

⑫ **EUROPEAN PATENT SPECIFICATION**

- ④⑤ Date of publication of patent specification: **27.06.84** ⑤① Int. Cl.³: **F 23 B 1/24, F 23 H 3/00,**
F 24 H 9/18
- ②① Application number: **81300987.5**
- ②② Date of filing: **10.03.81**

⑤④ **Heating apparatus for burning solid fuels, primarily to meet the heat demand of dwellings.**

③⑩ Priority: **11.03.80 HU B1000564**

④③ Date of publication of application:
16.09.81 Bulletin 81/37

④⑤ Publication of the grant of the patent:
27.06.84 Bulletin 84/26

⑧④ Designated Contracting States:
AT BE CH DE FR GB IT LI NL SE

⑤⑥ References cited:
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DE - B - 1 176 783
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GB - A - 9 555
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EP 0 035 908 B1

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Description

The invention relates to heating apparatus the use of which is recommended first of all to meet the heat demand of family homes and individual flats, or a small group of them. Solid fuel in respect of the invention is coal, brown coal or refined fuel, e.g. briquette and similar materials.

The term "household heating apparatus" as used herein is applied to those apparatuses used to meet the heat demand of individual flats, family homes or small groups of such flats or houses. The term "heat demand" used herein means the totality of the heat demand of a home ensuring heating and hot water supply. Accordingly, household heating apparatus in respect of the invention may be an apparatus similar to a stove, or the central boiler of a hot-water heating system and other similar apparatuses.

It is generally known that of the heating apparatuses used to meet the household heat demand those in which liquid or gaseous hydrocarbons are burnt are particularly suitable. It is a known fact that the liquid and gaseous hydrocarbon fuels are available for household purpose only in limited quantity. In view of this, solid fuels again come into the foreground to meet the household heat demand.

For the continuous operation of heating apparatuses used for burning solid fuels, the feeding of fuel, removal of ash and cinders and automation of the capacity variation are provided only in large heating apparatuses for industrial purposes, for instance in furnaces used for boilers of power plants. Mechanical grates used in the large industrial furnaces are e.g. chain grates, travelling grates, understokers, overfeed stokers, invert stokers and their various derivatives and alternatives. These known furnaces are not applicable to household purposes, hence they have not gained general acceptance in such a capacity. Industrial furnaces are designed generally for a fixed coal-type and the coal feeding auxiliary apparatus, the device used for the drawing in and distribution of air, the device for the removal of ash and cinder, and the automation realizing the functional co-ordination of the elements of the device are set accordingly.

It is obvious that in case of the household heating apparatuses no furnace will be acceptable that is suitable for burning only one type of coal. The solid fuels used for household purposes can vary not only annually, but even within the same heating season. The households may be supplied with coal types of generally poor quality, the dust-content, grain size and moisture content of which can vary within wide limits. Sometimes caking, and other times non-caking, cinder type coals are available. Such considerable variations actually require different household apparatuses and often radically different heating technology and fire control.

The most important requirements imposed on the household heating apparatuses are the following:

Effective combustion of fuel and utilisation of the heat arising during combustion; no, or only minimal, supervision in the process of operation; and continuous heating. In addition to the above, the simple construction, inexpensive production and upkeep and minimal wear are fundamental requirements. None of the known heating apparatuses used for burning fuels is capable of meeting the listed requirements.

Known heating apparatuses generally have a vertical grate. The result of this is that particulate cinders pile up behind the grate during the burning process and these cinders cannot fall through the gaps even when the grate is stirred. The accumulating cinders present a considerable resistance to the flow of combustion air drawn in from underneath, thus the flow of the air into the combustion zone necessary for combustion will vary over the time of heating. This will continue until the amount of air flowing into the required zone diminishes to such an extent that ignition and combustion can no longer occur. In short, the fire goes out and it cannot be restarted until the heating space and grate are cleaned. This process — namely extinction of the fire — is highly dependent on the coal type used in the household heating apparatuses. In the case of coal types forming caking cinders, the cinder cake forming on the grate makes combustion in the heating apparatus impossible within a short time. Under such circumstances no effective heating or continuous combustion is possible in traditional heating apparatuses. Thus, these heating apparatuses require a relatively large amount of maintenance work and handling activity.

So-called slow-combustion stoves are known, but these do not live up to their name in respect of continuous operation when using coal of extremely variable quality and physical condition. These heating apparatuses have not solved either the earlier outlined general problems in the field of household heating apparatuses.

French Patent No. 756,813 specifies a rotary grating design formed by drumlike elements. The grating is divided into a small number of chambers and the surface area of the grating is formed by solid bars covering the chambers. Air is injected into the chambers of the grating and flows through the gaps between the grate bars into the combustion chamber. The quantity of the air injected into the grating is much larger than the quantity of air required for the combustion. The surplus air escapes through the opening at the opposite end of the grating and serves for the removal of the ash. In this apparatus the air supply is not uniform because the rotary displacement of the grating interrupts the air supply periodically so that the air supply significantly fluctuates, thus disrupting the equilibrium of combustion of the fire setting.

The heating apparatus according to the invention represents a fundamental change compared to the known household heating apparatuses and it meets the requirements imposed on these apparatuses nearly to the full.

The aim of the invention was to provide an apparatus that is not sensitive to the available coal type, that ensures continuous heating in such a way that attendance of personnel is restricted only to the periodical feeding of raw fuel and emptying the ash space, and in addition to this that ensures the continuous flow of the combustion air in an evenly distributed manner and in adequate quantity.

The heating apparatus according to the invention contains a mobile grate construction formed by hollow grate elements for guiding and releasing the air necessary for the combustion. The grate elements are arranged along an endless surface, such as on the outside of a cylindrical surface, each grate element lying in the direction of the generatrix. An air inlet head is connected to one or both front ends of the grate construction supplying those grate elements which support the burning fuel with air. The air outlet openings are on the outside of the grate elements. It is advisable to use drum plates at the front ends of the grate which both fix the grate elements and are connected with the shaft of the grate construction, thus the shaft and grate elements are held together as a mechanical unit.

The whole grate construction is driven by the shaft with a motor of very low power output, since the speed of the grate construction is very low. The air inlet head is connectible to one or both drum plates forming the front ends of the earlier mentioned grate construction; this connection ensures a sliding fit, i.e. the drum plates slide along the abutting plane of the air inlet head, but an airtight fit is necessary along the plane. In order to ensure the airtight fit a device may be used in which a ring is fixed at the other side of the drum plate extending to the vicinity of the outlets of the grate elements and the air inlet head abuts this ring. It is advisable to insert a flexible element between the air inlet head and the supply tube in order that the seating of the air inlet head should follow the irregularities of the abutment plane. Such flexible element is preferably a tube joint.

According to the present invention there is provided heating apparatus for burning solid fuel, principally to meet the heat demand of dwellings or a group of dwellings, comprising a rotary grate construction having grate elements and a grate actuating mechanism for rotatably driving the grate construction wherein the grate elements are hollow elements provided with air outlet openings, characterised in that the grate elements are hollow tubes arranged around the cylindrical periphery of the rotary grate construction, said tubes abutting each other along their lengths and the air outlet openings being arranged on the outwardly facing parts of the

tubes, and wherein an air inlet head is provided at at least one of the ends of the grate construction to feed air to the tubes.

A suitable construction of the heating apparatus according to the invention is represented by an apparatus in which the ends of the grate elements are connected to drum plates, which are fixed to a shaft.

In case of another preferred construction a ring is connected to the ends of the grate elements at the outer side of at least one drum plate.

According to a recommended solution the size and position of the air inlet head should be suitable for connection to several grate elements at the same time.

The heating apparatus according to the invention is described in detail by way of example in the enclosed drawings:

Figure 1 — sectional view of the construction according to the invention by way of example;

Figure 2: section along plane A—A marked in Figure 1;

Figure 3: Side view of the air inlet head;

Figure 4: section along plane B—B marked in Figure 3.

In the heating apparatus shown by way of example the grate construction has a horizontally-arranged cylindrical shape in the space surrounded by side walls 8. The grate construction includes grate elements 4 arranged in the direction of the generatrix, drum plates 5 forming the front ends of the grate construction, rings 14 and shaft 6. The shaft 6 is connected with a driving mechanism (not shown) to move the grate construction. Generally an electric motor driving a gear is used to ensure a very low speed for the shaft 6. The shaft 6 is passed through the side walls 8 and is supported by bearings 13.

The grate elements 4 of the grate construction of the proposed heating apparatus are in fixed positions in relation to the drum plates 5 and rings 14. In the grate construction shown by way of example the grate elements 4 are made of tubes open at both ends. The outward looking outer parts of the grate elements 4 are provided with holes used as air outlet openings.

Air inlet heads 16 are fitted to both front ends of the grate construction. The air inlet heads 16 are connected with tubes 15, which in turn are connected to a fan or some kind of blower. The head 16 is suitably curved — as shown in Figure 3 — and its size is suitable to receive the outlets of several grate elements at the same time, i.e. it is able to supply several grate elements 4 with air. In the embodiment shown by way of example the openings of five grate elements 4 are covered by one head 16. According to the general requirements one head 16 covers the outlet of as many grate elements 4 as there are directly under the burning coal layer. The arrangement between the air inlet head 16 and front ends of the grate construc-

tion must be such that the grate construction is allowed to rotate relative to the head 16 without allowing the escape of significant amounts of air along the fitting plane of the head 16. In order to ensure this objective, it is advisable to use a ring 14 that is fixed to the outer side of the drum plate 5 according to Figure 4 and the outer plane of which is a machined surface, which abuts the head 16. In order that the head 16 should be properly seated on the drum plate 5 forming the front end of the grate construction or on the ring 14 in spite of minor irregularities, a flexible support is provided. For this purpose tube joint 17 is inserted between the head 16 and the tube 15.

The heating apparatus according to the invention still includes a conventional tank 2 for the raw fuel. Its upper part is closed by a cover 1, while its bottom part is a hopper 3 feeding fuel to the grate construction. A heated space 7 is formed to one side of the hopper 3 above the grate construction. Boiler tubes 10 for heating and producing hot water are arranged in the shaft-like section above the heating space 7 in the heating apparatus described by way of example. The flue gases leave through throat 11 above the boiler tubes 10 towards the chimney as shown by the arrows. An ignition hole 9 is provided on the side wall 8 in the vicinity of the heating space 7, which is actually a cut-out closed with door. Ash dump 12 is formed below the grate construction provided similarly with a door.

During operation of the heating apparatus according to the invention the fuel fed via the hopper 3 into the upper part of the grate construction is ignited through the ignition hole 9. The air necessary for ignition of the fuel and for the combustion is supplied via tubes 15, heads 16 and grate elements 4 connected to the heads 16 through the air outlet openings of the heads. During operation of the heating apparatus, the actuating device connected to the shaft 6 ensures rotation of the grate construction according to the curved arrow shown in Figure 1. During rotation of the grate construction the fuel in the upper part of the grate construction passes from left to right according to Figure 1. The fuel is fed by the hopper 3 onto the grate construction. Remnants of the burnt-off fuel slide down into the ash dump 12. The speed of the shaft 6 is selected and adjusted in such a way that the fuel on the upper part of the grate construction should burn off completely. The amount of fuel fed through hopper 3 — and thus the layer thickness of the fuel in the heating space — can be varied with the aid of a push plate used in the vicinity of the hopper. This push plate is not illustrated in the drawings.

During operation of the heating apparatus according to the invention, it cannot occur that the cinder and ash remaining after the fuel has burnt can accumulate below fresh fuel and thus prevent the ignition of and combustion of the fuel, since the grate construction itself ensures

the removal of cinders and ash from the heating space 7. Movement of the grate construction and the air flowing out of the grate elements 4 stir the burning fuel to a certain extent, resulting in better combustion of the fuel's carbon content and in reducing the loss of combustible cinders.

The personal supervision of the heating apparatus according to the invention is restricted to refilling the tank 2 and emptying the ash dump 12. This activity will be necessary only once a week, if the apparatus is correctly dimensioned. Capacity variation of the proposed heating apparatus is ensured by varying the amount of air supplied and possibly by varying the opening between the hopper 3 and grate construction. Variation of the speed of shaft 6 and that of the inducted amount of air are automated in a simple way with the aid of conventional devices.

In connection with the description of the construction by way of example it is apparent that the heating apparatus according to the invention has a simple construction, its production does not require special technology, hence it is inexpensive. In spite of this, it ensures the efficient burning of any solid fuel. The proposed heating apparatus is not demanding in respect of the varying quality and physical properties of the fuels to be burnt. It does not require permanent supervision and handling, furthermore its maintenance is insignificant. If necessary, its operation can be mostly automated.

Claims

1. Heating apparatus for burning solid fuel, principally to meet the heat demand of dwellings or a group of dwellings, comprising a rotary grate construction having grate elements (4) and a grate actuating mechanism for rotatably driving the grate construction, wherein the grate elements (4) are hollow elements provided with air outlet openings, characterized in that the grate elements are hollow tubes (4) arranged around the cylindrical periphery of the rotary grate construction, said tubes (4) abutting each other along their lengths and the air outlet openings being arranged on the outwardly facing parts of the tubes, and wherein an air inlet head (16) is provided at at least one of the ends of the grate construction to feed air to the tubes (4).

2. Heating apparatus as claimed in claim 1, characterized in that the ends of the tubes (4) are connected to drum plates (5) and the drum plates (5) are fixed to a shaft (6) by which the grate construction is rotatably mounted.

3. Heating apparatus as claimed in claim 1 or 2, characterized in that a ring (14) is connected to the ends of the tubes (4) at the outer side of at least one of the drum plates (5).

4. Heating apparatus as claimed in claim 3, characterized in that the air inlet head (16) is connected with a sliding fit either to a section of

the drum plate (5), or to a section of the ring (14).

5. Heating apparatus as claimed in claim 4, characterized in that the size and position of the air inlet head (16) are such that the air inlet head makes simultaneous communication with several tubes (4).

6. Heating apparatus as claimed in claim 5, characterized in that a flexible element, preferably a tube membrane (17), is inserted between the air inlet head (16) and a tube (15) which leads air to the air inlet head (16).

Revendications

1. Appareil de chauffage pour brûler du combustible solide, principalement pour satisfaire aux besoins en chaleur d'habitations ou d'un groupe d'habitations, comprenant une grille tournante comportant des éléments de grille (4) et un mécanisme d'actionnement de grille servant à entraîner en rotation la grille, dans lequel les éléments de grille (4) sont des éléments creux pourvus d'ouvertures de sortie d'air, caractérisé en ce que les éléments de grille sont des tubes creux (4) disposés autour de la périphérie cylindrique de la grille tournante, lesdits tubes (4) venant buter l'un contre l'autre sur leurs longueurs et les ouvertures de sortie d'air étant disposées sur les parties des tubes qui sont dirigées vers l'extérieur, et en ce qu'il est prévu un collecteur d'entrée d'air (16) sur au moins une des extrémités de la grille pour alimenter les tubes (4) en air.

2. Appareil de chauffage selon la revendication 1, caractérisé en ce que les extrémités des tubes (4) sont reliées à des plaques de tambour (5) et en ce que les plaques de tambour (5) sont fixées sur un arbre (6) au moyen duquel la grille est montée à rotation.

3. Appareil de chauffage selon l'une des revendications 1 ou 2, caractérisé en ce qu'un anneau (14) est relié aux extrémités des tubes (4) du côté extérieur d'au moins une des plaques de tambour (5).

4. Appareil de chauffage selon la revendication 3, caractérisé en ce que le collecteur d'entrée d'air (16) est relié par un joint glissant, soit à une partie de la plaque de tambour (5), soit à une partie de l'anneau (14).

5. Appareil de chauffage selon la revendication 4, caractérisé en ce que les dimensions et la position du collecteur d'entrée d'air (16) sont telles que le collecteur d'entrée d'air établit une communication simultanée avec plusieurs

tubes (4).

6. Appareil de chauffage selon la revendication 5, caractérisé en ce qu'un élément flexible, de préférence une membrane tubulaire (17), est interposée entre le collecteur d'entrée d'air (16) et un tube (15) qui canalise l'air vers le collecteur d'entrée d'air (16).

Patentansprüche

1. Heizgerät zum Verbrennen fester Brennstoffe, vorzugsweise zur Deckung des Wärmebedarfes von Wohnungen oder einer Gruppe von Wohnungen, mit einer rotierenden Rost-Konstruktion, die Rostelemente (4) und einen Antrieb zum Rotieren der Rost-Konstruktion aufweist, wobei die Rostelemente (4) als Hohl-elemente mit Luftauslaßöffnungen ausgebildet sind, dadurch gekennzeichnet, daß die Rostelemente hohle Rohre (4) sind, die um die zylindrische Außenfläche der rotierenden Rost-Konstruktion angeordnet sind, daß die Rohre (4) entlang ihrer Länge jeweils aneinanderstoßen und die Luftaustrittsöffnungen an den nach außen gerichteten Bereichen der Rohre angeordnet sind und wobei ein Lufteinlaßkopf (16) an zumindest einem der beiden Stirnenden der Rost-Konstruktion angeordnet ist, um den Rohren (4) Luft zuzuführen.

2. Heizgerät nach Anspruch 1, dadurch gekennzeichnet, daß die Enden der Rohre (4) mit runden Scheiben (5) verbunden sind und daß die runden Scheiben (5) mit einer Welle (6) verbunden sind, über die die Rost-Konstruktion verdrehbar ist.

3. Heizgerät nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß ein Ring (14) an der Außenseite zumindest einer der runden Scheiben (5) mit den Enden der Rohre (4) verbunden ist.

4. Heizgerät nach Anspruch 3, dadurch gekennzeichnet, daß der Lufteinlaßkopf (16) gleitend entweder an einem Abschnitt der runden Scheibe (5) oder an einem Abschnitt des Ringes (14) anliegt.

5. Heizgerät nach Anspruch 4, dadurch gekennzeichnet, daß die Größe und die Position des Lufteinlaßkopfes (16) so gewählt ist, daß der Lufteinlaßkopf die gleichzeitige Verbindung mit mehreren Rohren (4) herstellt.

6. Heizgerät nach Anspruch 5, dadurch gekennzeichnet, daß ein flexibles Element, vorzugsweise ein Wellrohr (17) zwischen den Lufteinlaßkopf (16) und ein ihm Luft zuführenden Rohr (15) zwischengeschaltet ist.

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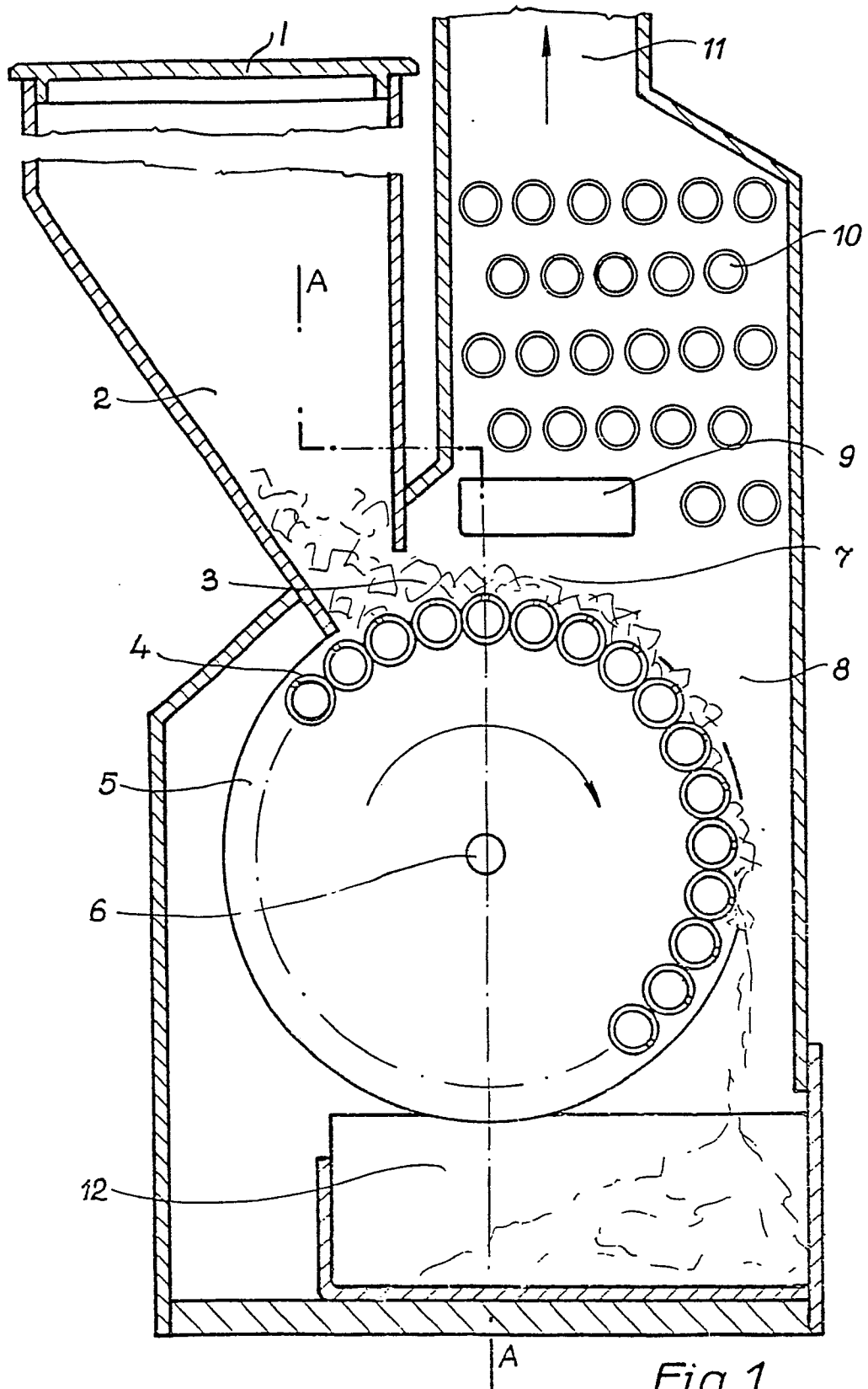


Fig. 1

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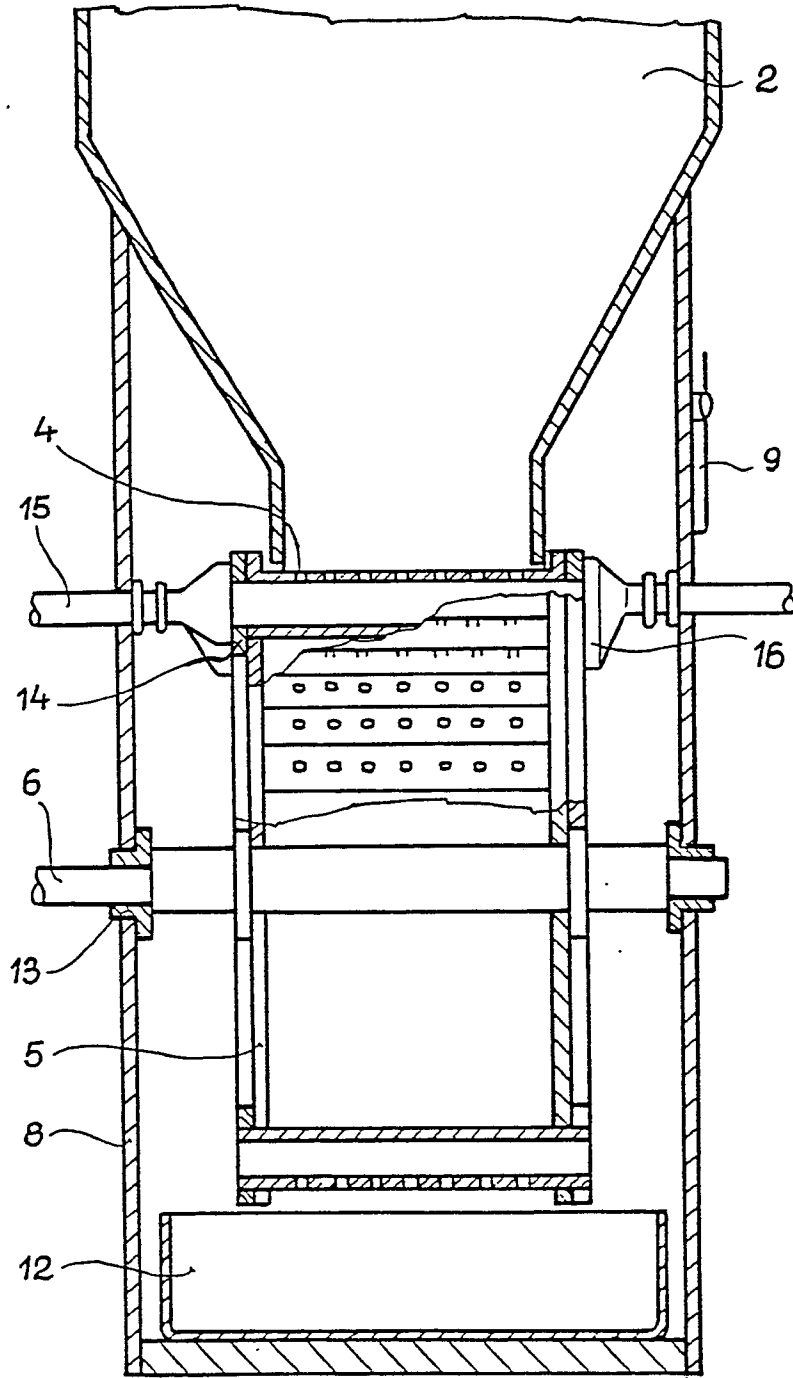


Fig. 2

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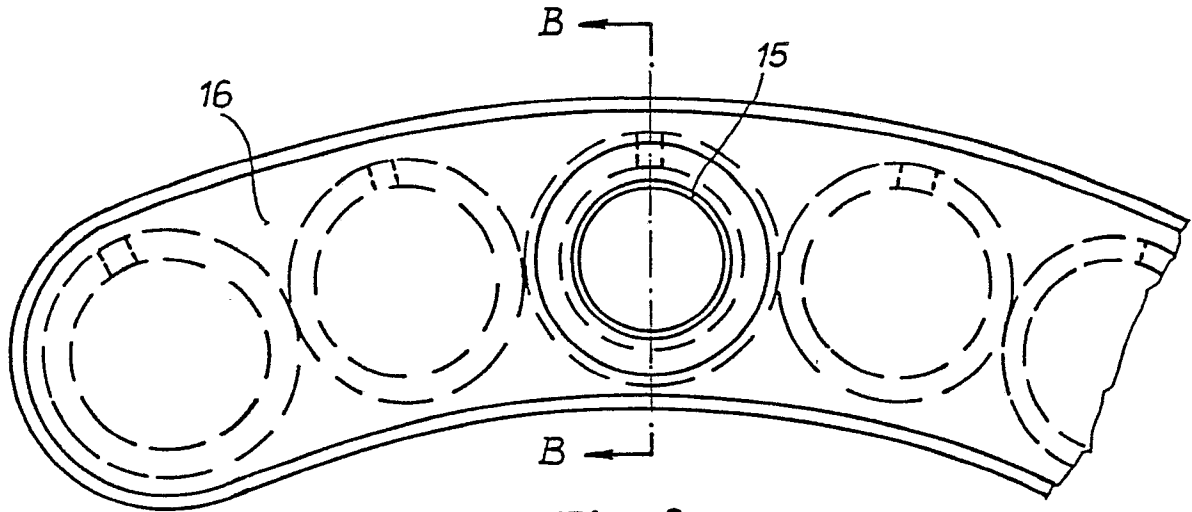


Fig. 3

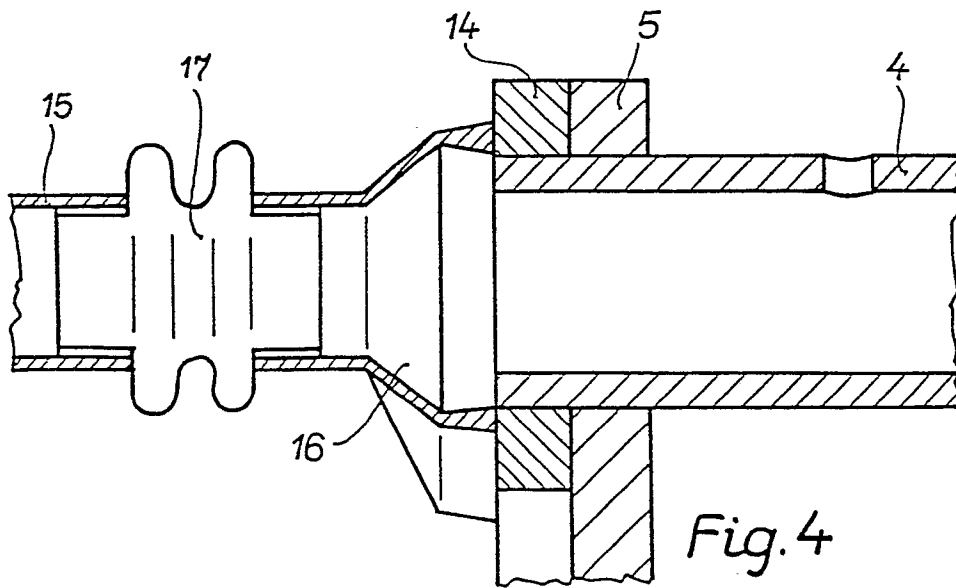


Fig. 4