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(71) Applicant *(for all designated States except US):* AKTIEBOLAGET SWEDOVO [SE/SE]; Bingbyvägen 3, S-794 33 Orsa (SE).

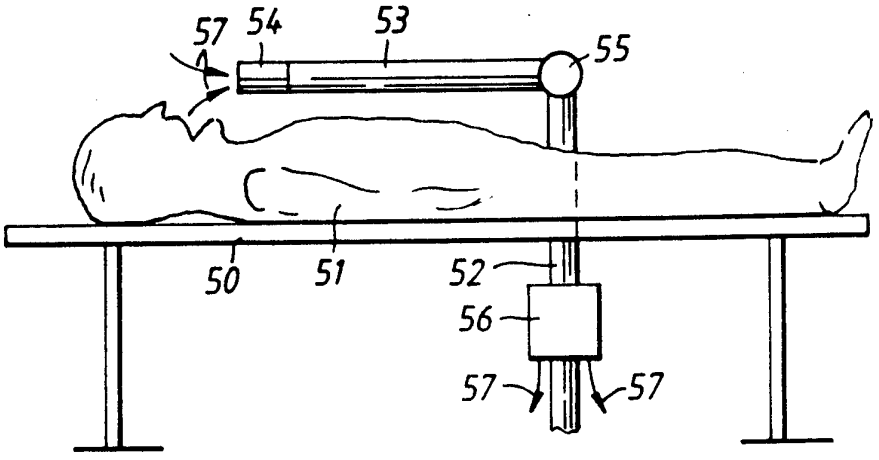
(72) Inventor; and
(75) Inventor/Applicant *(for US only) :* AGDUR, Bertil [SE/SE]; Bingbyvägen 3, S-794 33 Orsa (SE).

(74) Agents: NILSSON, Karl et al.; Stenhagen Patentbyrå AB, P.O. Box 17709, S-118 93 Stockholm (SE).

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(57) Abstract

An arrangement for cleansing air of its mercury vapour content includes a filter (14) having a very large surface against which mercury vapour molecules can impinge during their passage through the filter. The filter surface includes one or more precious metals, for instance platinum or gold, which are highly resistant to oxidation and to formation of other chemical compounds, such as sulfides. The arrangement may be included in dental drilling equipment, with the exit side of the filter (14) connected to a suction pump (15) typically found in dental drilling equipment, or may be included in a face mask (20) which is intented to be worn over the nose and mouth of the dentist when performing dental work, the mask being constructed so that air inhaled by the dentist is caused to pass through the filter (24). Alternatively, the arrangement may be included in air-purifying apparatus intended for a dental clinic and provided with one or more filters (34) through which air contaminated with mercury vapour and taken from one or more treatment rooms in the clinic is cleansed. The invention also relates to a method of cleansing mercury-vapour contaminated air at approximately room temperature with the aid of the air-purifying arrangement, and also to the use of the purifying arrangement at approximately room temperature for cleansing air from its mercury vapour content.

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AN ARRANGEMENT FOR REMOVING MERCURY VAPOUR FROM AIR.

The present invention relates to an arrangement for cleansing air of its mercury vapour content in accordance with the preamble of Claim 1. The invention also relates to a method according to the preamble of Claim 7 and to the use of the arrangement according to the preamble of Claim 8.

There is a great general need to cleanse contaminated air of its contaminant content in different localities and also in outdoor environment. In the case of the car industry, this need has forced the development of engine exhaust purifying techniques by means of which much cleaner engine exhaust gases are obtained. These exhaust gas purifiers extract gases other than mercury fumes and are not normally effective until temperatures in excess of 250°C are reached.

Methods for cleansing air of its mercury vapour content are known to the art. According to one known method, air that contains mercury vapour is passed through a container which includes a seleniferous material in the form of small "stones". This container is both large and expensive to provide.

According to another known method, mercury-containing air is passed through a honeycomb system of very thin, folded or pleated gold sheets.

As far as is known, these methods have not been used in practice in conjunction with dental work, which constitutes an important application of the present invention. This is probably because of the very high costs entailed.

In dental treatment, a tubular suction device is often used to remove the debris and particles formed when drilling an amalgam filling, and also the water which is used to cool the drill and which collects when drilling. There are indications which show increasingly that amalgam fillings and the treatment of such fillings can have a serious toxic effect on human beings and result, among other things, in headaches, giddiness and extreme tiredness. Consequently, the desire to extract effectively mercury vapours and amalgam dust by means of suction has grown progressively in recent times.

Although advances have been made with regard to sucking away mercury fumes and amalgam dust during dental treatment, significant quantities of mercury vapour still escape into the surroundings of the dental room or surgery when treating amalgam fillings. Another source of mercury vapour in a dental surgery resides in the amalgam dust and the amalgam particles that are liable to collect in the surgery/dental clinic in conjunction with dental treatment. There is therefore a need to cleanse the air of mercury vapour in dental clinics, in order to protect both personnel and patients from the adverse effect of mercurial contaminants.

It should also be noted that there is a need to extract those mercury vapours that are removed from the oral cavity through the suction tube when treating an amalgam filling. Otherwise, these vapours will pass either into the air in the dental surgery or to some other room in the dental clinic, which is naturally undesirable.

It is known in conjunction with car exhaust purifiers to use a ceramic or metallic body that includes a large number of fine passageways. These passageways are coated with inorganic oxides and precious metals.

As the exhaust gases pass through the body, at a temperature of about 500°C, a reaction takes place which "purifies" the exhaust gases (renders the gases safe). By way of example of catalysts (catalytic bodies) can be mentioned the catalyst designated (code name) Heraeus-Asalmaz and manufactured by Heraeus-Asalmaz-Katalysatorer GmbH in Hanau, Germany. This type of catalyst operates either with platinum, rhodium or palladium, according to the requirements of respective customers.

Another example of metallic catalysts is the catalyst manufactured by Gesellschaft für Emissionstechnologie mbH in Lohmar, Germany.

An inventive arrangement for cleansing air from its mercury vapour content is defined in the characterizing clause of Claim 1 and includes a filter which presents a large surface against which the molecules of the mercury vapours can impinge during their passage through the filter, said surface including one or more precious metals, such as platinum or gold, for instance. The filter includes a known catalyst body which has a large number of passageways and which has been developed to purify vehicle exhaust gases, the catalyst body being intended to operate at normal room temperature and the surface, including said at least one precious metal, is comprised of the combined surfaces of the aforesaid passageways.

Conveniently, only a small quantity of precious metal is used, in the order of some grams on a surface area of about 10,000 m^2. The filter will extract mercury vapour at a temperature as low as 20°C, and even lower. The filter is conveniently comprised of a ceramic or metallic body, through which the air carrying the mercury vapour flows. Thus, the catalyst body may be comprised of a ceramic or a metallic monolith which is coated with a mixture of inorganic oxides, of

which the major part in vehicle exhaust catalysts is comprised of aluminium oxide with additions of cerium oxide, zirconium oxide, lanthanum oxide, iron oxide and other oxides. This coating imparts a very large surface area to the catalyst body, said surface normally being in the order of 10,000-20,000 m^2 per litre monolith. The precious metal coating is in the order of 1.5-2.5 grams per litre monolith, while the coating of inorganic oxides is in the order of 50-200 grams per litre monolith.

An arrangement of the aforedescribed kind is intended for use in conjunction with dental treatment and finds particular utility in such applications.

For instance, the arrangement may be included in dental drilling equipment with the input side of the filter connected, via water/solids separating means, to a suction source for removing solids and vapours from the oral cavity of a patient by suction.

According to another embodiment of the invention, the arrangement is included in a face mask which is intended to be worn over the nose and mouth of the dentist while performing dental treatment, the construction being such as to cause the inhalation air drawn into the mask by the dentist to pass through the filter.

According to still another embodiment of the invention, the arrangement is included in air-purifying apparatus intended for installation in a dental clinic and provided with one or more filters through which air contaminated with mercury vapours is drawn-in from one or more rooms in the clinic and cleansed in said apparatus.

The invention will now be described in more detail with reference to the accompanying schematic drawings, in which

Figure 1 illustrates an arrangement which is intended to be incorporated in dental drilling equipment;

Figure 2 illustrates an arrangement which is intended to be incorporated in a face mask which will fit over the nose and mouth of the dentist;

Figure 3 illustrates an arrangement which is intended to be included in an air-purifying apparatus;

Figure 4 illustrates an arrangement which is intended to be included in an air-purifying apparatus which serves several rooms of a dental clinic; and

Figure 5 illustrates another arrangement for use in dental treatment.

The arrangement illustrated in Figure 1 includes a suction nozzle 10, a long, pliable hose 12, a water, dust and particle separator 13, a mercury vapour extraction filter 14, and a pump 15 for generating the requisite suction power. The pump may be common to a number of treatment rooms, as can also the filter 14. The arrangement is included in dental drilling equipment, with the nozzle 10 held close to the drill head of the dental drill.

The filter 14 measures 10 cm x 10 cm x 20 cm and will therewith take-up the minimum of space in comparison with other filters. The walls of the filter passageways are coated mainly with platinum or gold, among other things. Laboratory tests carried out with an arrangement of the aforedescribed kind have shown very good purifying results, in excess of 95%.

Mercury vapour may possibly escape to the ambient air in dental clinics, even when an arrangement according to Figure 1 is used, because the nozzle 10 fails to capture all of the vapours that are produced, or as a result of preparing amalgam substances for new fillings. According to a further development of the inventive concept, the novel filter arrangement may therefore be incorporated in face masks and air-purifying apparatus, so as to eliminate the risks to which patients, dentists and nurses are subjected by the escape of mercury vapours.

Figure 2 illustrates a conventional face mask 20 which is intended to be worn over the nose and mouth of the dentist while treating a patient. The mask is provided with an inventive filter 24, such that the air drawn into the mask as the dentist inhales is forced to pass through the filter, referenced 24 in Figure 2. The mask is secured around the dentist's head by means of tapes 21-22. The filter 24 is circular and has a diameter of 5-10 cm and a height of 1-2 cm.

In another embodiment of the face mask, the filter is positioned close to the mouth and the mercury-containing air leaving the mouth is sucked through the filter. The mercury vapour is thus sucked-up and the air leaving the filter is practically free of mercury vapour.

Figure 3 illustrates an air-purifying apparatus which is intended to be installed in a room in a dental clinic and includes a dust extraction filter 32, a funnel-shaped air intake 30, an inventive filter 34 and a suction fan 35, all of which are housed in a casing 31. The apparatus measures about 60 x 60 x 30 cm^3.

Figure 4 illustrates an air-purifying apparatus which is intended for larger dental practices comprising

four rooms. Each room is provided with an air intake 401, 402, 403, 404 and the intakes are connected to an inventive filter 44 whose output side is connected to a suction fan 45. Clean-air conduits (broken lines) extend from the output side of the fan to blower devices 481, 482, 483, 484 in respective rooms.

Figure 5 illustrates a patient 51 lying on a treatment table 50. The Figure also illustrates an air-purifying apparatus which comprises two tubular parts 52, 53, of which one part 52 is rotatable about a vertical axis. One end of the tubular part 53 is connected to the upper end of the tubular part 52 and the other end of the tubular part 53 carries a filter unit 54. The part 53 is connected to the part 52 by means of a hinge 55 which enables the part 53 to pivot about a generally horizontal axis. The filter unit 54 can thus be placed readily in any desired position close to the mouth of the patient 51. Located adjacent the bottom end of the tubular part 52 is a fan 56 whose suction side communicates with the interior of the tubular part 52. The fan 56 generates a subpressure in the tubular parts 52 and 53, so that air and mercury vapour will flow from the region above the patient's mouth into and through the filter unit 54 (as shown by the arrow 57), and the air cleansed of mercury vapours will pass through the tubular parts 52, 53 to the fan 56, and through the fan outlet and back into the room, in accordance with the arrows 58.

The mercury-vapour extraction filters 14, 24, 34, 44, 54 described in the aforegoing may include a ceramic body through which a large number of passageways are drawn. The channel walls are coated with inorganic oxides, including precious metals such as mainly platinum, for instance, so as to obtain a structure which presents a very large surface area through which the molecules of the mercury vapour pass and strike against the walls of the passageways, wherewith a

physical surface tension (in the case of a platinum-containing coating) or a chemical reaction (amalgamation in the case of gold coating) will be generated and the molecules will fasten to the channel walls.

The invention can be constructed and applied in a number of ways different to those described above with reference to Figures 1-5. A number of examples in this regard will be described briefly below.

For instance, instead of giving the air-purifier the form of an apparatus which is preferably placed on the floor or on a table in a clinic, as in the case of the Figure 3 embodiment, the air-purifier may be constructed so as to enable it to be hung from the ceiling and to blow the purified air that has passed through the filter over that area of the clinic in which the patient's head and the dentist are located during treatment. In this case, the air can be introduced into the filter through a funnel which is turned so that its opening faces the ceiling and to blow the air from the apparatus through a funnel whose opening faces the dental treatment area. The filter may also be constructed in a manner which will enable it to form part of a clinic ventilating and air-purifying system. The inventive arrangement for cleansing air from mercury vapours also finds use within other industrial applications, for instance when sorting or working with Hg-containing products, for instance batteries, thermometers, fluorescent tubes, etc.

It will be evident from the aforegoing that the catalyst body included in an inventive arrangement may have a surface which has been coated with precious metals, for instance platinum and rhodium, in accordance with the case of vehicle exhaust catalysts, although the catalyst body may also have a surface which has been coated solely with one precious metal, for instance gold.

The invention also relates to a novel method of purifying air which contains mercury vapours by passing the air at a temperature which is at least roughly equal to room temperature through a purifying arrangement in the kind described above and defined in the Claims. Finally, the invention also relates to the use of such an air-purifying arrangement at room temperature or roughly at room temperature, for cleansing air of its mercury vapour content.

Claims

1. An arrangement for cleansing air of its mercury vapour content, comprising a filter having a large surface against which the molecules of the mercury vapour can strike during their passage through tne filter, said surface containing a precious metal, c h a r a c t e r i z e d in that the filter includes a known catalyst body developed for the purification of vehicle exhaust gases and comprising a large number of passageways, where in the catalyst body is intended to work at normal room temperature and wherein the surface containing said precious metal is comprised of the combined surfaces of all said passageways.

2. An arrangement according to Claim 1, c h a r a c t e r i z e d in that the channel walls of the catalyst body are coated with a coating substance conventional in vehicle exhaust catalysts containing platinum and a further precious metal, preferably rhodium, in the approximate weight ratio of 5:1.

3. An arrangement according to Claim 1, c h a r a c t e r i z e d in that the passageways of the catalyst body are coated with gold.

4. An arrangement according to any one of Claims 1-3, c h a r a c t e r i z e d in that the arrangement is included in dental drilling equipment with the input side of the filter (14) connected to a suction source (10) for removal of particles, dust and vapour from the oral cavity of a patient, via apparatus for removing water, dust and particles, and in that the output side of the filter is connected to the suction pump conventionally included in dental equipment.

5. An arrangement according to any one of Claims 1-3, c h a r a c t e r i z e d in that the arrangement is included in a face mask (20) which is intended to be

worn over the nose and mouth of the dentist while performing treatment on the teeth of a patient, and in that the mask is constructed so as to cause the air inhaled by the dentist to pass through the filter (24).

6. An arrangement according to any one of Claims 1-3, c h a r a c t e r i z e d in that the arrangement is included in air-purifying apparatus intended for use in a dental clinic and is provided with one or more filters (34) into which air contaminated with mercury vapours is drawn from one or more treatment rooms of the dental clinic and cleansed in said filter(s).

7. A method for cleansing air of its mercury vapour content, c h a r a c t e r i z e d by passing air contaminated with mercury vapour through a purifying arrangement according to any one of Claims 1-6 at least roughly at room temperature.

8. The use of a purifying arrangement according to any one of Claims 1-6 for cleansing air of its mercury vapour content at at least roughly room temperature.

Fig. 1



Fig. 2

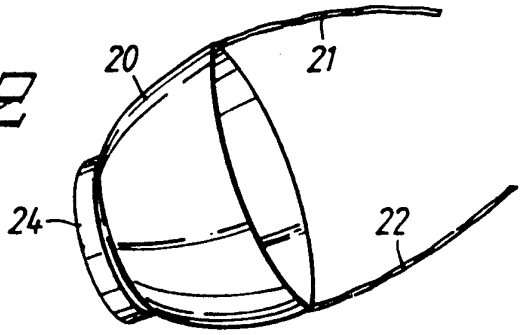


Fig. 3

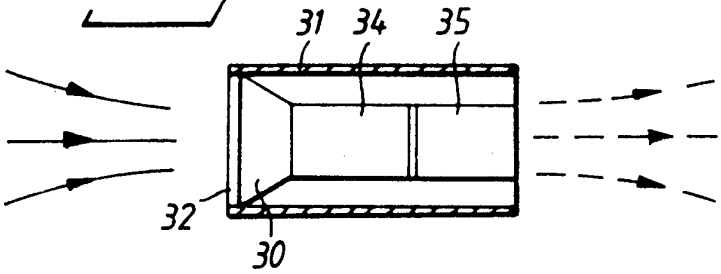


Fig. 4

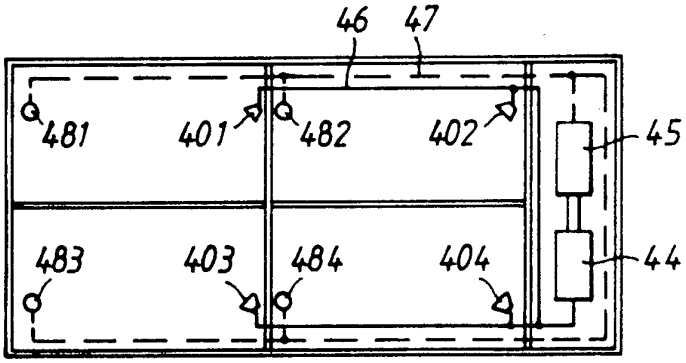
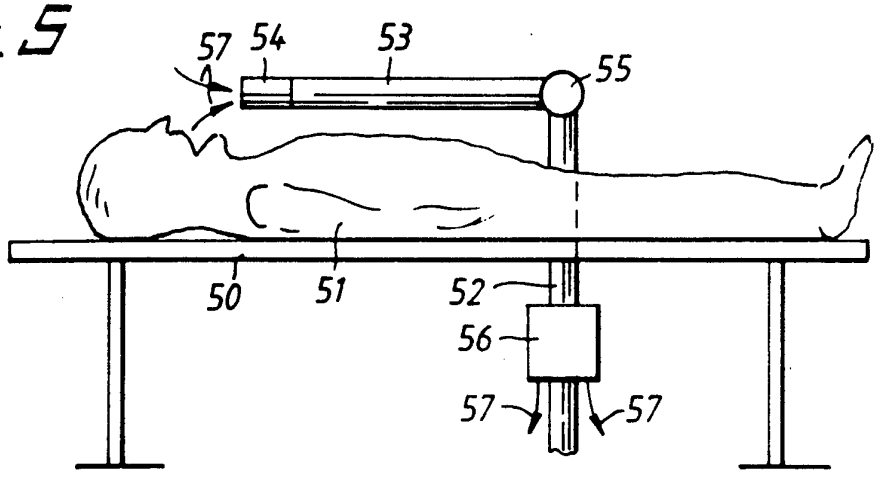


Fig. 5



INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 93/00570

A. CLASSIFICATION OF SUBJECT MATTER

IPC5: B01D 53/02, B01D 53/36, A62B 18/02
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)

IPC5: A62B, A62D, A61M, B01D

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

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, 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.
P,X	WO, A1, 9216284 (STIFTELSEN CENTRUM FÖR DENTALTEKNIK OCH BIOMATERIAL I HUDDINGE), 1 October 1992 (01.10.92), page 3, line 8 - page 5, line 19, figure 1	1
X	DE, A1, 4131811 (WERNISCH, JOHANN), 26 March 1992 (26.03.92), column 1, line 1 - line 29; column 2, line 28 - column 3, line 59	1,3,6-8
A	EP, A1, 0405119 (KRUPP KOPPERS GMBH), 2 January 1991 (02.01.91), abstract	1

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

* Special categories of cited documents:
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6 Sept 1993	20 -09- 1993
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INTERNATIONAL SEARCH REPORT

Information on patent family members

26/08/93

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO-A1- 9216284	01/10/92	AU-A- 1366092	21/10/92
		SE-A- 9100809	19/09/92
DE-A1- 4131811	26/03/92	AT-B- 395381	10/12/92
EP-A1- 0405119	02/01/91	DE-A- 3920702	10/01/91