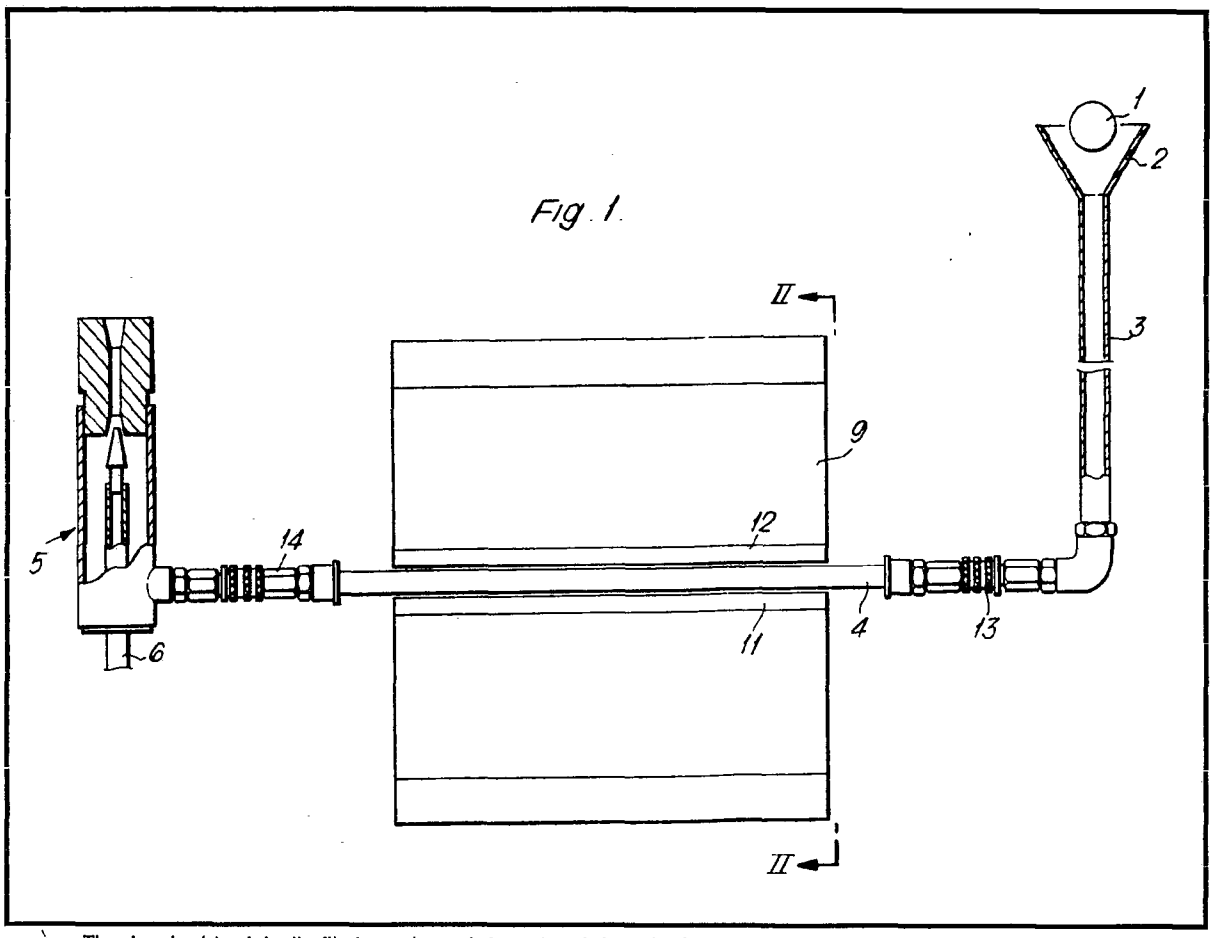
(12) UK Patent Application (19) GB (11) 2 022 465 A

(21) Application No **7911087**
(22) Date of filing
29 Mar 1979
(23) Claims filed
29 Mar 1979
(30) Priority data
(31) **18305/78**
(32) **8 May 1978**
(33) **United Kingdom (GB)**
(43) Application published
19 Dec 1979
(51) **INT CL² B23K 37/00**
B08B 15/00
(52) Domestic classification
B2J 101 304 306 A
F4X A2BX A2E
(56) *Documents cited*
GB 1543890
GB 1542471
GB 1365619
GB 1329907
GB 1045949
GB 971586
GB 920982
GB 764408
GB 751343
GB 442437
(58) Field of search
B2J
B3V
F4X
(71) Applicant
United Kingdom Atomic Energy Authority
11 Charles II Street
London SW1Y 4QP
(72) Inventor
James Douglas Frew
(74) Agents
M A Thacker

(54) Collection of particles

(57) In apparatus and a method for collecting particles formed by vapourisation during a high temperature treatment of steel (eg cutting or welding) gas is drawn from the area 1 in which the treatment is taking place through a collector 4 in which the particles are separated magnetically. The air may be drawn by an air ejector 5 from a hood 2 around the treatment area.

The invention has particular application where the high temperature treatment is the laser cutting of the stainless steel wrapper around a nuclear fuel sub-assembly.



GB 2 022 465 A

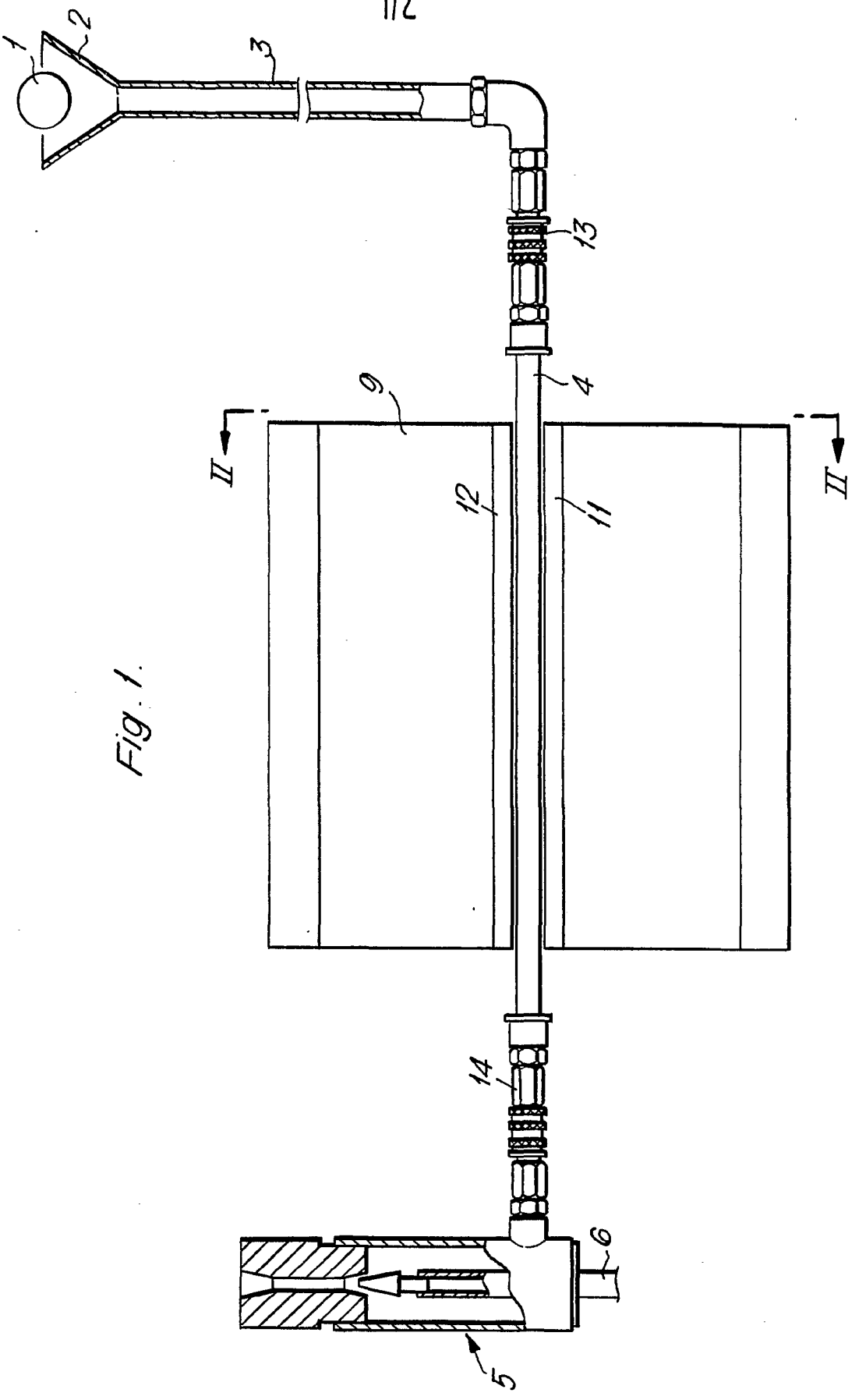
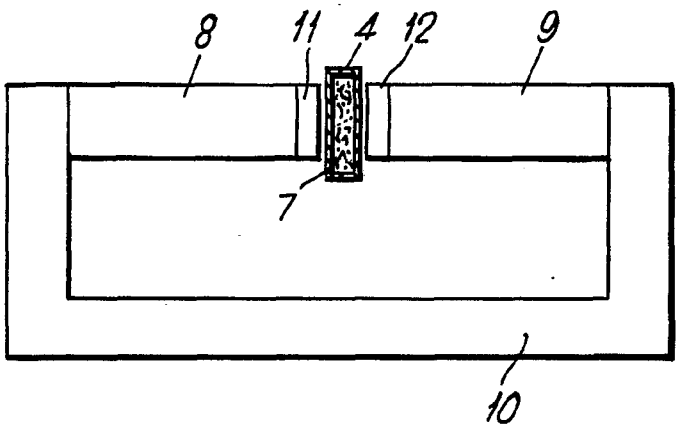


Fig. 1.

Fig. 2.



SPECIFICATION

Collection of particles

This invention relates to a process and apparatus for the collection of particles which are formed by vapourisation during high temperature treatments of steel.

High temperature treatments include cutting and welding operations on steel in which the heat generated causes vapourisation. The vapourised material condenses into particles which contaminate the environment in the working area and should preferably be removed to provide better working conditions for the workers and to protect any other apparatus in the working area which could be deleteriously affected by the particles.

According to a first aspect of the present invention a process for collecting particles formed by vapourisation during a high temperature treatment of steel comprises the steps of drawing gas from an area adjacent the point at which the high temperature treatments is occurring and passing the gas through a collector in which the particles which have been formed by vapourisation are separated from the gas magnetically.

According to a second aspect of the present invention apparatus for collecting particles formed by vapourisation during a high temperature treatment of steel comprises a suction device which draws gas from an area adjacent the point at which the high temperature treatment is occurring and through a collector in which the particles which have been formed by vapourisation are separated from the gas magnetically.

The high temperature treatment may be a cutting or welding operation which is performed by the application of heat such as laser cutting or oxy-acetylene cutting or welding.

The suction device may be any suitable device which is capable of drawing sufficient gas from the area adjacent the point at which the high temperature treatment is occurring to entrain any particles formed by vapourisation during the high temperature treatment and pass them to the collector. One suitable device is an air ejector.

The collector in which the particles are separated from the gas magnetically may comprise a vessel held between the poles of a magnet and containing a packing of magnetic material on which the particles are retained. The magnet may be an electromagnet or a permanent magnet. It has been found that the iron content of the steel is converted to magnetic Fe_3O_4 on vapourisation.

An example of a cutting operation in which particles are produced by vapourisation is the laser cutting of stainless steels such as the cutting of the stainless steel wrapper which surrounds the nuclear fuel pins in a nuclear fuel sub-assembly for use in a nuclear reactor. As a first stage in the reprocessing of nuclear fuel which has been irradiated in a nuclear reactor the wrapper has to be removed and it has been proposed to perform this task using a laser cutting technique. In the treatment of irradiated nuclear fuel all operations have to be performed remotely in closed cells which are fitted with filters to prevent the release of radioactive particles into the environment. Such filters would rapidly become blocked with vapourised steel if the steel was not separated from the gas in the cave. The invention will be illustrated by the following description of apparatus for removing vapourised steel from the atmosphere inside a cell in which the stainless steel wrappers of nuclear fuel sub-assemblies are cut by laser techniques. The description is given by way of example only and has reference to the accompanying drawings in which:

Figure 1 is a plane view of the apparatus and

Figure 2 is a cross-sectional view taken along the line II–II in Fig. 1.

Referring first to Fig. 1 there is shown schematically an area 1 in which the laser cutting occurs. The area 1 is surrounded by a hood 2 also shown schematically which is connected by tubing 3 to a collector tube 4 and an air ejector 5. As air passes into the ejector 5 through an inlet tube 6 it entrains air from the collector tube 4 and thus sets up a flow of air from the hood 2 to the ejector. This air flow entrains any air borne particles formed by vapourisation during the laser cutting and draws them through the tubing 3 into the collector tube 4. The collector tube 4 is rectangular in cross-section and is filled with a packing 7 of magnetic material for example iron wool or wire. The collector tube 4 is supported between two blocks 8, 9 of permanent magnet material which are supported in a soft iron yoke 10. The blocks 8, 9 are faced with soft iron pole pieces 11, 12 which are adjacent opposite sides of the collector tube 4. The particles entrained in the air flow through the collector tube 4 collect on the packing 7 and are retained inside the collector tube.

For use in laser cutting techniques on nuclear fuel sub-assemblies the hood 2, collector tube 4, magnetic blocks 8, 9 are located inside a closed cell which operates at a pressure slightly below atmospheric. Filters are provided at the exit of the cell to remove any particles from the atmosphere and thus prevent the release of radioactive particles into the environment. These filters would become blocked more rapidly and therefore need changing more frequently if the particles produced by the laser cutting were not removed. Frequent filter changing is undesirable as it involves a larger potential radiation dose to the operators who have to change the filters

and results in a larger volume of radioactively contaminated waste which has to be stored. The air ejector feeds air into the cell and the amount of air added in this way should be kept to a minimum so as to reduce the size of the ventilation system required to preserve the subatmospheric pressure in the cell. An air ejector is the preferred suction device for use in a cell because it requires little maintenance and has no moving parts.

The collector tube 4 is removable so that it can be replaced by a similar tube when necessary. As any changing of the collector tube 4 has to be performed remotely the tube is fitted at its ends with commercially-available quick release couplings 13, 14.

The above embodiment is given by way of example only and the air ejector may be replaced by other suction devices if they are suitable for the particular application. Also the permanent magnets may be replaced by electromagnets. The process and apparatus of the present invention have applicability in industries other than the nuclear industry for example they would be applicable to collect particles formed by vapourisation during welding operations in the shipbuilding and other engineering industries.

CLAIMS

1. A process for collecting particles formed by vapourisation during a high temperature treatment of steel comprises the steps of drawing gas from an area adjacent the point at which the high temperature treatment is occurring and passing the gas through a collector in which the particles which have been formed by vapourisation are separated from the gas magnetically.

2. A process as claimed in claim 1 wherein the high temperature treatment is an oxyacelytene cutting or welding operation.

3. A process as claimed in claim 1 wherein the high temperature treatment is a laser cutting operation.

4. A process as claimed in claim 3 wherein the laser cutting operation is performed on a stainless steel wrapper surrounding nuclear fuel pins in a nuclear fuel sub-assembly.

5. Apparatus for collecting particles formed by vapourisation during a high temperature treatment of steel comprises a suction device which draws gas from an area adjacent the point at which the high temperature treatment is occurring and through a collector in which the particles which have been formed by vapourisation are separated from the gas magnetically.

6. Apparatus as claimed in claim 5 wherein the suction device is an air ejector.

7. Apparatus as claimed in claim 6 wherein the air ejector draws air from a hood around area in which the high temperature treatment of steel is occurring and then through the collector.

8. Apparatus as claimed in any one of claims 5 to 7 in which the collector is a tube which is packed with iron wool or wire and which is located between the poles of a magnet.

9. A process for collecting particles formed during a high temperature treatment of steel substantially as hereinbefore described with reference to the accompanying drawings.

10. Apparatus for collecting particles formed during a high temperature treatment of steel substantially as hereinbefore described with reference to the accompanying drawings.

Printed for Her Majesty's Stationery Office
by Burgess & Son (Abingdon) Ltd.—1979.
Published at The Patent Office, 25 Southampton Buildings,
London, WC2A 1AY, from which copies may be obtained.