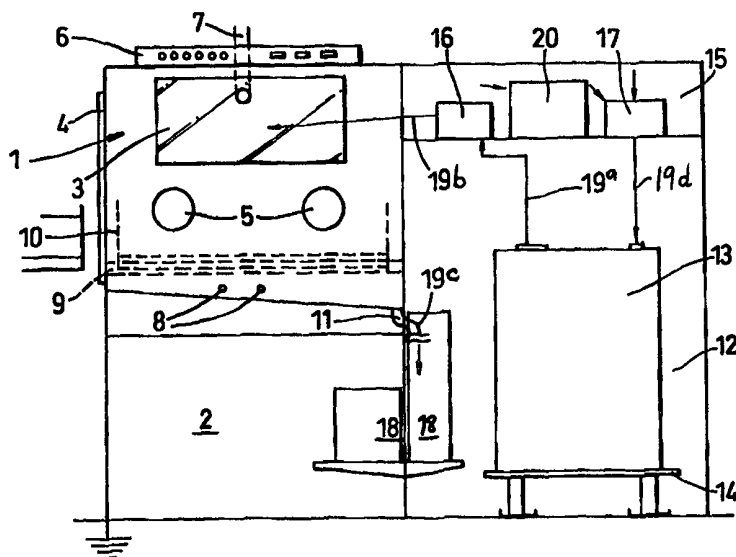




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(21) International Application Number: PCT/EP99/03035 (22) International Filing Date: 29 April 1999 (29.04.99) (30) Priority Data: 9809090.5 29 April 1998 (29.04.98) GB (71) Applicant (for all designated States except US): NASH INVESTMENTS LIMITED [IE/IE]; 4 Kent Terrace, Dalkey, County Dublin (IE). (72) Inventor; and (75) Inventor/Applicant (for US only): LENGLEN, Jean-Luc [FR/FR]; 81, rue du Bocage, F-59710 Merignies (FR). (74) Agents: BARKER, Rosemary, Anne et al.; Urquhart Dykes & Lord, Northern Assurance Buildings, 3rd floor, Albert Square, Manchester M2 4DN (GB).		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>

(54) Title: METHOD OF AND APPARATUS FOR CLEANING OBJECTS MANUALLY BY USE OF SOLVENTS

**(57) Abstract**

One or more objects (not shown) to be cleaned are placed in a cleaning chamber (1), which has two sealed sleeves (5) onto which gloves (not shown) are fitted, and the chamber (1) is hermetically sealed. The atmosphere within the chamber (1) is made inert, e.g. by removal of air via pipe (7) and supply of nitrogen via one inlet (8). A solvent, at a temperature below its flashpoint is supplied to the chamber (1), e.g. from reservoir (13). The object or objects are then cleaned. The solvent may be sprayed onto them. A brush may be used. Afterwards, solvent is drained from the interior of the chamber (1). Compressed air is supplied to reverse the inert state of the atmosphere therein and dry the cleaned object or objects and the interior of the chamber. Residual solvent vapours may be removed via a refrigeration unit (18) and returned to the reservoir.

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METHOD OF AND APPARATUS FOR CLEANING OBJECTS MANUALLY BY USE OF SOLVENTS

This invention concerns a method of and apparatus for cleaning objects manually by use of solvents.

In this specification the term "cleaning" means all operations carried out on objects, such as industrial component parts, to remove impurities, dirt or foreign bodies from their surface. For example, such a cleaning operation may involve degreasing new parts after being manufactured or worn parts for maintenance purposes.

Most industrial solvents, such as trichloroethylene, benzene, hydrocarbons, alcohols, cyclic fluorocarbons, require special handling and containment measures owing to their flammability or the danger they present to health, hygiene and the environment.

When solvents are used for manual cleaning operations, for example in factories, garages, or other work places using fountains, sprays, brushes or cleaning pads, the users' hands frequently have to be immersed in the solvent (albeit using protective gloves) and there is a risk of splashing and inhalation of vapours.

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An object of the present invention is to provide a method and apparatus for putting the method into effect whereby these problems and dangers are obviated.

In accordance with a first aspect, the invention proposes a method of cleaning objects manually comprising the following steps:

- (a) placing one or more objects in a cleaning chamber which has two sealed sleeves onto which gloves are fitted, and sealingly closing the chamber in working position;
- (b) making the atmosphere within the chamber inert;
- (c) supplying a solvent, at a temperature below its flashpoint, to the chamber;
- (d) submitting the object or objects to a cleaning process;
- (e) draining used solvent from the interior of the chamber;
- (f) supplying compressed air to the chamber to reverse the inert state of the atmosphere therein and dry the cleaned object or objects and the interior of the chamber;

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- (g) extracting residual solvent vapours; and
- (h) removing the object or objects from the cleaning chamber.

Thus the cleaning procedure is carried out in a hermetically sealed environment, but manually by means of the two sleeves and gloves.

The cleaning process may involve spraying solvent onto the object or objects, or brushing the object or objects with solvent, or dipping the object or objects into solvent.

By making the atmosphere inert, any flammability risk is obviated. This is preferably accomplished by pumping air out of the cleaning chamber and introducing nitrogen, which is inert. However, any other inert gas or mixture of gases may be used in place of nitrogen. Alternatively, the air may simply be evacuated and not replaced so that the procedure is carried out in a partial or substantial vacuum.

There may be two refrigeration steps. The first refrigeration step consists, through the intermediary of a refrigeration unit, in bringing the solvent to a temperature below its flashpoint. This must be undertaken before any cleaning operation is started. The second refrigeration step, which is optional, follows drainage. This enables all residual vapours of solvent to be removed from the nitrogen before the latter is sent back out into

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the atmosphere.

In accordance with a second aspect, the invention also proposes corresponding apparatus for cleaning objects manually by use of solvent comprising:

- (a) a cleaning chamber having two sealed sleeves onto which gloves are fitted, which chamber is adapted to receive the object or objects to be cleaned and has sealingly securable closure means;
- (b) means for making the atmosphere within the chamber inert;
- (c) a container for holding solvent at a temperature below its flash point;
- (d) means for supplying solvent from the container to the object or objects within the cleaning chamber;
- (e) means for draining used solvent from the cleaning chamber to the container of solvent; and
- (f) means for supplying compressed air to the interior of the cleaning chamber.

The method and apparatus of the invention will be explained further, by way of example, with reference to the accompanying

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drawings, in which:

Figure 1 is a diagrammatic front view of an exemplary embodiment of the apparatus of the invention;

Figure 2 is a side view of the same apparatus; and

Figure 3 is a plan view of the same apparatus.

As illustrated, a practical embodiment of the apparatus of the invention comprises a cleaning chamber (1) preferably made of non-corrodible material mounted upon a technical compartment (2). The chamber (1) has a sloping window (3) so that a user can observe the cleaning process. The chamber has a door (4) which allows access to the chamber and enables a user to put objects to be cleaned inside. When closed, the door (4) is sealed around its edges so that the interior of the chamber (1) is hermetically sealed off from the outside atmosphere. Below the window (3), there are two sleeves (5) projecting into the chamber (1), to which gloves (not shown) are attached.

Above the cleaning chamber (1), there is a control panel (6).

Behind the cleaning chamber (1), there is a pipe (7) enabling evacuation of air and nitrogen, as well as solvent vapours in the case where there is no system to liquify and recuperate the solvent vapours. Also at the back of the cleaning chamber (1), there are delivery ducts (8) for air and for nitrogen,

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respectively.

Rails (9) are mounted in the interior, at the front and the back of the cleaning chamber (1). The rails (9) enable a sliding platform or tray (10), which may be of mesh, to be slid in and out of the cleaning chamber (1) when the door (4) is open. The sliding platform (10) holds the object or objects to be cleaned (not shown).

Next to the cleaning chamber (1) and the technical compartment (2), there is a housing (12) that contains a tank or reservoir (13) which is mounted on a transport trolley (14) enabling the tank or reservoir to be moved in and out of the housing (12).

Above this housing (12), there is a second smaller housing (15) which contains a pump (16) for supply of solvent to the cleaning chamber (1) and an extraction pump (17) for the removal of the solvent and its return to the tank or reservoir (13).

The technical compartment (2) and the housing (12) also contain refrigeration units (18) and associated pipework, the unit (18) in compartment (2) being a compressor, while that in the housing (12) is an evaporator.

The cleaning chamber (1), the technical compartment (2), the pumps (16) and (17) and the tank of solvent (13) are connected by means of pipes (19) permitting the supply of solvent to the cleaning chamber (1) from the tank of solvent (13) but also

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permitting return or drainage of the used solvent from the cleaning chamber (1) to the tank of solvent (13).

Thus in use of the apparatus, the pump (16) removes solvent from the tank (13) by way of pipe (19a) and supplies solvent to the chamber (1) via pipe (19b). The extraction pump (17) removes solvent from the chamber (1), first via a drain (11), at the bottom, which may simply be a plugable aperture, and then via pipe (19c), although the connection of the latter back to the pump (17) is not shown in the drawings.

The pump (17) returns solvent to the tank (13) via pipe (19d).

Use of the apparatus may be entirely automated, and there may be several different options for cleaning.

Firstly, an object to be cleaned is placed on the sliding platform (10). The sliding platform is pushed in to the chamber (1). The door (4) is sealed until the end of the cleaning programme. A cleaning programme is then selected on the control panel (6) above the chamber (1). Air is extracted from the interior of the chamber (1) via pipe (7) and nitrogen is supplied via one of the ducts (8). Thus, solvent is supplied to the chamber (1).

When cleaning is finished the solvent is allowed to drain back into the tank (13) and the chamber is then sealed off by an electrically controlled valve.

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Nitrogen is removed and replaced by compressed air, entering at (8) causing the reverse in the inert state of the chamber (1) and the drying of the cleaned objects and the interior of the chamber. In this respect both the nitrogen and the residual solvent vapours are sucked into a cryogenic refrigeration unit (20) to remove impurities and pollutants. Only after this has been done can the door (4) be opened. In some cases, both the nitrogen and the residual vapours may be directly extracted by the extraction duct (7) equipped with an extraction system.

If desired, the nitrogen, when initially supplied, can be led into the solvent in the cleaning chamber (1) so as to assist in the cleaning process by bringing about a mechanical/mixing effect. In this respect, the chamber (10) may be partially filled with solvent so that the object, upon the sliding platform (10), is submerged, or so that it can be dipped into the solvent by the operative by the use of the gloves.

Alternatively, the solvent may be directed into the cleaning chamber (10) by way of a brush (not shown) or by way of a spray head or nozzle (not shown), so that it can be directed more precisely onto the object being cleaned by the user who may manipulate the brush or the object by having his/her hands in the gloves (not shown).

Naturally, various safety, checking and control components are also present.

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The invention is not limited to the precise details of the apparatus or method just described. In particular, the design of the casing which defines the cleaning chamber (1) may vary from that in the illustrated example. The window to the chamber need not be sloping, and may serve also as a door to the chamber. There may be a door on each side of the casing, if desired. The housing (12) for the solvent tank (13) may be behind the chamber (1) and the technical compartment (2). The sliding platform (10) may be round and rotate inside the chamber. Numerous other variations in design detail are possible within the scope of the invention.

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CLAIMS

1. A method of cleaning objects manually comprising the following steps:

- (a) placing one or more objects in a cleaning chamber which has two sealed sleeves onto which gloves are fitted, and sealingly closing the chamber in working position;
- (b) making the atmosphere within the chamber inert;
- (c) supplying a solvent, at a temperature below its flashpoint, to the chamber;
- (d) submitting the object or objects to a cleaning process;
- (e) draining used solvent from the interior of the chamber;
- (f) supplying compressed air to the chamber to reverse the inert state of the atmosphere therein and dry the cleaned object or objects and the interior of the chamber;
- (g) extracting residual solvent vapours; and

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- (h) removing the object or objects from the cleaning chamber.
-
- 2. A method according to claim 1 wherein the cleaning process involves spraying solvent onto the object or objects.
 - 3. A method according to claim 1 or 2 wherein the cleaning process involves brushing the object or objects with solvent.
 - 4. A method according to any of claims 1 to 3 wherein the cleaning process involves dipping the object or objects in solvent.
 - 5. A method according to any of claims 1 to 4 wherein the atmosphere within the cleaning chamber is made inert by removal of air.
 - 6. A method according to claim 5 wherein gaseous nitrogen is supplied to the cleaning chamber as air is removed.
 - 7. A method according to claim 6 wherein the residual solvent vapours and the nitrogen in the cleaning chamber are replaced by the compressed air.
 - 8. A method according to any preceding claim wherein the residual solvent vapours are cooled, and liquified.

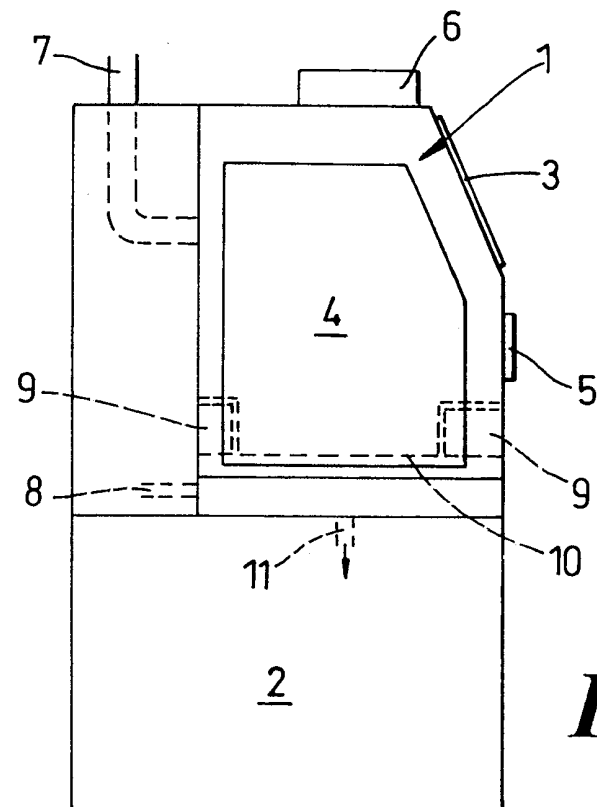
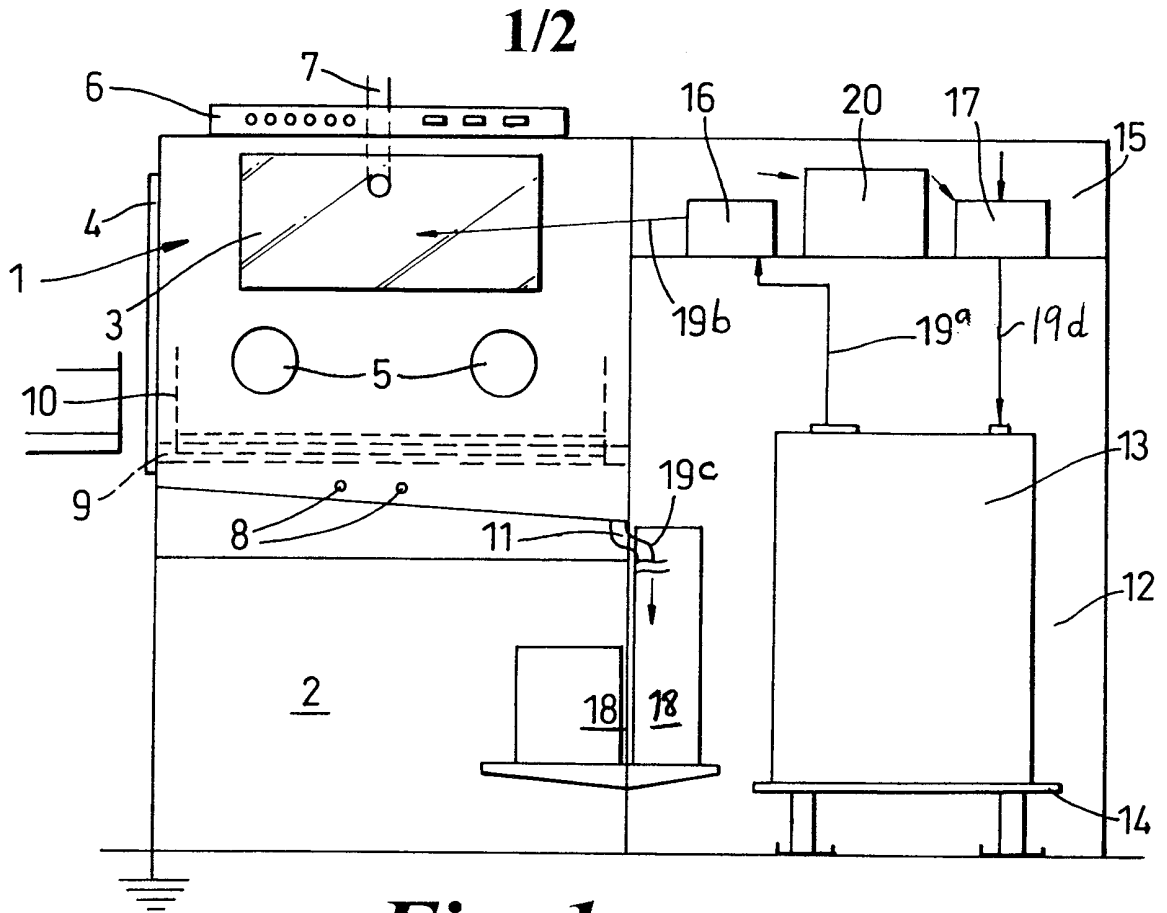
- 12 -

9. A method according to claim 8 wherein the nitrogen is extracted from the cleaning chamber and cooled along with the residual vapours.
10. Apparatus for cleaning objects manually by use of solvent comprising:
 - (a) a cleaning chamber having two sealed sleeves onto which gloves are fitted, which chamber is adapted to receive the object or objects to be cleaned and has sealingly securable closure means;
 - (b) means for making the atmosphere within the chamber inert;
 - (c) a container for holding solvent at a temperature below its flash point;
 - (d) means for supplying solvent from the container to the object or objects within the cleaning chamber;
 - (e) means for draining used solvent from the cleaning chamber to the container of solvent; and
 - (f) means for supplying compressed air to the interior of the cleaning chamber;
11. Apparatus according to claim 10 wherein the means for

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making the atmosphere inert comprises means for removal of air from the cleaning chamber and wherein means for supply of compressed air to the chamber are also provided.

12. Apparatus according to claim 10 wherein the means for making the atmosphere inert comprises means for evacuating air from the interior of the cleaning chamber and means for supplying nitrogen thereto.
13. Apparatus according any of claims 10 to 12 further including cleaning brushes located within the chamber to enable cleaning of the object or objects placed therein.
14. Apparatus according to any of claims 10 to 13 further including a spray nozzle located in the chamber whereby at least some of the solvent is supplied to the chamber.
15. Apparatus according to any of claims 10 to 14 further including a platform or tray within the chamber upon which the object or objects may be placed.
16. Apparatus according to any of claims 10 to 15 further including a refrigeration unit adapted for receiving, cooling and liquifying residual solvent vapours from the cleaning chamber.



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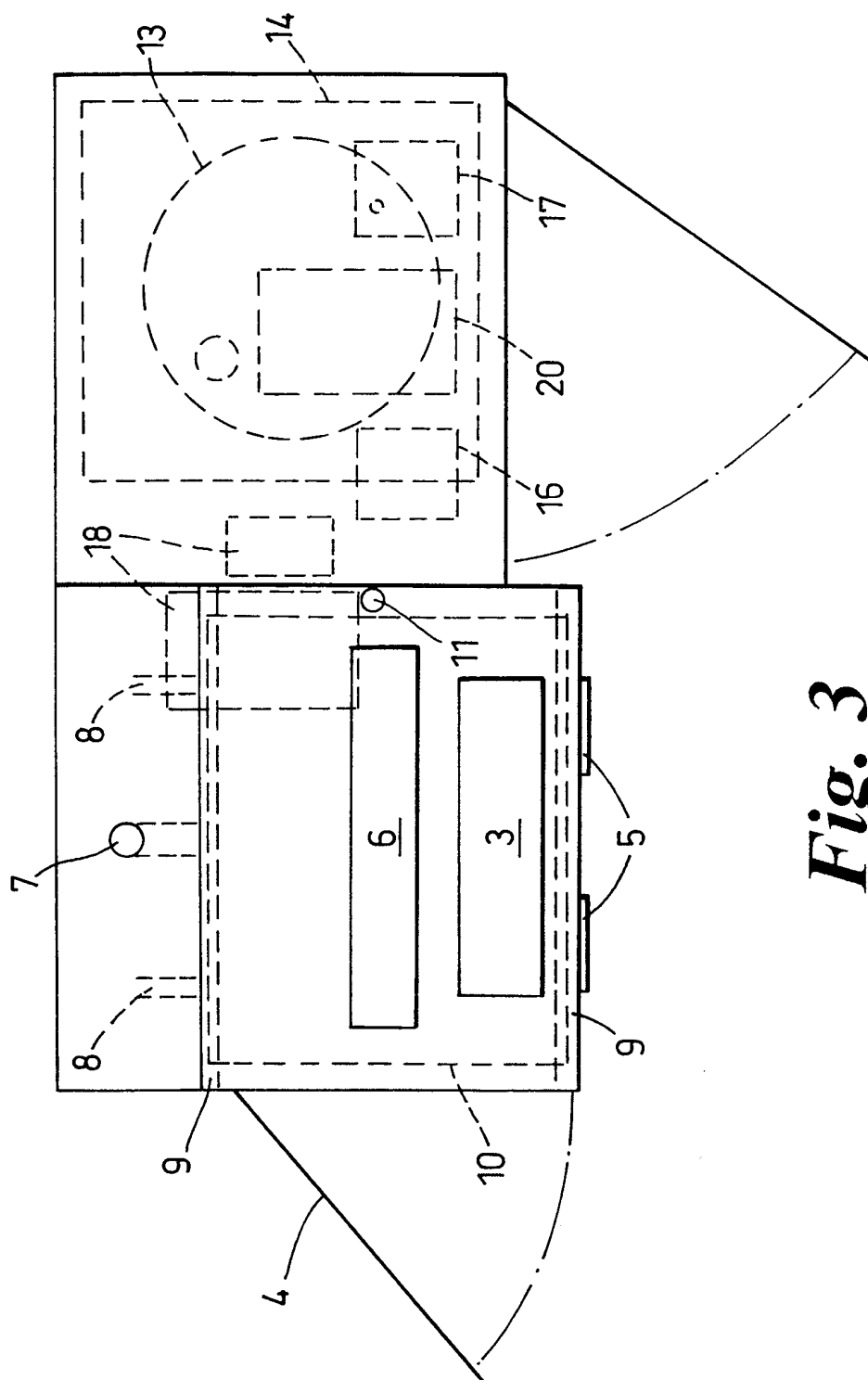


Fig. 3

INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 99/03035

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B08B15/02

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)

IPC 6 B08B B25J

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 practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 273 060 A (HILL) 28 December 1993 (1993-12-28) column 5, line 1 - column 6, line 14 column 6, line 54 - line 59; figures 1-3 ----	1,2, 5-12, 14-16
Y	US 5 027 841 A (BREUNSBACH) 2 July 1991 (1991-07-02) column 3, line 8 - column 4, line 68 figure 2 ----	1,2, 5-12, 14-16
A	US 5 107 876 A (OZYJIVSKY) 28 April 1992 (1992-04-28) figures ----	1,3,10, 13
A	US 5 045 120 A (MITTAG) 3 September 1991 (1991-09-03) ----- -/--	



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Date of the actual completion of the international search

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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A	US 5 205 303 A (GILETA) 27 April 1993 (1993-04-27) -----	

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International Application No

PCT/EP 99/03035

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