALDERON) * Claim 1; figure 2 *	1,5-9
A	US - A - 2 040 887 (VAN ACKEREN) * Claim 1; figure 1 *	1,5-9
AD	US - A - 2 279 791 (LAMB) * Claim 1 *	1-3, 8-10
AD	US - A - 3 814 613 (HUBBLE et al) * Claim 1 *	1,3,10

CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)

C 10 B 25/16
F 27 D 1/18

TECHNICAL FIELDS SEARCHED (Int.Cl. 3)

C 10 B 25/16
25/06
F 27 D 1/18

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	02-07-1980	MEERTENS