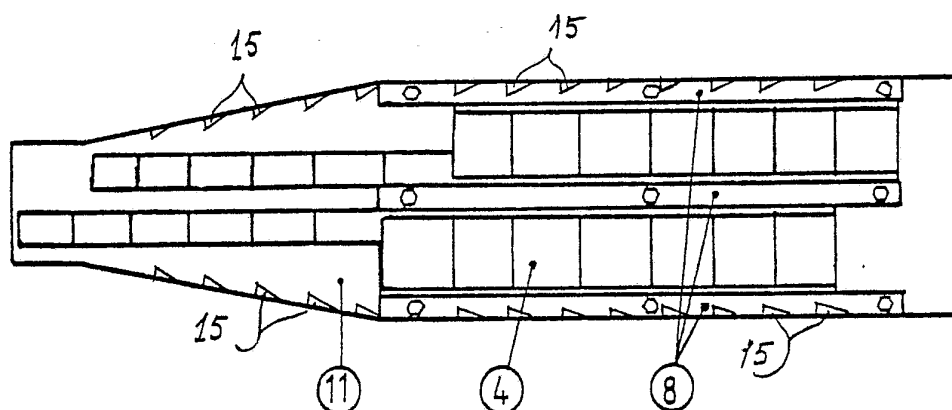




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ³ : B65G 65/44	A1	(11) International Publication Number: WO 85/ 01036 (43) International Publication Date: 14 March 1985 (14.03.85)
(21) International Application Number: PCT/FI84/00059 (22) International Filing Date: 3 September 1984 (03.09.84) (31) Priority Application Number: 833146 (32) Priority Date: 2 September 1983 (02.09.83) (33) Priority Country: FI (71)(72) Applicants and Inventors: RÄTY, Matti [FI/FI]; SF-74930 Herukkamäki (FI). PITKÄKANGAS, Juhani [FI/FI]; Ambrontie 11 C 3, SF-74700 Kiuruvesi (FI). (74) Agent: INSINÖÖRITOIMISTO OLLI HEIKINHEIMO KY; Mannerheimintie 25 A 29, SF-00250 Helsinki 25 (FI).		(81) Designated States: AT (European patent), BE (European patent), CH (European patent), DE, DE (Auxiliary utility model), DE (European patent), DK, FR (European patent), GB (European patent), HU, JP, LU (European patent), NL (European patent), NO, SE (European patent), US. Published <i>With international search report.</i> <i>In English translation (filed in Finnish).</i>

(54) Title: APPARATUS FOR CONVEYING, FEEDING AND/OR UNLOADING GRANULAR MATERIAL FROM A CONTAINER



(57) Abstract

The apparatus comprises two elongate, adjacent supporting members (3) which move in turns back and forth in the transport direction and on the same level; in the upper part of the supporting members there are arranged the shifting members (4). These are unsymmetrical in the shifting direction so that while the supporting member (3) moves towards the outlet channel, the shifting member (4) grabs the conveyed material along, but while the supporting member (3) moves in the opposite direction, the shifting member (4) allows the fuel to slide over. The supporting members (3) are plates which are shifted along slide rails (8) or equivalent grooves. The shifting members (4) are either protrusions or bulges (16) which advantageously have the form of a calotte half or they are at least roughly triangular in side profile, so that the front surface of the shifting members (4) is essentially steeper than the rear surface. In the border region of the walls of the container (10) and the supporting members (3) there are located unsymmetrical obstruction members (15) which allow the material to shift forward in the desired direction but prevent it from moving backward. Several adjacent apparatuses according to the invention can be compiled to form a bottom discharger which is advantageously formed of separate unloader units which can be connected to other similar units.

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APPARATUS FOR CONVEYING, FEEDING AND/OR UNLOADING GRANULAR MATERIAL FROM A CONTAINER

5 The present invention relates to an apparatus for conveying, feeding and/or unloading granular material from a container. The apparatus of the invention is designed particularly for conveying, feeding or unloading solid fuel for various combustion devices - fuel such as lump chips, small chips, sawdust, bark, sod peat, milled peat, pellets
10 and coal - and in general for conveying granular materials, the grain size whereof may vary between 0...200 mm as regards the average grain diameter.

15 The apparatus of the invention can be applied to form an unload by joining several apparatuses side by side. The unloader may be employed for conveying and exact dosing of granular materials even within a comparatively large power range, for instance in conveying solid fuels from storage onto the stoker which leads to the boiler, and in unloading
20 solid materials from a tractor trailer or from the bed of a truck or other vehicle and in dosing the said material. The unloader can further be employed in dosing and measuring flour while producing full feed out of concentrate, and for example in charging sod peat and pellets to be mixed with
25 chips as auxiliary fuel.

In the previous art there are known several different conveyor and/or stoker devices, such as spiral conveyors and spiral stokers, piston stokers and flake stokers.
30 However, these previous art conveyors and stokers are sensitive to sand and pebbles as well as to the inhomogenous nature of the feed material. Moreover, they need a disproportionate amount of driving power compared to their conveying or feeding power. Therefore their running
35 costs rise high. Often their purchase price also becomes high.



The purpose of the present invention is to eliminate the drawbacks in the prior art and to achieve an apparatus of a new type, more reliable than the known devices, for conveying, feeding and/or for unloading solid fuels or
5 equivalent.

The invention is based on the principal idea that two or more dented or scaled support members such as plates, bars or rails move back and forth so that adjacent members
10 always move to opposite directions, and that the denting or scaling is made unsymmetrical in the moving direction of the supporting members in such a fashion that the solid fuel which is to be conveyed or fed and is located on top of the dents or scales is more easily shifted towards one
15 direction, i.e. the transport direction, than towards the opposite direction.

The apparatus of the invention is mainly characterized by the novel features enlisted in the Patent Claim 1.

20

Remarkable advantages are achieved by employing the present invention. Thus the apparatus of the invention can be used for conveying and/or feeding extremely inhomogenous and/or light materials. The transport of the material is carried
25 out surprisingly effectively, if the supporting members are provided with a denting or scaling which is relatively slight with respect to the grain size and grain distribution of the treated material. By adjusting the range of the back-and-forth movement of the supporting
30 members, optimal transport properties can be regulated for the apparatus while the weight, porosity etc. of the treated material change. The power demand compared to the conveying or feeding power is extremely small. Arching does not take place in any noticeable degree. The apparatus has
35 a simple structure. By employing the apparatus it is



possible to achieve an even feeding rate of for instance fuel such as chips into the combustion chamber of a boiler, in which case the overall efficiency of the heating device is improved and pitches are stuck onto the boiler walls in a much lesser degree than before. In addition to this, the conveyor, stoker and/or unloader according to the invention is not easily blocked and it is suited for instance for very large boilers, up to 1000 kW.

The unloader can be formed of several adjacent stoker units or stoker elements. This allows for the manufacturing and delivering of the unloader in elements. Thus it is possible that only mounting is carried out on the operation site proper, which is easy enough for the buyer to do, if so desired. The unloader, as well as a single stoker, can also be used as a dryer. Thus the drying process of grain, chips etc. can be enhanced.

In the following the invention is explained in detail with reference to the appended drawing, where

Figure 1 illustrates one preferred embodiment of the conveyor and/or stoker of the invention seen in cross-section;

Figure 2 illustrates the structure of the conveyor and/or stoker of Figure 1, seen from the top;

Figure 3 illustrates the same apparatus seen from below;

Figure 4 illustrates a detail of one shifting member seen from the top;

Figure 5 is an exploded view of the shifting member of Figure 4;

Figure 6 shows a unloader according to the invention, compiled of the conveyors and/or stokers of the invention, seen from the top;

Figure 7 is an exploded view of the unloader of Figure 6; and

Figure 8 is an exploded view of the elements of the unloader of Figure 6.



The preferred embodiment of the invention illustrated in Figures 1 - 3 mainly specifies the fuel stoker. The stoker is adjusted between the fuel inlet channel, which in this case is the container 10, and the outlet channel, i.e. the fuel supply pipe 1. Within the supply pipe 1 there is advantageously located the closing hatch 2 and the regulating member thereof, such as the electromagnet 14. The apparatus of the invention comprises two or more elongate and adjacent supporting members 3, which are arranged on the same level and which are moved back and forth in turns in the transport or shifting direction B of the fuel. In the upper part of the said supporting members 3 there are arranged the proper shifting members 4, which are unsymmetrical in the shifting direction B in such a fashion that while the member 3 moves towards the outlet channel 1, the shifting member 4 grips the fuel to be conveyed, but while the member 3 moves to the opposite direction, the shifting member 4 allows the fuel to slide over.

In the preferred embodiment of the invention, the supporting member 3 and the shifting members 4 form the bar 3 provided with dents 4, i.e. they form a dented bar. Each supporting member 3 is adjusted to be supported by at least one slide rail 8, and the slide rail is connected to a power actuator, such as the electric motor 5, by means of the articulated rod 7 and the reduction gear 6.

In the border region of the container 10 and the movable shifting members 3 there are arranged unsymmetrical slots, dents, brackets or equivalent obstructing members. For example they can be bent at the edges of the walls 8 so that they allow the material to move forwards towards the outlet channel 1, but prevent it from moving backwards. The obstructing members can be for instance scale-like or



triangular. The lower part of the container wall, as well as the walls of the channel wherein the movable supporting members are installed, can have a structure similar to the supporting members 3 and the shifting members 4, but they are fixed on the spot so that they serve as obstructing members.

The stoker is operated so that the electric motor 5 drives the reduction gear 6, onto the outlet axes 13 whereof there are eccentrically adjusted the articulated rods 7, which rods 7 serve as means for moving the two dented bars 3, 4 installed on the bottom 11 of the container 10 by means of the slide rails 8. Power is transmitted to the dented bars 3, 4 along the adjusting members 9 which are installed in the apertures 12 made through the bottom 11 of the container 10. There can be several dented bars 3, 4 located side by side. The adjacent dented bars 3, 4 move back and forth in the opposite directions on the same level, so that the solid fuel is conveyed from the container 10 into the fuel supply pipe 1 owing to the triangular side profile of the shifting members 4 and to the to-and-fro motion in opposite directions of the supporting members 3. The obstructing members 15 effectively prevent the material from moving backwards, particularly while conveying light fuels and suchlike. The closing hatch 2 is open while the stoker is in operation and closed while the stoker is off. The closing hatch 2 is controlled by means of the electromagnet 14.

The structure of the container 10 and the fuel supply pipe 1 is welded to be air-tight, so that air has not got any access into the combustion device through the stoker. The purpose of the slide rails 8 located on the bottom of the container 10 is to prevent the supporting members 3 from moving sideways or up and down, and to prevent the fuel



from falling down under the supporting members 3. The purpose of the closing hatch 2 is to prevent fire from entering the container 10 while the stoker is not in operation. If the outlet channel 1 is high enough, the closing hatch 2 is unnecessary.

The container 10 must have a form gently convergent towards the fuel supply pipe 1, so that the fuel is not jammed at any spot of the fuel path. The dented bars 3, 4 must fill the area of the bottom 11 as fully as possible, i.e. they are preferably plate-like. Thus the width of the supporting members 3 can vary; for instance the supporting members can be narrowed towards the supply pipe 1 as is seen in Figure 2. Any possible arching of the fuel is effectively prevented, because it is in continuous motion in the area of the bottom 11.

The bars or the supporting members 3 and the dents 4 or equivalent shifting members must be designed so that the amount of fuel they draw along while moving away from the supply pipe 1 is as slight as possible. In the case of the preferred embodiment, the dents 4 are roughly vertical at the side facing the supply pipe 1 and gently inclined at the other side, the angle of inclination being for instance $10...30^{\circ}$. The width of the supporting members 3 and the shifting members 4 in the above embodiment can vary for instance within the scale $5...100$ cm. The number of the said members, located side by side at the bottom of the container 10, can be for instance $2...8$.

The shifting members can be as broad as the supporting members, as is seen in Figures 1 and 2. They can also be protrusion or bulges 16 having the form of a cupola or a calotte half protruding from the surface of the plate serving as the supporting member 4 as is illustrated in



in Figures 4 and 5. A large amount of such bulges can be arranged on the plate surface both side by side and in succession. They are unsymmetrical in the movement direction, i.e. the lengthwise direction of the supporting members, so that the steep edge always faces to the conveying direction B and the curved edge faces to the opposite direction.

The height h of such a bulge can vary between 1...5 mm, whereas for instance the grain size of the conveyed material varies between 20...100 mm. It is pointed out that bulges of the height h, which are very small compared to the granular nature or grain size of the conveyed material, already help to achieve a remarkably effective shifting performance. The finer the conveyed material, the smaller the employed bulges.

The conveying power of the apparatus of the invention can be regulated or changed by changing the number and the range of motion of the supporting members 3, by adjusting the rotating speed of the electric motor, by changing the transmission ratio of the reduction gear 6, by changing the width of the container bottom 11 and of the supporting members 3 by making them narrower or broader and by running the electric motor 5 in periods.

The length of the motion range of the supporting member is adjusted according to the properties of the conveyed material. The more porous, the more flexible and the lighter the conveyed material is, the longer the required to-and-fro motion. Heavy materials are shifted by short motions.

The power of the electric motor 5 is defined by the size of the container 10, by the transmission ratio of the gear 6



and by feeding power. Practical tests have been carried out with 500 l containers so that the transmission ratio has been 60:1, in which case the outlet rotation speed of the gear 6 is 25 rpm and the frequency of the to-and-fro motions of adjacent supporting members is about 25/min. Accordingly the feeding power with a 0,25 kW electric motor is 600 l/h of chips, which corresponds to the caloric capacity of 600 kW.

10 Figures 4-6 illustrate an unloader which is compiled of the above described stokers. The unloader is preferably manufactured of separate elements by compiling as is seen in Figure 6. The same elements can be used for manufacturing a solid material stoker, and by uniting two or more elements it is possible to construct a dosing bottom discharger, the size whereof is defined by the number of elements used. Thus each control ridge 17 comprises two elongate and inclined plates 19 belonging to adjacent pairs of conveyors 18, which plates 19 are attached to each other at the top for instance by means of suitable connecting means. Consequently, each control ridge 17 has a cross-section which roughly resembles an isosceles triangle positioned with the apex upwards. In the case of the preferred embodiment, the width of the control ridge 17 on the level of the bottom 11 of the container 10, and its height measured from the bottom level, roughly correspond to the size of one pair of conveyors 18.

When the shifting conveyor 20 is removed of the bottom discharger, the resulting apparatus is a dosing unloader which can be installed for instance in a tractor trailer for spreading manure, sand or fresh feed directly on to the field.

35 The dosing unloader can be installed for instance in a



tractor trailer by means of attaching it with bolts. Power can be obtained for example from the tractor hydraulics through a double-acting valve, in which case the unloader operates as a self-unloading trailer (general trailer). It can also be installed in a feed mixer unit, in which case it is employed for measuring and dosing concentrates and flour, or it can be installed in the fuel storage to serve as an intermediary store between the stoker and the main store. There it works as an automatic bottom discharger wherein the fuel, for instance chips, can also be dried.

Between each pair of conveyors 18 and the inclined plates 19 connected thereto, it is advantageous to arrange an aperture or apertures 25 through which warm air can be conducted into the container 10 or equivalent. Thus the fuel contained in the container, such as fresh chips, can be dried. In the air drying of the fuel, for instance the temperature of the boiler room is utilized so that warm air is sucked therefrom and conducted to below the dosing unloader and through the control ridges as is shown by the arrows C, towards the batch of fuel to be dried at any given time. Air is transferred for instance by means of blowers and suitable pipes.

Several modifications differing from the preferred embodiment of the above specification can be carried out without deviating from the scope of the present invention. Thus it is not necessary that the conveying members are installed in pairs; they can also be installed in larger groups. The cross-section of the control brushes can have a form other than that of a regular triangle. Naturally it is essential that the cross-section is tapered upwards. Thus the sides of the control ridges can be for instance convex or concave.



The shifting conveyor 20 is advantageously located within the closed channel 24 and provided with a particular inner supporting member - shifting member pair 21, which reaches over the length of the whole conveyor. The fuel that is to be shifted on top of the front end of the said conveyor, for example into the boiler 22, falls down from the stokers located at the bottom of the container 10. The shifting conveyor 20 is driven by its own power unit 23, for instance an electric motor.

The stoker or feeder of the above described type can be employed for transporting chips or equivalent along relatively long paths, i.e. at least tens of meters for example from storage into the combustion plant proper. In that case the apparatus of the invention is placed for instance within an open trough, closed pipe or channel wherein the conveyor proper 3, 4 or the pair of conveyors 18 is installed. The inner surface of the canal, or the walls of the trough, are advantageously provided with the unsymmetrical obstruction means illustrated in Figure 2. This ensures that particularly the shifting of light and porous materials is carried out successfully. Apart from the above mentioned fuels, the conveyor of the present invention is well suited for shifting many other types of granular materials.



PATENT CLAIMS

1. An apparatus for conveying, feeding and/or unloading granular material from a container, c h a r a c t e r i -
z e d in that the apparatus comprises at least two
elongate and adjacent supporting members (3) which are
arranged on the same level and move back and forth in turns
in the transport direction and that on the upper part of
the said supporting members there are arranged shifting
members (4) which are unsymmetrical in the transport
direction so that while the supporting member (3) moves
towards the outlet channel (1) the shifting member (4)
grabs the conveyed fuel along, but while the supporting
member (3) moves to the opposite direction, the shifting
member (4) allows the fuel to slide over.

2.- The apparatus of Claim 1, c h a r a c t e r i z e d
in that the supporting members (3) are plates which can be
moved along slide rails (8) or equivalent grooves.

3. The apparatus of Claim 1 or 2, c h a r a c t e r i -
z e d in that the adjacent supporting members (3) are
arranged to move in opposite phases.

4. The apparatus of Claim 1, 2 or 3, c h a r a c t e r i -
z e d in that the shifting members (4) are protrusions or
bulges (16), which advantageously have the form of a
calotte half.

5. The apparatus of Claim 1, 2 or 3, c h a r a c t e r i -
z e d in that the shifting members (4) are at least
roughly triangular in side profile, so that the front
surface of the shifting members (4) is essentially steeper
than the rear surface.

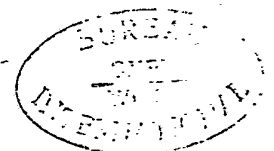


6. The apparatus of Claim 4 or 5, c h a r a c t e r i -
z e d in that at least in the border region of the
container (10) or of the channel (24) and the supporting
members (3) there are located unsymmetrical slots, dents or
5 similar obstructing members (15) which allow the material
to move forward in the desired direction but prevent it
from moving backward.

7. The apparatus of Claim 4 or 5, c h a r a c t e r i -
10 z e d in that the to-and-fro motion of the supporting
members (3) is created by means of an articulated rod
assembly (7) essentially driven by an electric motor (5).

8. An unloader wherein the bottom of the container (10) or
15 equivalent is formed of at least two apparatuses according
to any of the previous claims, i.e. of a pair of conveyors
(18), for feeding material out of the container (10), and
each pair of conveyors (18) is provided with a feeding
funnel or equivalent for conducting the material contained
20 within the container (10) to move on top of the pair of
conveyors (18), c h a r a c t e r i z e d in that the
control ridge (17) belonging to adjacent pairs of conveyors
or equivalent consists of two elongate, inclined plates
(19) or other similar constructions which belong to two
25 adjacent pairs of conveyors (18), which plates are attached
to each other at the top edge in order to form the apex of
the control ridge (17) and that each group of conveyors
(18) together with the inclined plates (19) located on both
sides thereof form a separate unloading unit which can be
30 connected to other respective units.

9. The apparatus of Claim 8, c h a r a c t e r i z e d
in that the width and/or height of the control ridge (17)
measured from the level of the bottom of the container (10)
35 roughly corresponds to the width of one pair of conveyors.



10. The apparatus of Claim 8 or 9, c h a r a c t e r i -
z e d in that between each pair of conveyors (18) and the
inclined plates (19) connected thereinto there is an
aperture or apertures (25), through which warm air can be
5 conducted from below the unloader into the container (10)
or equivalent.

10



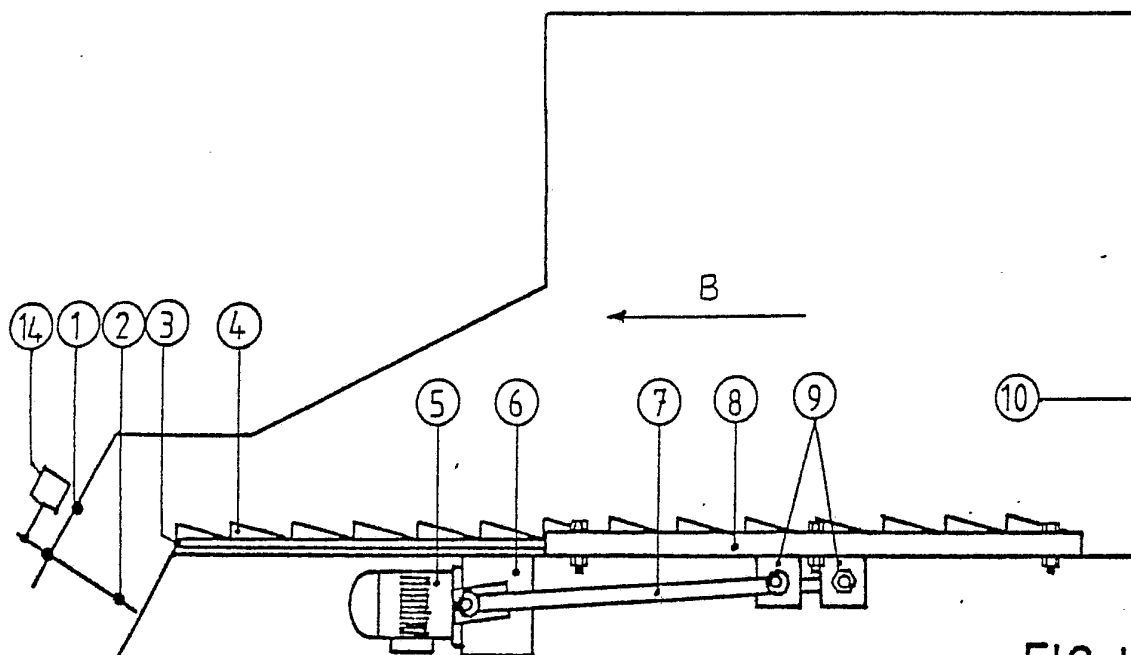


FIG. 1

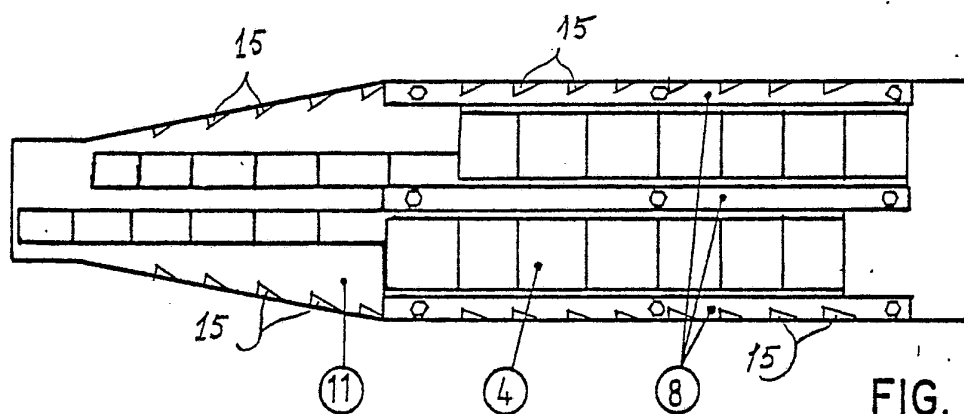


FIG. 2

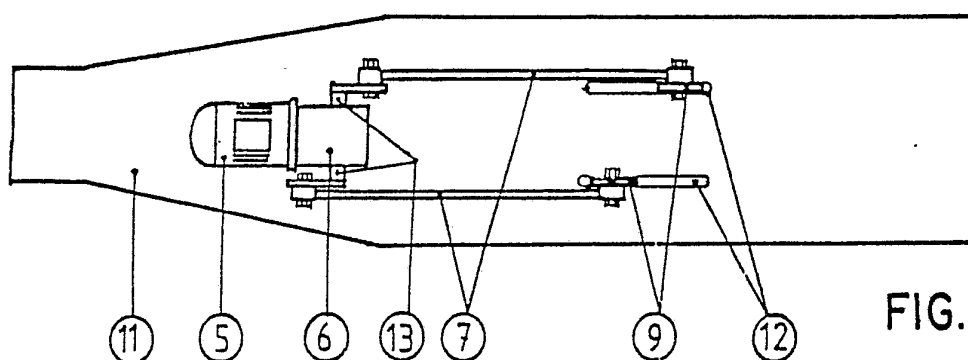


FIG. 3

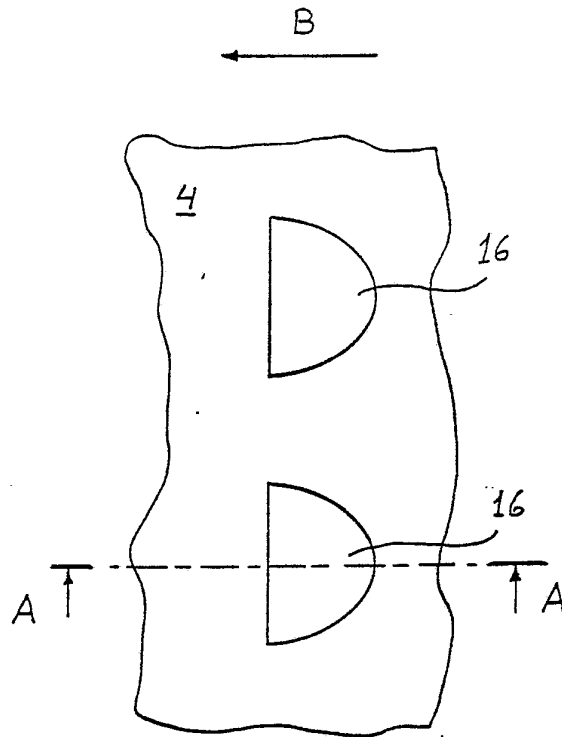


FIG. 4



FIG. 5

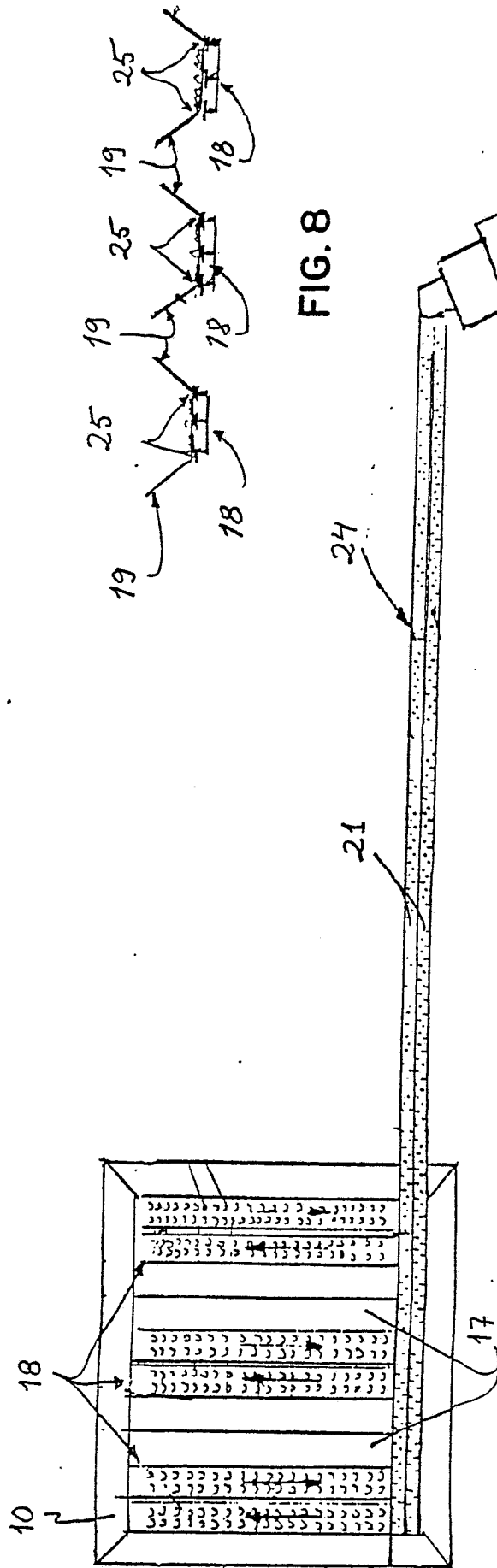


FIG. 6

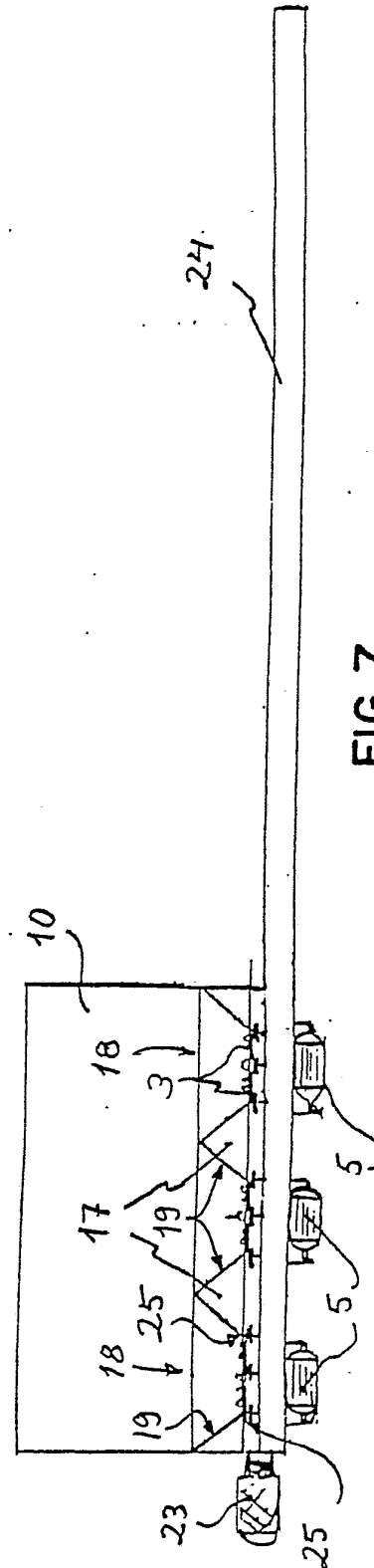


FIG. 7

INTERNATIONAL SEARCH REPORT

International Application No PCT/FI84/00059

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ³ According to International Patent Classification (IPC) or to both National Classification and IPC 3		
B 65 G 65/44		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁴		
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IPC 3 US C1	B 65 G 65/44, 25/04, 08 214: 17; 198: 736, 747, 748, 773	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁵		
SE, NO, DK, FI classes as above		
III. DOCUMENTS CONSIDERED TO BE RELEVANT ¹⁴		
Category ⁶	Citation of Document, ¹⁶ with indication, where appropriate, of the relevant passages ¹⁷	Relevant to Claim No. ¹⁸
X	NO, B, 144 826 (OY TÄHKÄ AB) 10 August 1981	1-5
X	SE, B, 430 322 (BRUKS MEKANISKA AB) 7 November 1983	1-5
Y	EP, A1, 0 065 303 (MAYFRAN, INC) 24 November 1982 & JP 58026711 US 4433775	6
Y	US, A, 3 255 867 (K.M. ALLEN et al) 14 June 1966	7
X	US, A, 2 148 946 (O. HUBMANN et al) 28 February 1939	8-10
X	SE, C, 389 083 (A. AHLSTRÖM OY) 25 October 1976	8-10
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IV. CERTIFICATION		
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