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(54) Vacuum cleaning equipment for ceramic firing tunnel furnace carts

(57) The vacuum cleaning equipment for ceramic firing tunnel furnace carts (8) is comprised of several vacuum units (1) and filtering units (2), an intake conduit (3), an aspirating nozzle (4) and a trolley (5). The conduit (3), nozzle (4) and trolley (5) are supported by a stationary gantry (6) above the path of the carts (8). The vacuum units (1) and filtering units (2) are in a fixed position with respect to the gantry (6). The filtering units (2) consist of a vertical cyclone (15) surrounded by filter bags (16); the intake conduit (3) consists of a duct (26) in the shape of an upside down "U" in which the open side (27) is covered with a flat strip (28) which can be rolled up over a rotating drum (33). The length of the intake conduit (3) is determined by the position of the trolley (5) as it moves back and forth throughout the process of cleaning the surface (7) of the cart.

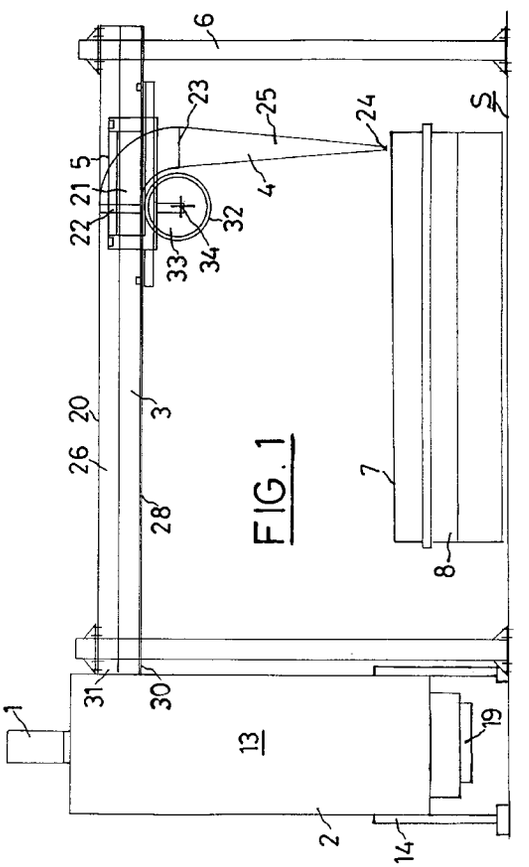

FIG. 1

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Description

This invention refers to vacuum cleaning equipment for the carts used in ceramic firing tunnel furnaces. Specifically, the equipment of the invention is used to clean the cart surfaces which -once the material fired has been unloaded- are left covered with ceramic fragments of different sizes, ash, clay dust, etc.

Said equipment is of the type which consists of at least one aspirating nozzle, one intake conduit, several vacuum units and several filtering units.

Background of the invention

As is well known, the process used to fire ceramic pieces in tunnel furnaces requires that the cart loading surfaces be cleaned once the fired material has been removed, otherwise ceramic debris (generally known as rubble) has a negative effect on the stability of the new cart load and lowers the life of the refractory coating of the carts.

Manual cleaning of the cart surfaces often requires more time than is available for this operation between the unloading and loading of the ceramic material and is costly.

Automatic cleaning of the cart surfaces is done with vacuum cleaning machines and a number of models are available in the market. These machines generally consist of one or more portable aspirating nozzles and a vacuum and filtering unit which is either stationary or mobile with respect to the aspirating nozzle(s).

Machines with a stationary vacuum and filtering unit have a major disadvantage, which is that the connection between the vacuum and filtering unit and the aspirating nozzles is very complex. Furthermore, these machines are quite large.

Machines in which the vacuum and filtering unit is mobile also have a major disadvantage which is that, due to its structure, the vacuum and filtering unit is rather small, thus affecting the vacuum capacity and, consequently, the cleaning of the cart surfaces.

Detailed description of the invention

In order to provide a solution to the aforementioned problems posed by operating automatic machinery to clean the cart surfaces, vacuum cleaning equipment for the ceramic firing tunnel furnace carts has been designed, with a new structure and system of operation.

Essentially, this equipment is characterised in that the aforementioned filtering units are in a stationary but separate position close to the path of the carts, that they are then attached to aspirating nozzles via the intake conduit and that they consist of a vertical cyclone, located above a debris collection chamber which is surrounded by a number of filter bags through which the aspirated air must pass before exiting.

The aforementioned characteristics mean that the equipment of the invention has the advantage that the vacuum and filtering units are located on the floor in a fixed position and can be of considerable size, allowing them to have a high vacuum capacity for a relatively small volume of these units. Intake conduits hung from the ceiling are no longer needed, thus simplifying assembly tasks and reducing their respective costs.

Another characteristic of the equipment of the invention is that the aspirating nozzle is suspended from a trolley which can be moved back and forth over the overhead horizontal rail located in a stationary gantry, under which the carts travel. This aspirating nozzle has a lower tip at the end which is very narrow in comparison to its length and which converges towards the top, through a square conduit of variable size, in an elbow section of 90°, with an upper tip (also square) permanently snugly connected into the intake conduit.

An additional characteristic of the invention is that this intake conduit consists of a square duct with an open bottom and a length practically the same as the aforementioned overhead horizontal rail. Said bottom is covered with a flat strip slightly wider than the duct itself and constructed of material which is noticeably flexible although rigid in the crosswise direction, such as metal sheet, with one end fixed to one end of the duct and the other end rolled up over a rotating drum turning on a shaft perpendicular to the gantry's vertical plane and mounted on the aforementioned trolley which can be moved below the duct, in such a way that the length of the intake conduit varies in accordance with the position of the trolley.

Brief description of the drawings

The attached drawings illustrate a nonrestrictive example of how this invention can be preferably used.

Fig. 1 is a front view of the equipment of the invention;

Fig. 2 shows a side view of the nozzle and the trolley supporting it;

Fig. 3 contains a front schematic representation of the vacuum and filtering units of the equipment;

Fig. 4 is a schematic representation of the aspirating nozzle, intake conduit and filtering units of the equipment of the invention; and

Fig. 5 is a schematic view of the V-V cross section in Fig. 4.

Detailed description of an embodiment

In these drawings, it is possible to see that the vacuum cleaning equipment of the invention for the ceramic firing tunnel furnaces -described as an embodiment example- consists of several vacuum units (1), several fil-

tering units (2), an intake conduit (3), an aspirating nozzle (4) and a trolley (5). The duct (3), aspirating nozzle (4) and trolley (5) are mounted on a stationary gantry (6).

The equipment of the invention is designed to clean the loading surface (7) of carts similar to the one shown (8) in Figs. 1, 2 and 4. Said cart (8) can be moved on wheels (9) over rails (10) anchored to the floor S, crossing through the stationary gantry (6) in the direction of travel indicated by arrow A in Fig. 2.

The vacuum units (1), which consist of an electric motor (11) coupled to a turbine (12), are located on the top of a tank (13) for filtering units (2). The tank (13) is mounted in a high position on brackets (14) and is located rather close to the path of the cart (8).

Inside the tank (13) of the filtering units (2) there is a vertical cyclone (15) placed in a coaxial position and surrounded by a number of filter bags (16) in an essentially vertical position. The vertical cyclone (15) is connected at the top to the intake conduit (3) through the inlet (17) for air containing dust and debris whereas the filter bags (16) empty at the top into some outlets (18) for the filtered air. At the bottom of the tank (13) there is a debris collection chamber (19).

The stationary gantry (6) consists of an overhead horizontal rail (20) on which the intake conduit (3) and the trolley (5) are mounted. The latter can be moved by sliding in either direction along the rail (20). An elbow section (21) is coupled as one unit to the trolley (5). This elbow section has a square cross section and is sized so that its upper tip (22) is snugly connected in the intake conduit (3) whereas its lower tip (23) contains the aspirating nozzle (4).

The lower tip at the end (24) of the aspirating nozzle (4) is very narrow compared to its length and is connected to the lower tip (23) of the elbow section (21) by means of a square duct (25). In the vacuum direction, said section becomes gradually larger until reaching the lower tip (23) of the elbow section (21).

The intake conduit (3) has a generally square cross section. The conduit (3) consists of a duct (26) in the shape of an upside-down "U" open on the bottom (27) and a flat strip (28) made of a flexible material that is rigid in its crosswise direction.

The flat strip (28) is sized in such a way that its width is larger than the width of the open bottom (27) of the duct (26). The flat strip (28) acts as a cover for the bottom (27) as it rests on some lengthwise joints (29) located on the respective side ridges of the open bottom (27).

The duct (26) of the intake conduit (3) stretches over practically the entire length of the overhead horizontal rail (20) of the stationary gantry (6). One of the ends of the flat strip (28), which is the fixed end marked with reference 30, is securely joined to the end (31) of the duct (26), which empties into the inside of the filtering units (2), whereas the other end portion (32) is rolled onto rotating drum (33), fixed securely to the trolley (5) and placed under the duct (26).

The rotational axis (34) of the rotating drum (33) is placed perpendicularly with respect to the vertical plane defined by the stationary gantry (6), i.e., the rotational axis (34) is in a crosswise position relative to the duct (26).

With this position of the duct (26), flat strip (28) and rotating drum (33), the length of the intake conduit (3) is determined by the position of the trolley (5) on the overhead horizontal rail (20) of the stationary gantry (6), i.e., by the length in which the flat strip (28) has unrolled from the rotating drum (33) as it covers the open bottom (27) of the duct (26), as shown in Figs. 4 and 5.

Operation of the equipment of the invention is as follows. Once the loading surface (7) of the cart (8) is properly situated with respect to the aspirating nozzle (4), the vacuum units (1) are started and the trolley (5) begins to move back and forth over the width of said loading surface (7), vacuuming the air (35) loaded with dust and debris from the surface (7) through the lower tip at the end (24) of the aspirating nozzle (4).

As the trolley (5) moves, the flat strip (28) is rolled and unrolled over the rotating drum (33), covering and uncovering, respectively, the open bottom (27) of the duct (26) of the intake conduit (3). The flat strip (28) maintains this open bottom (27) in closed position, thanks to a powerful vacuum exerted on the flat strip (28) in its unrolled position by the depression produced in the intake conduit (3) by the vacuum units (1). When there is no aspiration, the flat strip is held by magnet attraction of its edges to a number of attached magnets on the ridges of the open bottom (27).

The air (35) loaded with dust and debris continues to move through the lower tip (24), square duct (25), elbow section (21) and intake conduit (3) until it enters the filtering units (2).

Conduits carrying the respective nozzles can be connected to an opening (36) located near the inlet (17) of the filtering units (2) for auxiliary cleaning purposes, for example, a flexible hose for manual cleaning.

The air (38) loaded with dust and debris, which may consist of a mixture of air (35) aspirated by the nozzle (24) and air (37) from the opening (36) enters the cyclone (15) where gravity is used to unload a receptacle (39) in the debris collection chamber (19) located at the bottom of the cyclone (15).

The debris-free air (38) is forced later towards a diffusor (40) located on the top of the tank (13). By means of a turbine (12), the air (38) is forced to an area (41) where the filter bags (16) operate in such a way that the dust contained in the air (38) falls, by gravity, into a receptacle (42) and the filtered air (43), which passes through the side wall of the filter bags (16), is expelled into the atmosphere through the outlets (18) located in the top of the tank (13).

The dust collection receptacle (42) is placed in a coaxial position with respect to the debris collection receptacle (39) and conveniently secured to the same.

Having given a sufficiently detailed description of the nature of the invention as well as of the way of putting it

into practice, let it be placed on record that anything that does not alter, change or modify the main principle can be subject to variations in the details of the essential characteristics, and for this reason, an invention patent is requested, as summarised in the following claims.

Claims

1.- Vacuum cleaning equipment for ceramic firing tunnel furnace carts, of the type which includes at least one aspirating nozzle (4), one intake conduit (3); several vacuum units (1); and several filtering units (2), characterised in that the filtering units (2) are located in a fixed position near but not in the direct path of the carts (8), are connected to the aspirating nozzle (4) via the intake conduit (3) and consist of a vertical cyclone (15) located above a debris collection chamber (19) and surrounded by a number of filter bags (16), through which the air (35) which has been aspirated by the nozzle (4) must pass through in order to be expelled into the atmosphere.

2.- The vacuum cleaning equipment for ceramic firing tunnel furnace carts of Claim 1, characterised in that the aspirating nozzle (4) is suspended from a trolley (5) which moves back and forth over the overhead horizontal rail (20) of a stationary gantry (6) above the path of the carts (8), in which said aspirating nozzle (4) consists of a lower tip end (24) which is very narrow in comparison with its length and which converges towards the top, through a square duct (25) of variable size, in an elbow section (21) of 90° and with an upper tip (22), also with a square cross-section, permanently snugly connected to the intake conduit (3).

3.- The vacuum cleaning equipment for ceramic firing tunnel furnace carts of Claims 1 and 2, characterised in that said intake conduit (3) consists of a duct (26) with a square cross-section, with an open bottom (27) and a length practically matching the length of the aforementioned overhead horizontal rail (20), where said bottom (27) is covered by a flat strip (28) with a width somewhat larger than that of the aforementioned duct (26) and made of a material, such as metal sheet, which is somewhat flexible but rigid in the crosswise direction, and which has one of its ends (30) secured to one of the ends (31) of the duct (26), and the other end (32) rolled up over a rotating drum (33) around an axis (34) which is perpendicular to the gantry's vertical plane (6), mounted on the aforementioned trolley (5) below the duct (26), all in such a way that the length of the aforementioned intake conduit (3) varies depending on the position of the trolley (5).

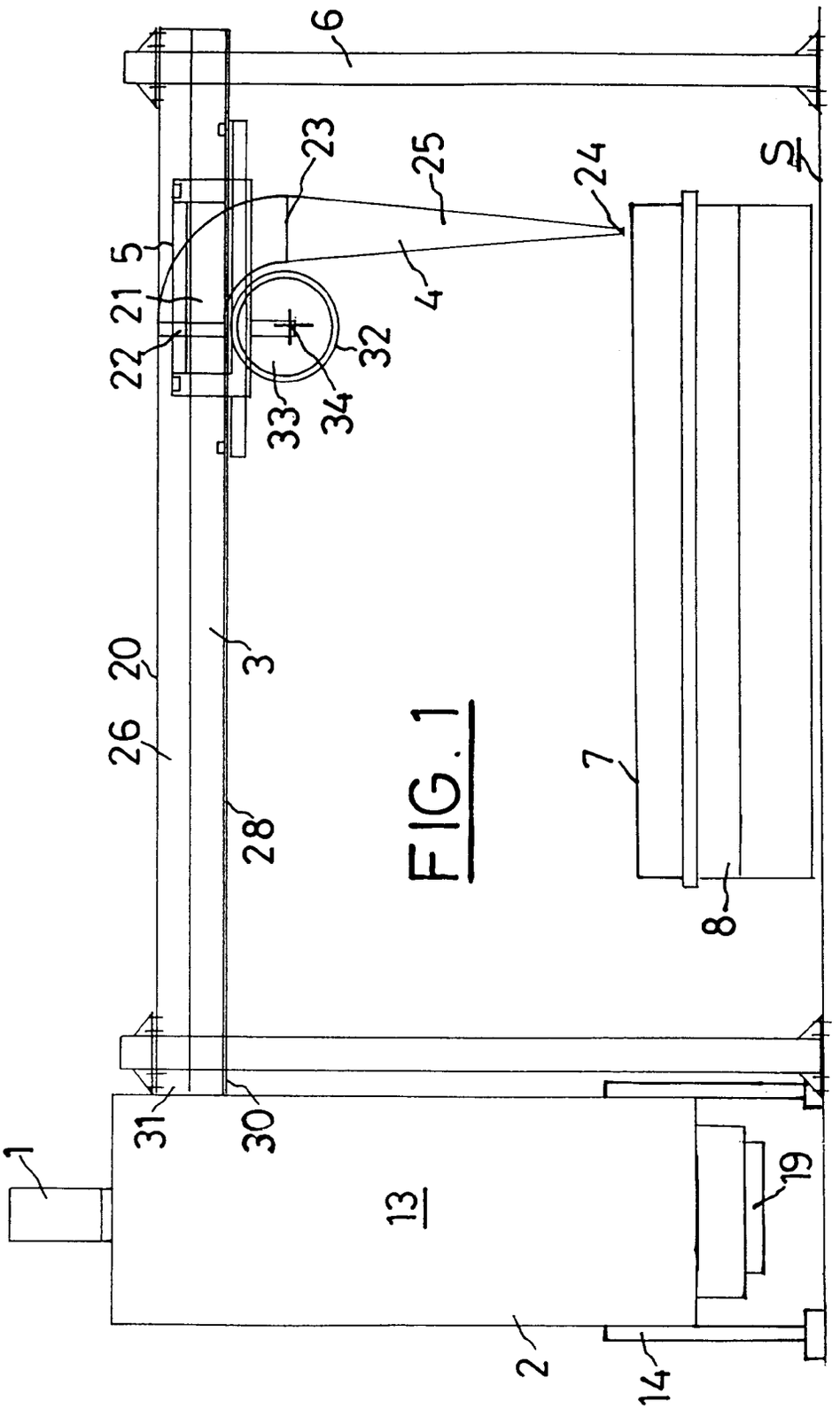

FIG. 1

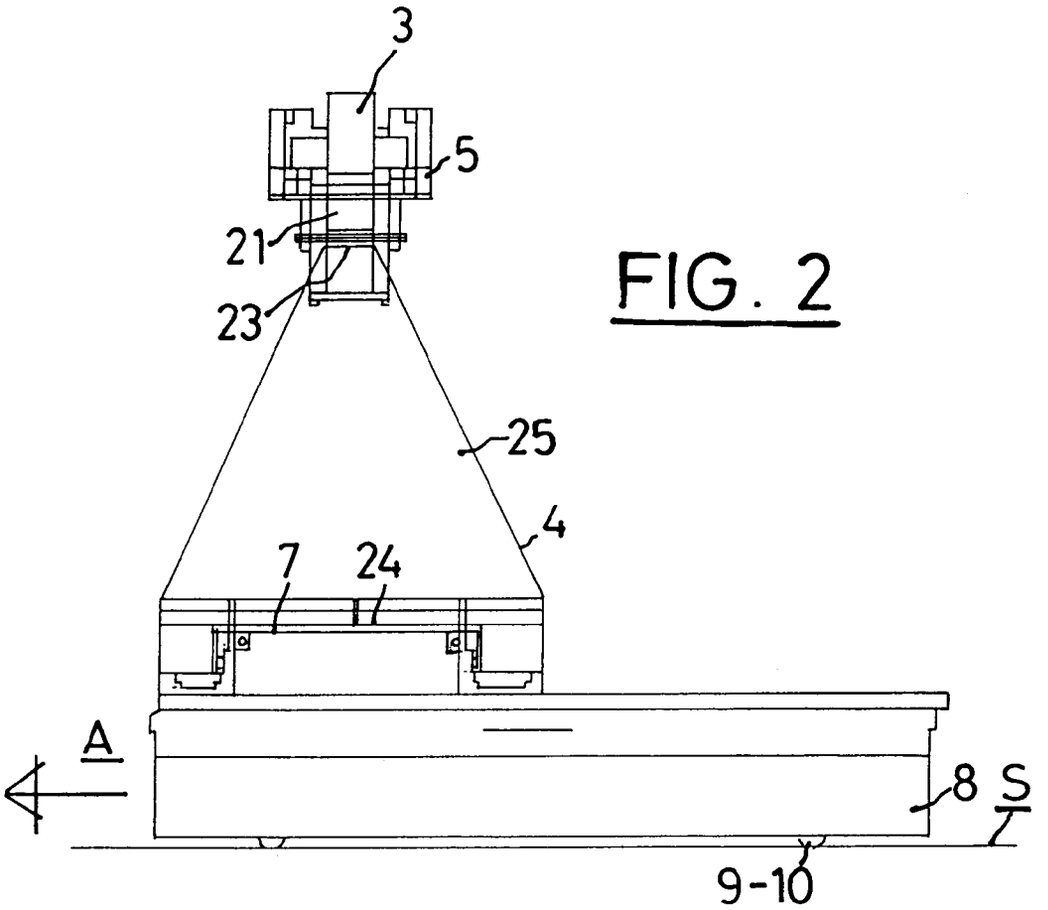

FIG. 2

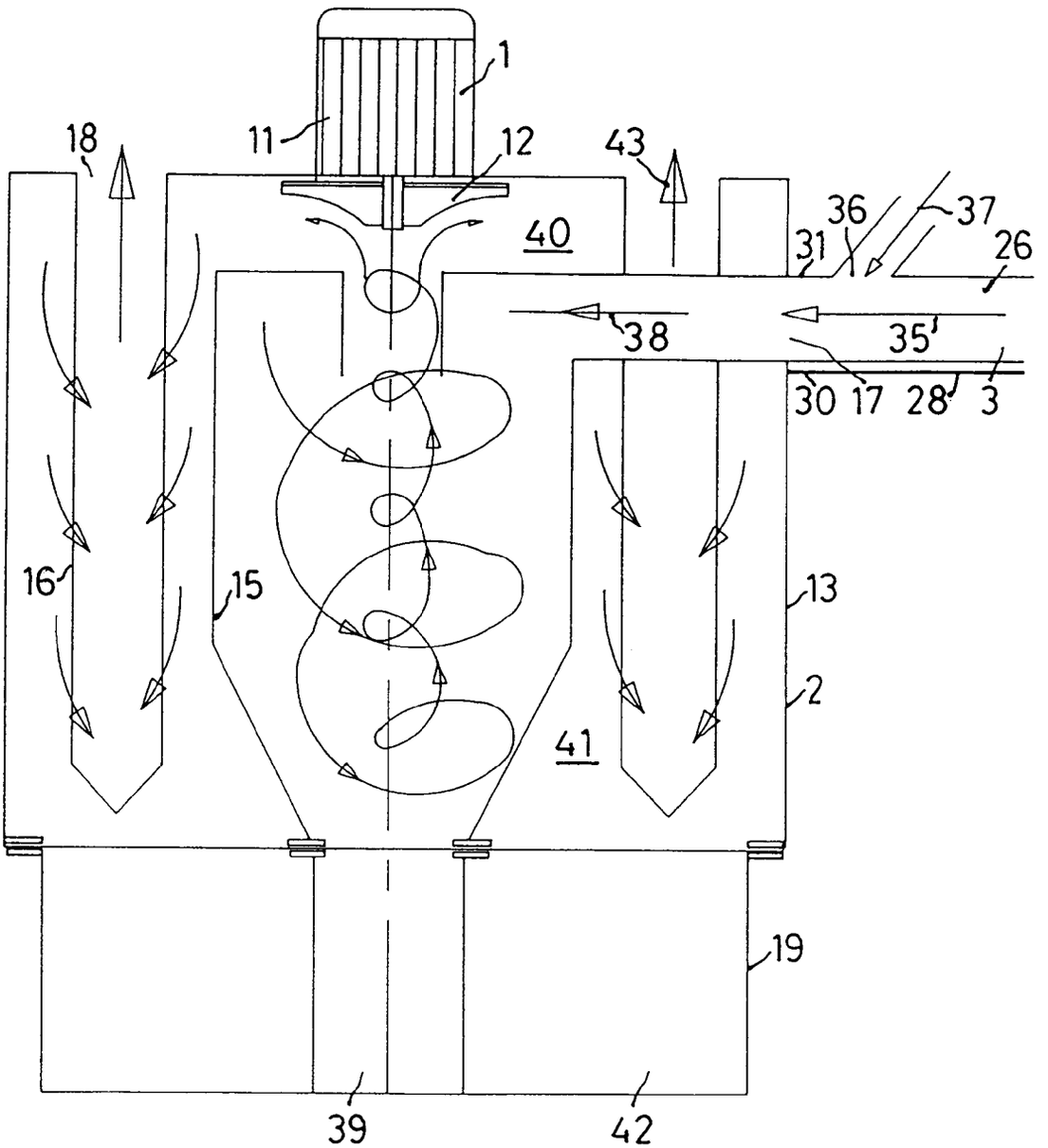

FIG. 3

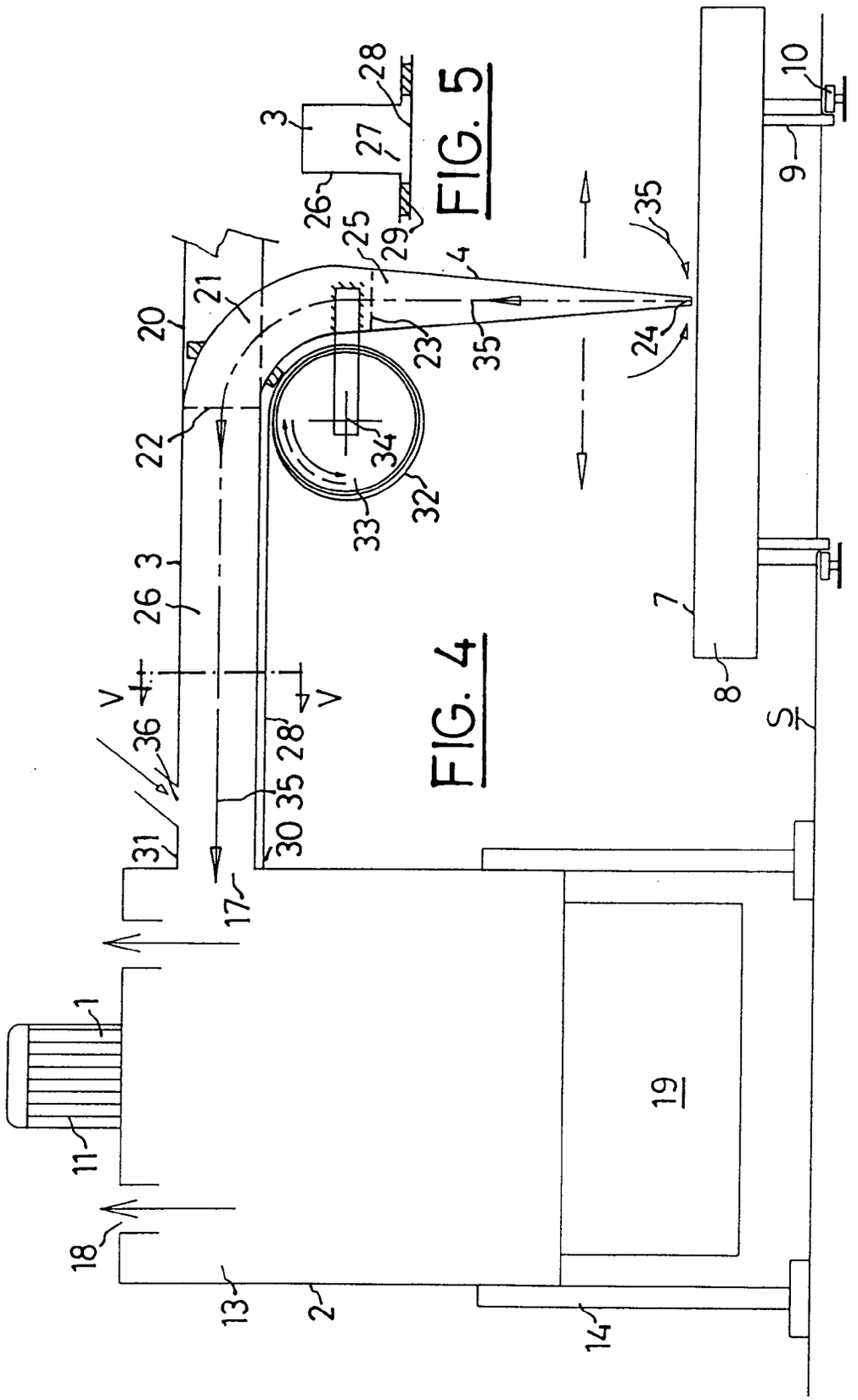
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FIG. 4

FIG. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 95 50 0102

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Y	DE-U-93 02 202 (ZWN ZIEGELWERK NEUNKIRCHEN GMBH) * the whole document *	1,2	B08B15/00 F27D23/02
Y	US-A-3 854 910 (P.A. HAMMERQUIST) * abstract * * column 4, line 55 - column 5, line 20 *	1,2	
A	DE-U-89 01 691 (HARTMANN FÖRDERANLAGEN GMBH) * claim 1; figures 1,2 *	1,2	
A	DE-A-27 18 801 (GFE GESELLSCHAFT FÜR ENTSTAUBUNGSTECHNIK AG) * page 14, line 5 - page 15, line 16 *	1,2	
A	US-A-5 129 922 (D.M. KAISER) * column 3, line 54 - column 4, line 22 *	1,2	
A	US-A-4 802 392 (L. STRIEBIG) * column 2, line 34 - line 68 *	3	TECHNICAL FIELDS SEARCHED (Int.Cl.6)
A	GB-A-1 357 079 (HAWLEY MANUFACTURING CORP.) * page 2, line 18 - line 85 *	3	B08B F27D C10B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	14 November 1995	Lilimpakis, E

CATEGORY OF CITED DOCUMENTS

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