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(54) Solid fuel boiler.

(57) A solid fuel boiler (5) has a heat exchanger (10) above the fuel bed.

The heat exchanger (10) comprises a plurality of vertically disposed tubes (11) whose upper ends debouch into a chamber (14) which is in communication with a flue (12).

Chains (40) hang down from a frame (13) which is located in said chamber (14), each of said chains (40) extending along and through a respective one of said tubes (11).

The frame (13) is supported (a) by flexible means (35) (e.g. chains) attached to the boiler framework (6), and (b) by a coupling device (16,17) which is in turn connected in a gas-tight manner and eccentrically to a motor driven gear train (23, 24, 25, 26, 27).

Rotation of a gear of said train (23, 24, 25, 26, 27) is converted into orbital movement of said frame (13) by said eccentric connection, whereby the chains (40) remove deposits from the inner surfaces of the tubes (11).

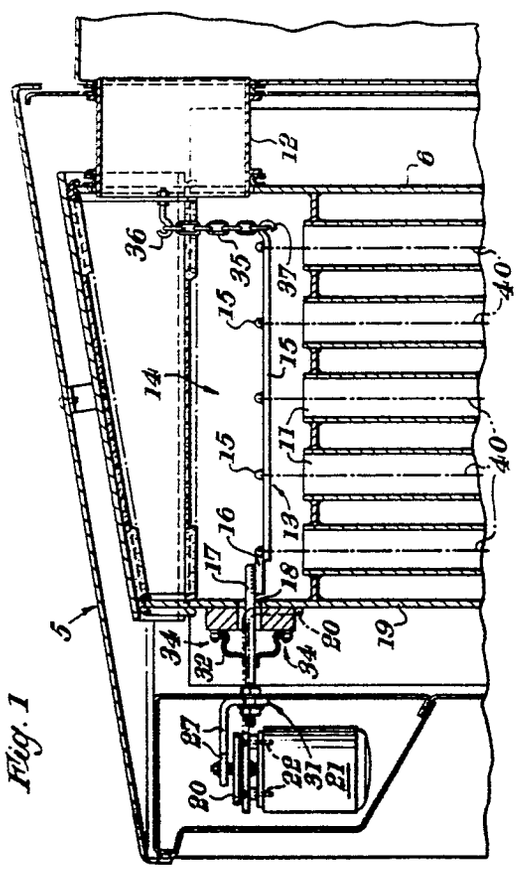

Fig. 1

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SOLID FUEL BOILER

FIELD OF THE INVENTION.

This invention relates to a solid fuel boiler.

BACKGROUND OF THE INVENTION

In boilers using solid fuel, even in a pulverised form, there is inevitably deposition of gas-borne dust and other products of combustion,and cleaning these deposits off the surfaces concerned is a dirty and unpleasant job which ideally should be done daily.

In each of United Kingdom Patent Specification No.2,124,322B and United States Patent Specification No.4,471,725, there is a disclosure of a solid fuel boiler which has a heat exchanger above the fuel bed. The heat exchanger comprises a plurality of vertically disposed tubes within each of which is an elongate means (for example, a chain) which depends from a support member which can be driven, at will, by a motor in order to cause said elongate means to scrape off or dislodge any soot or other powdery deposits from the inner surfaces of the tubes. The support member is mounted on four eccentric cranks, and said support member and its eccentric cranks are located in a chamber into which the upper ends of the tubes open and which is also in communication with the boiler flue. Upon operation of the motor, the support is moved horizontally on its cranks in an orbital path by said motor with consequent dislodgement of all of the fly ash and soot from the tubes by the elongate means. Other features of the solid fuel boiler are disclosed in said Specifications but it is not considered to be necessary to describe all of them in the present Specification.

BRIEF SUMMARY OF THE INVENTION

The solid fuel boiler described and claimed in said Specifications works very well but it is now considered that it will be an advantage to remove all (or a considerable proportion) of the bearing elements, which are associated with the support member, from the area in which they are or are liable to be subjected to high temperatures and/or to foul chemical/abrasive conditions. The principal aim of the present invention is, therefore, to provide a solid fuel boiler which obtains the advantage mentioned in the preceding paragraph and which does so in a simple, effective and cheap manner.

There are also other advantages which are to be obtained, as described later, and all of these advantages are obtained by a solid fuel boiler, comprising:

a boiler framework;

parts of said boiler framework defining a chamber;

vertically disposed tubes mounted in said boiler to act as a heat exchanger, each of said tubes having an inside surface and upper and lower ends;

a frame disposed above the upper ends of said tubes and within said chamber which is in direct communication both with said tubes and with a flue by means of which hot air and combustion products are vented from the boiler;

flexible means connected between said framework and said frame;

chains inside said tubes, each chain consisting of interconnected links and extending lengthways of the respective one of said tubes, and each chain having a first end attached to said frame and hanging downwardly from said frame;

drive means located wholly outside said chamber and connected by a coupling device to said frame and operable to move said frame in an horizontal orbital path such that each chain is caused to move in a corresponding orbital path in order to scrape the whole of the inside surface of the respective tube, said flexible means contributing to the support of said frame and freely permitting the movement of said frame in said horizontal orbital path; and

the connection of said drive means to said frame being effected in a gas-tight manner.

The drive means preferably include a motor drivingly connected to a train of gears of which at least one gear has an eccentric connection to one end of a rod whose other end is fixed to said frame. In a preferred embodiment of a boiler as described in the preceding sentence, said one end of the rod may be fixed to a driving arm which is connected eccentrically to each of two spur gears of said train, said train further including a pinion attached to the driving shaft of said motor and meshing with the teeth of intermediate idler gears each of which is also in mesh with a respective one of said spur gears, whereby the rotation of the spur gears is converted into orbital movement of the rod.

In a boiler as described in either of the two preceding paragraphs, said first ends of said chains may be connected to said frame by swivel devices each of which permits (during operation of said drive means) random rotation of the respective chain within the respective tube relatively to said frame.

A boiler as described in any one of the three preceding paragraphs may include a pot type underfeed stoker, a rotatable conveyor screw driven to feed coal along a tube to a retort surmounted by tuyeres which are connected by way of a plenum chamber to forced-draught means which supply primary air to said retort, and a device by means of which secondary air is directed onto the fuel bed (which is supported by said retort) from above. Said device preferably takes the form of or is included in a so-called reflective arch, at least some of said chains being long enough to make contact with and thus to clean at least the top of the reflective arch.

In a boiler as described in any one of the four preceding paragraphs, the flexible means preferably consist of at least one depending chain whose upper end is connected to said framework and whose lower end is connected to the frame; in a preferred embodiment, two such chains will be provided, these being connected to horizontally spaced points on the framework and to corners of the frame. Alternatively, the flexible means may consist of flexible spring mountings connected between the underside of the frame and the framework; indeed, said mountings could be connected to suitable parts of the heat exchanger between the adjacent open upper ends of the tubes.

BRIEF DESCRIPTION OF THE DRAWINGS

One embodiment of a solid fuel boiler according to the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:-

Figure 1 is a vertical section through a solid fuel boiler according to the present invention, only so much of the upper section of the boiler having been illustrated as is necessary to illustrate the parts concerned; and

Figure 2 illustrates a plan view of said parts of the boiler, certain elements like the outer casing and portions of the framework having been removed or cut away in order to reveal said parts.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Before specifically referring to the accompanying drawings, it is to be understood that the entire contents of United Kingdom Patent Specification No. 2,124,322B and United States Patent Specification No. 4,471,725 are hereby incorporated herein by reference; in this manner, the length of the present description can be kept shorter than would otherwise be the case and many points of detail, which are adequately disclosed in said Specifications, will not be described again in the present description.

Referring to the drawings, there is illustrated a solid fuel boiler 5 which has a multi-component framework of which one component is indicated by the reference numeral 6 in Figure 2. The boiler 5 includes a heat exchanger 10 having vertically arranged tubes 11 through which flue gases (gas-borne dust and other products of combustion) will pass from the fuel bed (not illustrated) to a flue pipe connection 12. There are twenty-five tubes 11 in the particular embodiment illustrated arranged in a block five wide and five deep and a frame indicated generally by the reference numeral 13 is positioned above the upper ends of said tubes within a chamber 14 (Figure 1) which is in communication with all of the tubes 11 and with the flue pipe connection 12. The frame 13 consists of two sets of parallel rods 15 so arranged that the rods of one set cross those of the other set, the rods being welded or otherwise secured to one another at the crossing points. A chain 40 (Figure 1) is suspended from each crossing point of the sets of rods 15, thereby providing twenty-five chains in the illustrated embodiment, and it will be understood from what is disclosed in said Specifications that each crossing point is so placed (relatively to the respective tube 11 beneath the frame 13) that each chain hangs down into a respective one of the tubes 11 and is in contact with the inside surface of said tube over the entire length of said tube.

The chains 40 are illustrated diagrammatically by interrupted lines in Figure 1, it being well understood both from said Specifications and generally what is meant by a chain. Moreover, it has been discovered during use of the boiler that it is desirable to connect each chain to the respective crossing point by means of a swivel device which is not shown in the accompanying drawings but which is shown in said Specifications and which is well-known in itself and which comprises two closed eyes or rings which are so interconnected as to be capable of rotation through 360° one relatively to the other.

The retiform frame 13 has a plate 16 secured thereto and one end portion of a rod 17 is secured to the plate. The rod 17 extends through a rectangular slot 18 formed in a wall 19 which forms part of the heat exchanger.

A bracket 20 is mounted on said wall 19 in any suitable manner (for example, by welding) and a motor 21, preferably an electric motor, is secured to said bracket by screws or bolts 22. The motor has a driving shaft 23 to which is connected a pinion 24 which meshes, at diametrically opposed positions thereon, with two identical idler gears 25.

Each idler gear 25 meshes, at a point diametrically opposite to the one at which it meshes with the pinion 24, with a respective one of two spur gears 26.

An appropriately apertured L-shaped driving arm 27 is connected at two points 28 to the spur gears 26, the connection being made in each case by a drive pin 29 of which one screw-threaded end is screwed into a tapped hole formed in the respective gear 26 and of which the other screw-threaded end extends through the respective aperture in the arm 27 and has a washer. and nut placed thereon.

The free end of the short limb of the L-shaped arm 27 is secured, as indicated by the reference numeral 31, to that end of the rod 17 which is remote from the plate 16.

A flexible gaiter 32 encircles the rod 17 at 33 and provides a gas-tight seal therewith and is fixed (as illustrated and as indicated by the reference numeral 34) to the wall 19 in a gas-tight manner, the fixing at 34 preferably following the rectangular shape of the slot 18. Of course, the actual shape of the slot may be other than rectangular.

That side of the frame 13 which is remote from the plate 16 is connected to the framework 6 by a pair of chains 35 of which one can be most clearly seen in Figure 1; the upper end of each chain is connected to a hook 36 which is secured to the framework 6 and the lower end of each chain is connected to the hooked free end 37 of a respective one of the rods 15.

The arrangement operates as follows:-

When it is desired to clean the tubes 11, the motor 21 is energised in order to rotate the pinion 24. Rotation of said pinion rotates the two idler gears 25 which, in turn, rotate the two spur gears 26. Rotation of the gears 26 causes the eccentric points 28 to rotate about the respective axes of rotation of said gears 26 and this causes the driving arm 27 to move horizontally in an orbital path. Therefore, the rod 17 and the frame 13 are also caused to move horizontally in an orbital path, with the consequence that the several chains depending from the frame scrape over the inner surfaces of the tubes 11 and clean them. The chains 35 have the desired flexibility to keep the frame in its proper attitude whilst said frame moves orbitally. The gas-borne dust and other products of combustion are prevented from reaching the gear train by the gaiter 32.

It is to be understood that other means could be used in place of the chains 35; devices which are hooked at both ends for connection to the hooks 36 and to the hooked free ends 37 could be made of rod-like material. Moreover, the chains 35 or the alternative means just described do not have to be connected to the corners of the frame 13.

Without wishing in any way to limit the scope of the present invention, it has been found to be suitable to employ the following in the gear train:-

Pinion 24 Pitch circle diameter,0.625 inch (16 mm)
Number of teeth, 15.
Pressure angle, 20°
Idler gears 25 Pitch circle diameter,1.792 inches (45 mm).
Number of teeth, 43.
Pressure angle, 20°
Spur gears 26. Pitch circle diameter,2.625 inches (67 mm).
Number of teeth, 63.
Pressure angle, 20°

The motor 21 which has been used in trails ran at about 1500 r.p.m. with the result that the frame 13 ran at about 360 r.p.m. in its orbit.

The following advantages are obtained from the use of a solid fuel boiler according to the present invention:-

1. There are now no close-tolerance parts or mechanisms in the chamber 14 through which the foul products of combustion have to pass on their way to the boiler flue.

2. All close-tolerance parts or mechanisms are now in a single easily accessible position.

3. A single gaiter is used as compared with a plurality of gaiters which had to be used in a development of the boiler disclosed in United Kingdom Patent Specification No.2,124,322B and United States Patent Specification No.4,471,725.

4. Relative thermal expansion of various parts of the overall mechanism will not in the least affect the proper running of the heat exchanger cleaner.

Claims

1. A solid fuel boiler whose heat exchanger comprises a plurality of vertically disposed tubes in each of which there is arranged a chain depending from a reticular frame which is located in a chamber above the upper ends of said tubes and to which orbital movement in a horizontal plane is imparted in order to cause said chains to clean the inner surfaces of the respective tubes characterised in that the frame (13) is supported firstly by a coupling device (16,17) which extends in a gas-tight manner through a wall (19) of said chamber (14) to drive means (27,26,25,24,23,21) to which the coupling device is connected and secondly by flexible means (35) extending between the boiler framework (6) and the frame (13).

2. A solid fuel boiler as claimed in Claim 1, characterised in that said gas-tight manner is provided by a single flexible gaiter (32) and in that

said coupling device (17) extends through an elongate slot (18) in said wall (19), one end of the gaiter being secured around said slot (18) and the other end thereof being secured around the coupling device (17).

3. A solid fuel boiler as claimed in Claim 1 or Claim 2, characterised in that that end of the coupling device (17) which is remote from the frame (13) carries an arm (27) which has an eccentric connection (28) with each of two spaced spur gears (26) which are rotated simultaneously and in the same rotational direction about their axes of rotation by a pinion (24) through the intermediary of idler gears (25), said pinion (24) being fast with the output shaft (23) of the motor (21).

4. A solid fuel boiler as claimed in any one of the preceding Claims, characterised in that said flexible means comprise chains (35), one end of each chain being anchored at (36) and the other end being anchored at (37).

5. A solid fuel boiler as claimed in any one of Claims 1 to 3, characterised in that said flexible means comprise a spring mounting or mountings connected between the underside of the frame (13) and the framework.

6. A solid fuel boiler as claimed in Claim 5, characterised in that the or each spring mounting is mounted on the plate through which the upper ends of the tubes (11) extend and to which said upper ends are welded.

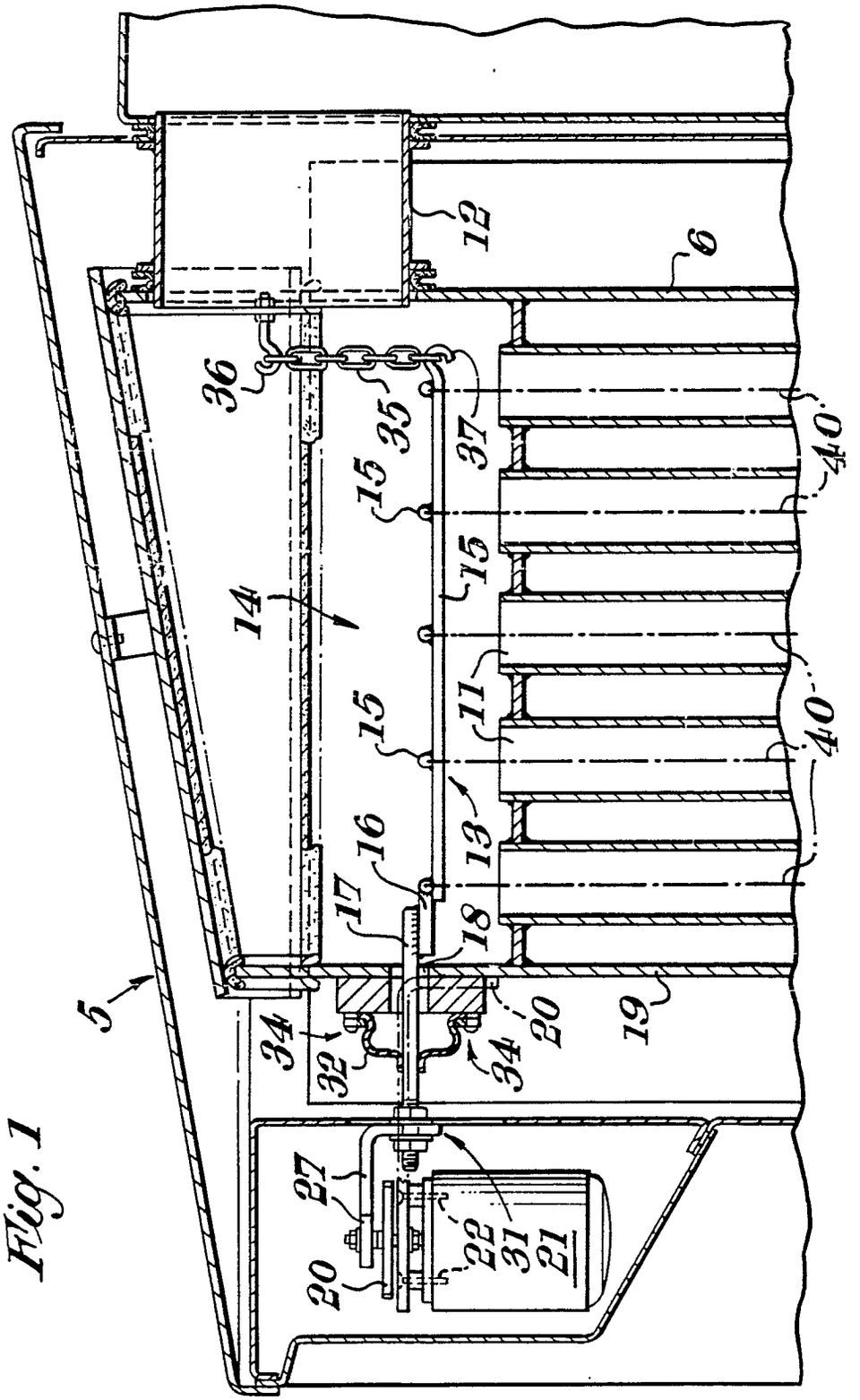
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Fig. 1

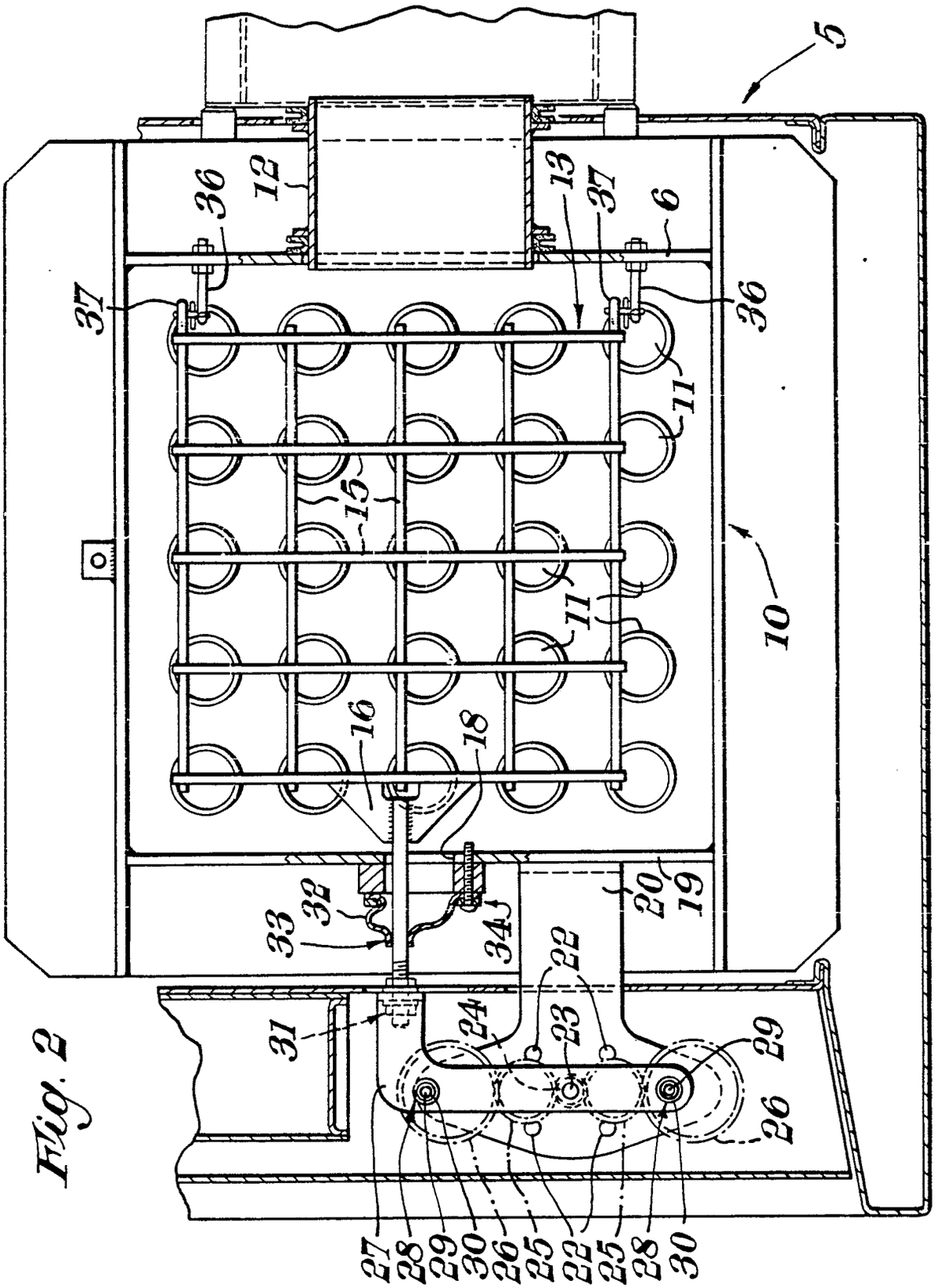
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Fig. 2

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EUROPEAN SEARCH REPORT

Application number

EP 87 30 2963

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.4)
D,Y	GB-A-2 124 322 (W.J. HOLDEN) * Abstract; figures 1-7 *	1,2	F 28 G 3/06 F 28 G 3/02
Y	GB-A-1 123 741 (SVENSKA CARBON BLACK CO.) * Page 2, lines 28-30; figure 1 *	1,2	
A	DE-B-1 003 905 (R. HINGST) * Figures 1-3 *	3	
A	GB-A- 774 299 (W.H. SMITH) * Figures 1-4 *	3	
A	DE-C- 242 423 (J.B. NIRASCOU) * Figure 2 *	4	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

F 28 G
F 23 J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	24-07-1987	HOERNELL, L.H.

CATEGORY OF CITED DOCUMENTS

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