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(54) **Plant for the separation of solid waste similar to solid urban refuse, in particular for the recovery of long, flexible material**

(57) Plant for the treatment of solid waste similar to urban refuse, in particular for the recovery of long, flexible material, comprising conveyor belts (11, 12) positioned in sequence and designed to transport the product, wherein at least one (12) of these belts carries the product to a raised area, characterised in that the raised area has at least one distribution device (13) for distributing long products comprising at least one support for one or more rods (15, 30, 41) or pick-up elements (34) designed to sort the material and deposit it in a container or onto a special conveyor (22) provided for this purpose.

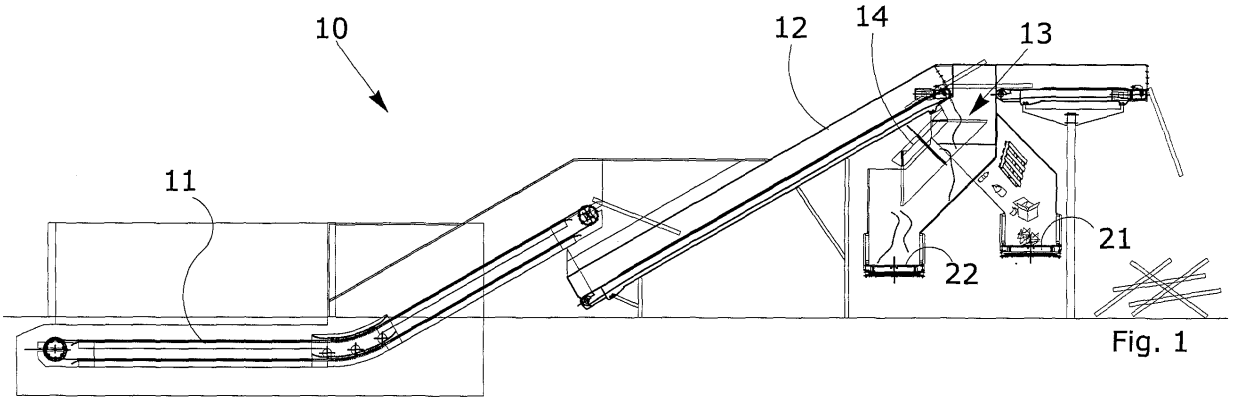

Fig. 1

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Description

TECHNICAL FIELD

[0001] The present invention relates to automatic plant for the sorting of solid waste similar to solid urban refuse, but not including special waste, and in particular for the separation and distribution of material, separating from the remainder any long, flexible material which can be recycled.

[0002] In particular the present invention relates to a device which enables the extraction from waste material (consisting mostly of packaging) originating from commercial, industrial or construction site sources of long, light, flexible and relatively thin material (film, sheeting, straps etc.) which usually obstructs the efficient sorting of various types of waste.

[0003] The device according to the present invention comprises a drum rotating around its own axis fitted around its circumference with rods extending radially and suitably angled. The drum rotates so that the rods intersect the surface conveying the material at right angles. The rods sweep the material into a special container.

[0004] The present invention relates to the field of plant and equipment for the sorting and recycling of waste and in particular waste which is similar to solid urban refuse and does not contain special or toxic wastes.

BACKGROUND ART

[0005] There is widespread public interest in waste disposal and the recycling of waste materials.

[0006] At present there are already many technologies and methods in existence for the sorting of waste material. Waste material must be sorted before it can be recycled and selection and sorting are therefore necessary parts of the recycling process.

[0007] At the present time the technical solutions developed for sorting waste materials are as follows:

- Rotary screens.
- Ballistic screens.
- Air separation systems.
- Electronic-optical systems.

These technical solutions are widely used in the treatment of solid urban refuse and enable the separation of an initially heterogeneous flow of waste into multiple sub-flows each of which has a reasonable level of homogeneity; at this point the sub-flows require relatively little further human intervention which consists mainly of manual sorting and quality control.

[0008] The treatment of solid waste similar to urban refuse has benefited to a very limited extent from these technical developments. One of the main reasons for this is the presence inside waste of this type of long, light, flexible and thin material such as wrapping film, sheeting, straps, cables and similar items.

[0009] All these materials, even though they do not constitute special or toxic waste, represent a serious problem for the treatment process in that they hinder the sorting process used to separate materials into various types.

[0010] In the traditional types of plant for sorting refuse, polyethylene tape, nylon sheeting or wires wrap around and hold small items of waste thereby preventing efficient sorting. In some cases these obstructions can even block the equipment.

[0011] When this happens, the sorting operatives are obliged to stop the equipment and recover this material by hand removing it from the conveyor belt. This is a laborious method of freeing the remaining material so that the sorting process cycle can continue.

[0012] An alternative practice at this point is to stop further sorting of what is still heterogeneous material. However, this approach is costly because the polyethylene and plastic film that could otherwise be recovered are materials with a high recycling value.

[0013] At this point the sorting and recovery of this material would obviously be advantageous. Recovery offers three advantages:

- It enables improved sorting of other waste.
- It makes it possible to recycle this material once it has been recovered and separated.
- It makes it possible to use existing plant originally designed for treating solid urban refuse for treating solid wastes similar to urban refuse.

[0014] At present, a system for recovering light, plastic or broad-surface material such as polythene belts, tapes or nylon sheeting, is implemented on a machine covered by the patent no. EP 1.105.222.

[0015] This patent combines a conveyor device carrying the heterogeneous material flow with a pickup device for picking up the material. The pickup device comprises a conveyor equipped with teeth which act on the heterogeneous flow of material; the teeth exert pressure on the material as they pickup the material.

[0016] This solution, too, has numerous functional limitations when applied to the treatment of solid wastes similar to urban refuse because this type of material is not handled efficiently by the action of the pickup teeth. By its nature this type of refuse frequently consists of large and heavy items. Packing cases, for example, are difficult to handle because they are difficult to pickup with the teeth and also shield the material underneath.

DESCRIPTION OF THE INVENTION

[0017] The object of the present invention is that of providing plant for the separation and subsequent recycling of long, flexible products, which eliminates or at least reduces the shortcomings described previously.

[0018] The invention also provides a plant for the recovery, disposal and recycling of long, flexible products

which given that it is simple and relatively inexpensive to manufacture could advantageously be used widely on a large scale.

[0019] These objectives are achieved by means of a plant for the recovery, disposal and recycling of long, flexible products, whose characteristics are described in the main claim.

[0020] The dependent claims describe example embodiments of the present invention.

[0021] The main advantages of this solution, in addition to those which derive from the simplicity of its construction, principally concern the fact that long fibrous waste products are collected by a special device which then channels these products to a channel which is separate from that for normal products or for those of a certain size.

[0022] In a preferred embodiment the channel is positioned to the side and it is for this reason that the selector device, in its preferred embodiment, comprises a drum rotating on its own axis, fitted around its circumference with rods extending radially and suitably angled.

[0023] In this solution, as described in more detail below, the drum rotates so that the rods intersect the flow of material to be sorted as it passes by.

[0024] The rods are suitably spaced apart and are positioned at an angle in relation to the drum surface.

[0025] The angle of the rods in relation to the drum surface is such that each rod passes gradually from a horizontal position where it touches the flow of material to a vertical position.

[0026] The effect of this movement is such that the rods sweep the long, flexible material into a special container.

DESCRIPTION OF THE DRAWINGS

[0027] Further features and advantages of the invention will become apparent from the description of an embodiment which follows with reference to the annexed drawings, given purely by way of a non-limiting example, in which:

- Figure 1 shows a side view of the plant according to the present invention.
- Figure 2 shows a plan view of the same.
- Figures 3 and 4 show a side view and plan view of part of the extractor device of the plant according to the present invention.
- Figures 5 and 6 show a side view and a plan view of further embodiment of the plant according to the present invention.
- Figures 7 and 8 show a side view and a plan view of further embodiment of the plant according to the present invention.
- Figures 9 and 10 show a side view and plan view of part of the extractor device of the plant according to the embodiment in Figures 7 and 8.
- Figures 11 and 12 show a side view and a plan view of a variant of part of the extractor device of the plant according to the embodiment in 7 and 8, where the variant is obtained by doubling the extraction mechanism.
- Figures 13 and 14 show a side view and a plan view of a further embodiment of the plant according to the present invention.
- Figures 15 and 16 show a side view and plan view of part of the extractor device of the plant according to the embodiment in Figures 13 and 14.
- Figures 17 and 18 show a side view and a plan view of a further embodiment of the plant according to the present invention.
- Figures 19 and 20 show a side view and a plan view of a further embodiment of the plant according to the present invention.

DESCRIPTION OF ONE EMBODIMENT OF THE INVENTION

[0028] With reference to the accompanying drawings and in particular to Figures 1 to 4 which show a preferred embodiment, the plant according to the present invention is shown in its entirety by the numeral 10 and substantially comprises one or more conveyor belts 11 and 12 positioned in sequence and designed to transport the product.

[0029] At least one of the conveyor belts, in this case the conveyor belt 12, carries the product to a raised area where the long product distribution device 13 according to the present invention is positioned.

[0030] The distribution device 13 is fixed under the drive head of the conveyor belt 12 and comprises a drum 14 carrying a plurality of rods 15 which are positioned to intercept the long, flexible material.

[0031] The drum 14 is fitted to a shaft 16, mounted on a bracket 17, which receives rotary power from a gear motor 18.

[0032] The bracket 17 in turn is mounted on a column 19 which supports the sorting device at the top and which is fixed to the floor by means of a fixing plate 20.

[0033] In the first embodiment described and illustrated here, the drum 14 is mounted on an axis angled for example at approximately 45° and has rods 15 extending radially which are also angled at a specified angle in relation to the drum axis to form a layout which is substantially a truncated cone.

[0034] The drum 14 carrying the rods 15 rotates in continuation driven by a shaft 16 powered by a gear motor 18.

[0035] As already described, the machine is located directly underneath the conveyor belt drive head and where the material transported by the conveyor belt drops down into the area directly below where it can be collected by a first collection belt 21, while the long, flexible products selected by the device according to the present invention are collected on a second collection belt 22 running parallel to the first belt and in any case positioned outside the collection zone of the first belt.

[0036] The collection belts 21 and 22 are positioned at right angles to the direction of travel of the conveyor belt 12.

[0037] Large-size or rigid items of material drop directly down onto the first belt 21 and are only marginally disturbed by the movement of the rods 15 of the machine.

[0038] Long, flexible items, such as cables, strapping and film, on the other hand, tend to hang from the head of the belt for a length of time (which depends on their length) long enough for the rods 15 to push them sideways so that they fall into an area which is not the area where they would have fallen naturally, in other words onto the second separate collection belt 22.

[0039] The angle of the drum 14 and also of the rods 15 as they pass from a horizontal to a vertical position, means that the rods, when they are in their upper, horizontal position, can intercept the long, flexible material suspended from the belt head and then push it sideways holding it there until the following rod arrives in such a way that the material drops downwards onto a second conveyor belt 22.

[0040] Separating efficiency and the size of the items extracted depends on the device speed in relation to the speed of the belt and the distance of the machine from the drive head of the belt.

[0041] This means it is possible to select various positions between the two limit settings:

- The sorting machine 13 is positioned very close to the drive head of the belt 12 and rotates at a high speed:

  the machine is very efficient and will also extract medium-sized (less than 1.5 metres) flexible items

- The sorting machine 13 is positioned far away from the belt drive head (so that the material drops a considerable distance, for example 2 metres) and rotates at a slow speed:

  machine efficiency is relatively limited and the machine misses items which are shorter than 2 to 3 metres; longer items are intercepted.

[0042] Figures 5 and 6 show a machine similar to that described previously with the only difference being that the drum 23, rather than being positioned underneath and on an axis with the feed belt 12, is positioned to the side on an axis which is at right angles to the conveyor.

[0043] In this case the drum 23 selects all the long, rigid and flexible material first and then picks up the long, flexible material only from the belt 22 while the long, rigid material proceeds downstream.

[0044] Figures 7 and 8 show an embodiment where the selector 24 is not a drum type but a type with oscillating rods.

[0045] As the detail drawings in Figures 9 and 10 show, the selector device 24 comprises a supporting framework 25 fitted with a pivot 26 on which an oscillating mobile slider 27 swivels.

[0046] The selector device 24 is fixed with brackets 28 to the conveyor belt 12. The oscillating slider 27 is moved by an actuating cylinder (pneumatic or hydraulic) 29 fixed to the supporting framework 25.

[0047] An end of the oscillating slider 27 is equipped with a sliding rod 30 which intercepts the long, flexible material. The sliding rod is moved backwards and forwards between a retracted position and an extended position by a second actuating cylinder 31 whose rod is connected to an attachment 32 enabling retraction and extension of the rod 30.

[0048] From the functional point of view, the slider 27 moved by the cylinder 29, continuously travels quarters of a circle forwards and backwards swivelling around the pivot 26. The rod 30 on the slider 27 moves the long, flexible material transported by the conveyor belt 12 above to the side 12 so that it falls to the side of the normal dropping zone, in other words, onto the belt 22, while the short and rigid material drops onto the belt 21.

[0049] Figures 11 and 12 show the previous device doubled where the two cylinders 31 operate to retract the rod but only at preset times thus enabling the long, flexible material to be conveyed to one side only.

[0050] The mode of operation of the device and its related belt can be of two types, Solution A where the device and the belt operate in the continuous mode and Solution B where the device and the belt operate alternately.

[0051] For example, the belt travels forward by approximately 2 metres and then stops. At this point the device starts, completes its cycle and then stops. The belt then restarts.

[0052] The separating efficiency and the size of the items extracted depend on the speed of the device in relation to the speed of the belt.

[0053] For example, if you wish to extract material which is longer than 2 metres, the device must perform a complete cycle in at least the time it takes for the belt to travel 2 metres in Solution A, or, in Solution B the device must run be at twice the speed.

[0054] Figures 13 to 16 show a solution where the device for selecting long, flexible material consists of a gripper 34.

[0055] In this case the machine on which the gripper 34 is mounted is positioned at a pre-set distance in front of the drive head of the conveyor 12 to which it is linked.

[0056] The gripper 34 is on the belt axis while the machine structure and arm are in an offset position parallel to the belt axis.

[0057] In this case the machine comprises an arm 35 hinging on the pivot 36 of a support structure 37 and carrying, on its other end, a gripper 34 which substantially comprises two jaws hinged to each other which are opened and closed by means of actuating cylinders 34'.

[0058] The arm 35 is rotated by an actuating cylinder 38 while the angle of the gripper is regulated by another

actuating cylinder 39.

[0059] From the functional point of view, the rest or start position of this device is with the arm 35 in the upper position and therefore, in this cycle step, with the cylinder 38 fully extended.

[0060] Next, the cylinder 39 extends thus retracting the gripper 34 so that it closes on the long, flexible material; while this is happening, the cylinder 38 is retracted until the arm 35 is at the end of its downward stroke.

[0061] The gripper cylinders 34' open the gripper 34, the cylinder 39 shortens so that the gripper moves forwards; the gripper 34 activated by the gripper cylinders 34' closes thereby gripping the material which is hanging from the conveyor belt drive head.

[0062] The work cycle continues as follows. The cylinder 39 extends thus retracting the gripper 34; the cylinder 38 extends thus raising the arm 35 to its upper position.

[0063] The gripper 34, actuated by the cylinders 34' opens and deposits the long items in a special space or, better, on a special machine designed to recover the material.

[0064] The mode of operation of the device and its related belt can be of various types. The preferred mode is the alternating operating mode where the machine and the belt operate alternately and where the gripper 34 travels forwards under the belt drive head and closes when the belt is stopped.

[0065] The separating efficiency depends on the speed of the device in relation to the speed of the belt.

[0066] Figures 17 and 18 show an embodiment where the selection device for long, flexible material comprises a chain 40 with rods 41 which move on a plane which is at a tangent to the material flow or which is at right angles to the flow of material, as shown in Figures 19 and 20. The rods 41 located on the chain 40 push the long, light material into a container or onto a special conveyor belt 22 while the remaining product is deposited onto a conventional conveyor belt 21.

[0067] It is clear that the separation of this type of refuse from the remainder, using the principles embodied in this invention, takes place at the beginning of the selection cycle and does not include the possibility of treating other types refuse in an automatic mode and sending them on to a dedicated treatment selection line.

[0068] To summarise, according to the present inventions there are substantially seven ways of treating waste:

a) A drum rotating around its own axis fitted around its circumference with rods extending radially and suitably angled. The rotary motion of the drum is at a tangent to the material flow. The rods are suitably spaced apart and are angled in relation to the drum surface. The rods intersect the material flow at right angles and accompany the long, flexible material into a special container or onto a conveyor.

b) A drum rotating around its own axis fitted around its circumference with rods extending radially and suitably angled. The rotary motion of the drum is at right angles to the material flow. The rods are suitably spaced apart and are angled in relation to the drum surface. The rods accompany the long, flexible material into a special container or onto a conveyor.

c) A rod, pivoted at one end, performs an alternating motion on a plane intersecting the material flow. The rod pushes the long, light material on the two opposite sides and conveys it into a special container or onto a conveyor belt.

d) A pair of rods, each pivoted at one of their ends, which are coordinated to perform an alternating motion on a plane intersecting the material. The rods push the long, light material on one side and conveys it into a special container or onto a conveyor belt.

e) A rod, pivoted at one end, which performs an alternating motion on a plane at a tangent to the material flow, fitted on its mobile end with grippers for gripping the long, flexible material and accompanying into a special container or onto a conveyor.

f) A chain with rods moving on a plane at a tangent to the material flow. The rods push the long, light material into a container or onto a conveyor belt.

g) A chain with rods moving on a plane at right angles to the material flow. The rods push the long, light material into a container or onto a conveyor belt.

The invention as described above refers to a preferred embodiment. Naturally, while the principle of the invention remains the same, the details of construction and the embodiments may widely vary with respect to what has been described and illustrated purely by way of the example, without departing from the scope of the present invention

Claims

1. Plant for the treatment of solid waste similar to urban refuse, in particular for the recovery of long, flexible material, comprising conveyor belts (11, 12) positioned in sequence and designed to transport the product, wherein at least one (12) of these belts carries the product to a raised area, **characterised in that** the raised area has at least one distribution device (13) for distributing long products comprising at least one support for one or more rods (15, 30, 41) or pick-up elements (34) designed to sort the material and deposit it into a container or onto a special conveyor (22) provided for this purpose.

2. Plant for the separation of solid waste similar to urban refuse according to the previous claim, **characterised in that** the distribution device (13) is fixed under the drive head of the conveyor belt (12) and comprises a drum (14) carrying a plurality of rods (15) designed to intercept the flow of long, flexible mate-

rial and where the drum (14) is fitted to a shaft (16), mounted on a bracket (17), which receives rotary power from a gear motor (18) or similar, and also **characterised in that** the bracket (17) is mounted on a column (19) which supports the sorting device at the top and which is fixed to the floor by means of a fixing plate (20).

3. Plant for the separation of solid waste similar to urban refuse according to one of the foregoing claims, **characterised in that** the drum (14) is mounted on an axis angled for example at approximately 45° and has supporting rods (15) extending radially which are also angled at a specified angle in relation to the drum axis to form a layout which is substantially a truncated cone.

4. Plant for the separation of solid waste similar to urban refuse according to one of the foregoing claims, **characterised in that** the machine 13 is located directly underneath the drive head of the conveyor belt (12) and where the material transported by the conveyor belt drops down into the area directly below where it can be collected by a first collection belt (21), while the long, flexible products selected by the device according to the present invention are collected on a second collection belt (22), parallel to the first belt and in any case positioned outside the collection zone of the first belt.

5. Plant for the separation of solid waste similar to urban refuse according to one of the foregoing claims, **characterised in that** the collection belts (21, 22) are positioned at right angles to the direction of travel of the conveyor belt (12) and the long, flexible items, such as cables, strapping and film tend to hang from the head of the belt for a length of time (which depends on their length) which is long enough for the rods (15) to push them sideways so that they fall into an area which is not the area where they would have fallen naturally, in other words onto the second separate collection belt (22).

6. Plant for the separation of solid waste similar to urban refuse according to one of the foregoing claims, **characterised in that** the angle of the drum (14) and of the rods (15) as they pass from a horizontal to a vertical position, enables the rods, when they are in their upper, horizontal position, to intercept the long, flexible material suspended from the belt head and push it sideways holding it there until the following rod arrives in such a way that the material drops downwards onto a second conveyor belt (22).

7. Plant for the separation of solid waste similar to urban refuse according to one of the foregoing claims, **characterised in that** the drum (23), rather than being positioned underneath and on an axis with the feed belt (12), is positioned to the side on an axis which is at right angles to the conveyor, and also **characterised in that** the drum (23) selects all the long, rigid and flexible material first and then picks up the long, flexible material only from the belt (22) while the long, rigid material proceeds downstream.

8. Plant for the separation of solid waste similar to urban refuse according to one of the foregoing claims, **characterised in that** the device for selecting long, flexible material is an oscillating rod (24) and also **in that** the selector device (24) comprises a supporting framework (25) fitted with a pivot (26) on which an oscillating mobile slider (27) swivels.

9. Plant for the separation of solid waste similar to urban refuse according to one of the foregoing claims, **characterised in that** the selector device (24) is fixed with brackets (28) to the conveyor belt (12) while the oscillating slider (27) is moved by an actuating cylinder (29) fixed to the supporting framework (25) and also **characterised in that** the slider (27) is equipped with a sliding rod (30) which intercepts the long, flexible material, and where the sliding rod (30) is moved backwards and forwards between a retracted position and an extended position by a second actuating cylinder (31) whose rod is connected to an attachment (32) enabling retraction and extension of the rod (30) and where the cylinder (31) operates to retract the rod but only at preset times thus enabling the long, flexible material to be conveyed to one side only.

10. Plant for the separation of solid waste similar to urban refuse according to one of the foregoing claims, **characterised in that** efficiency and the size of the items extracted depend on the speed of the device in relation to the speed of the belt and that the device for selecting long, flexible material consists of a gripper (34).

11. Plant for the separation of solid waste similar to urban refuse according to one of the foregoing claims, **characterised in that** the machine on which the grippers (34) are mounted is positioned at a preset distance in front of the drive head of the conveyor (12) to which it is linked.

12. Plant for the separation of solid waste similar to urban refuse according to one of the foregoing claims, **characterised in that** the grippers (34) are on the belt axis while the machine structure and arm are in an offset position parallel to the belt axis.

13. Plant for the separation of solid waste similar to urban refuse according to one of the foregoing claims, **characterised in that** the machine comprises an arm (35), hinging on the pivot (36) of a support struc-

ture (37) and carrying on its other end a gripper (34) which substantially comprises two jaws hinged to each other which are opened and closed by means of actuating cylinders (34').

14. Plant for the separation of solid waste similar to urban refuse according to one of the foregoing claims, **characterised in that** the arm (35) is rotated by an actuating cylinder (38), while the angle of the gripper is regulated by another actuating cylinder (39) and **characterised in that** the separating efficiency depends on the speed of the device in relation to the speed of the belt.

15. Plant for the separation of solid waste similar to urban refuse according to one of the foregoing claims, **characterised in that** the selection device for long, flexible material comprises a chain (40) with rods (41) which move on a plane which is at a tangent to, or at right angles to the material flow and **characterised in that** the rods (41) located on the chain (40) push the long, light material into a container or onto a special conveyor belt (22) while the remaining product is deposited onto a conventional conveyor belt (21).

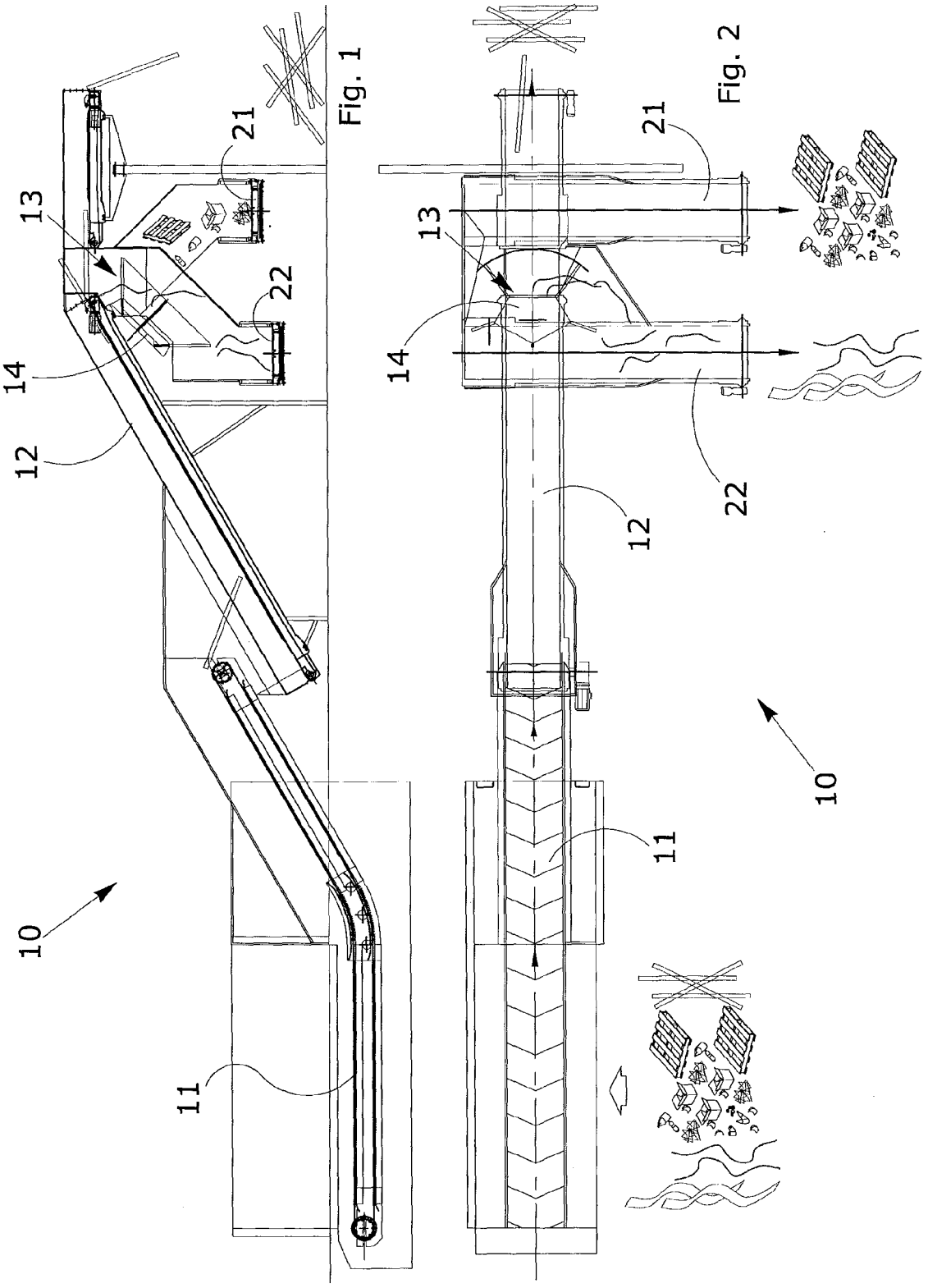

Fig. 1

Fig. 2

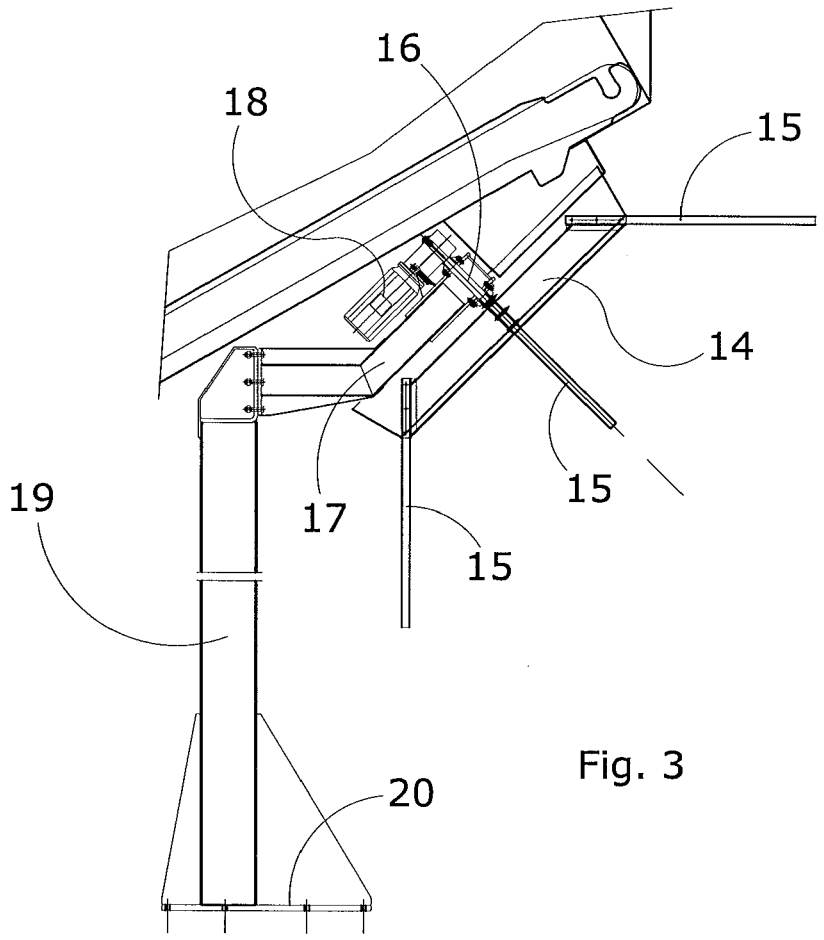

Fig. 3

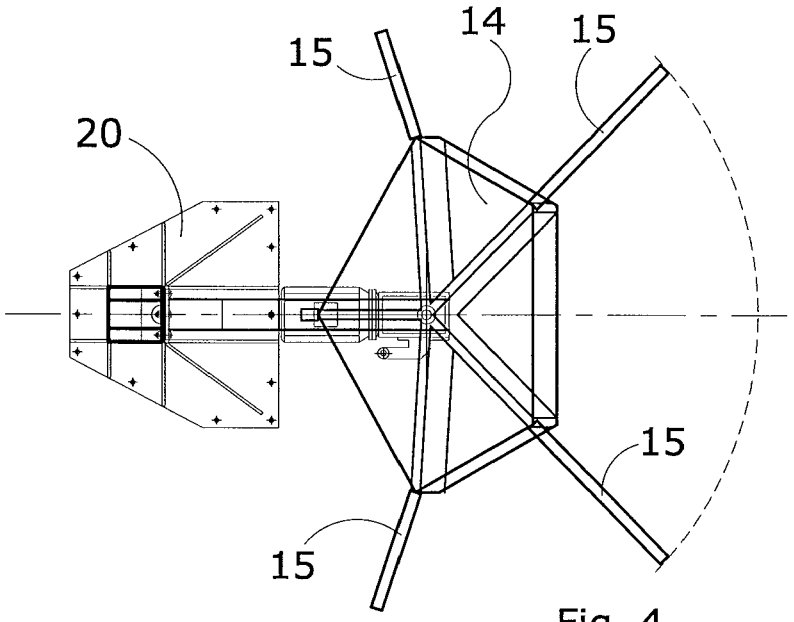

Fig. 4

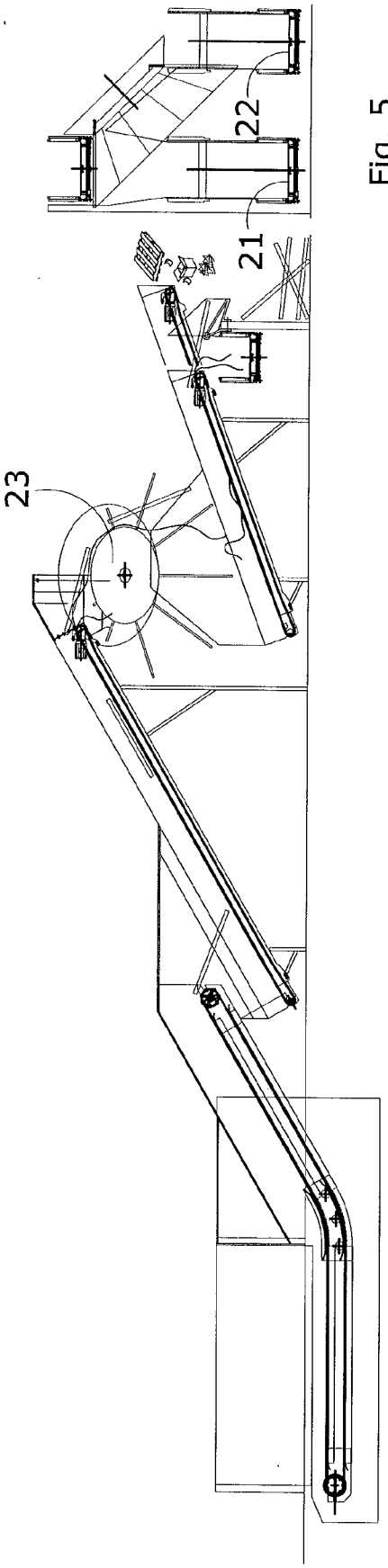

Fig. 5

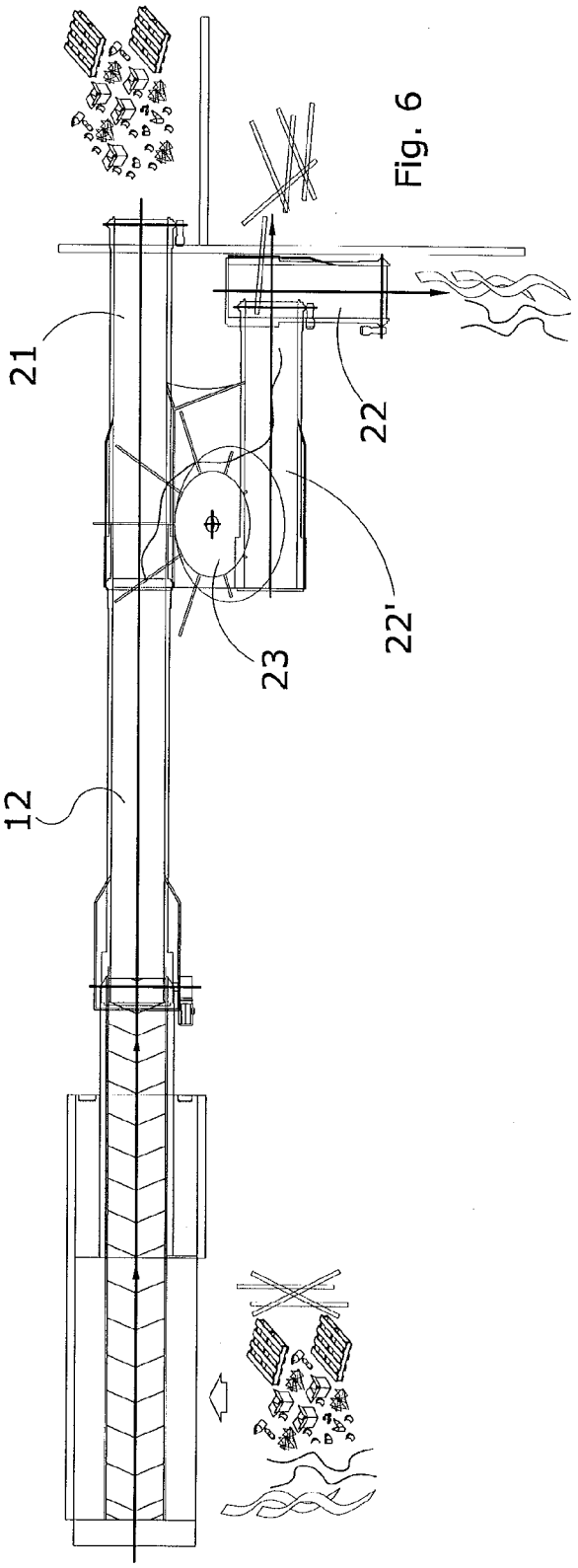

Fig. 6

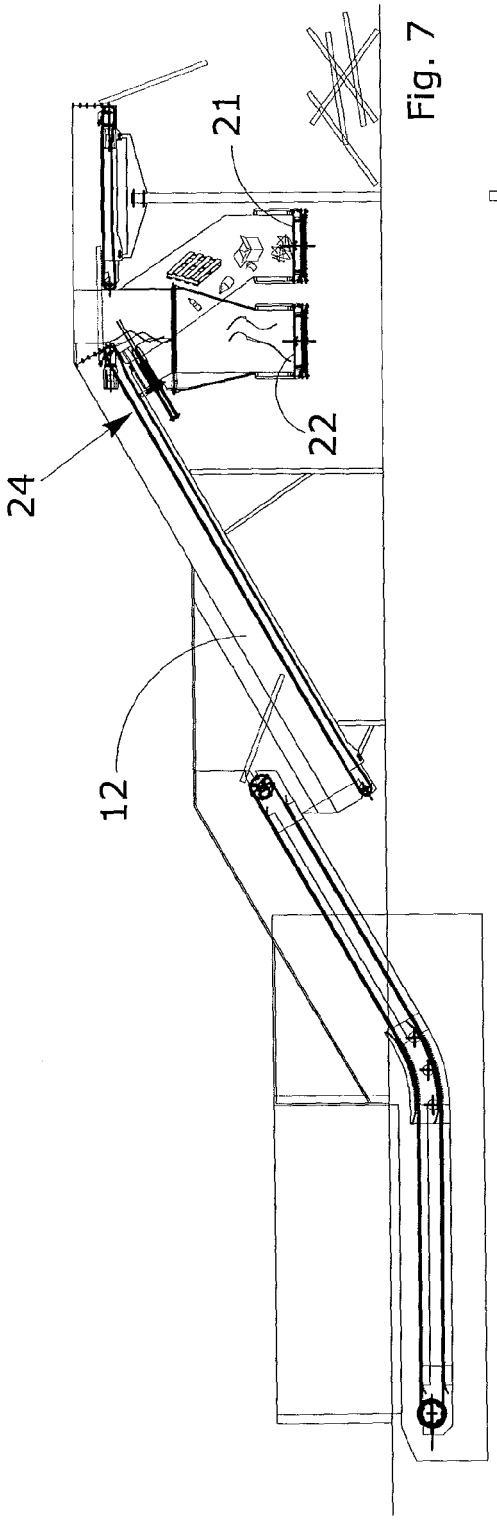

Fig. 7

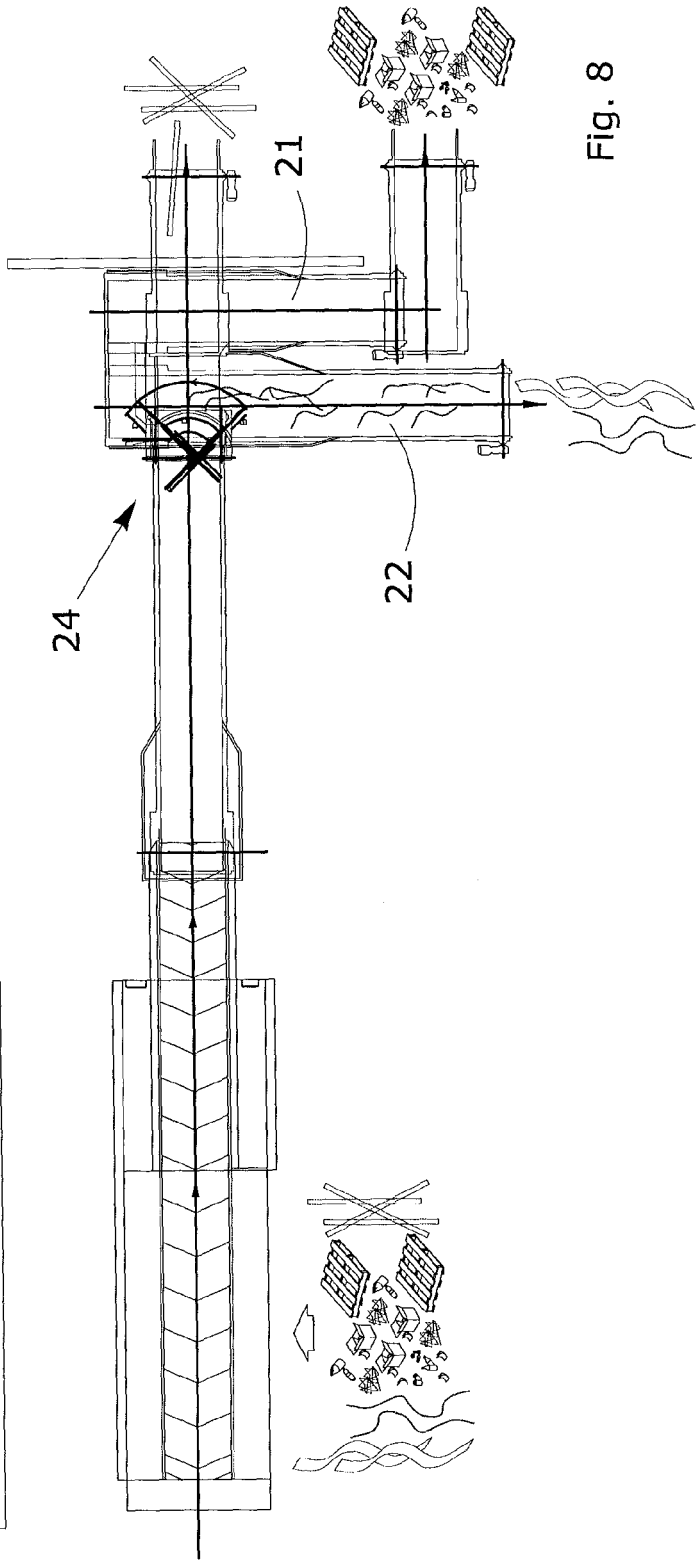

Fig. 8

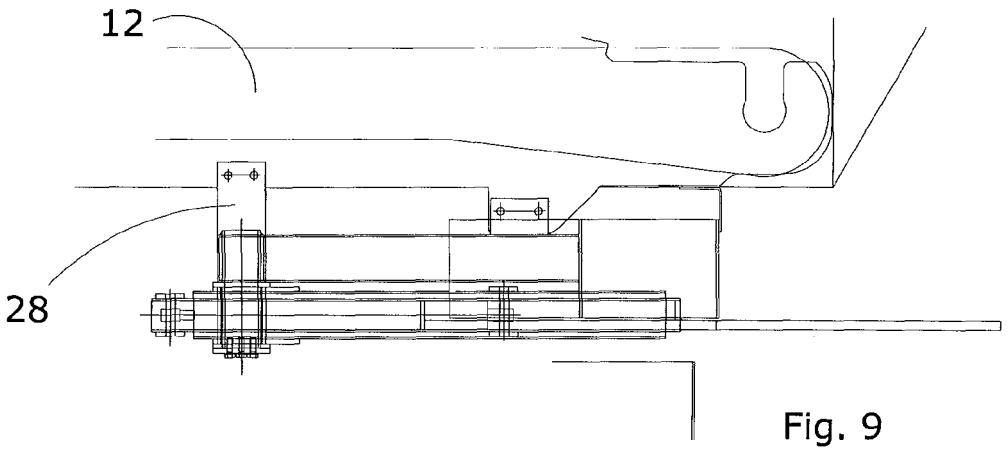

Fig. 9

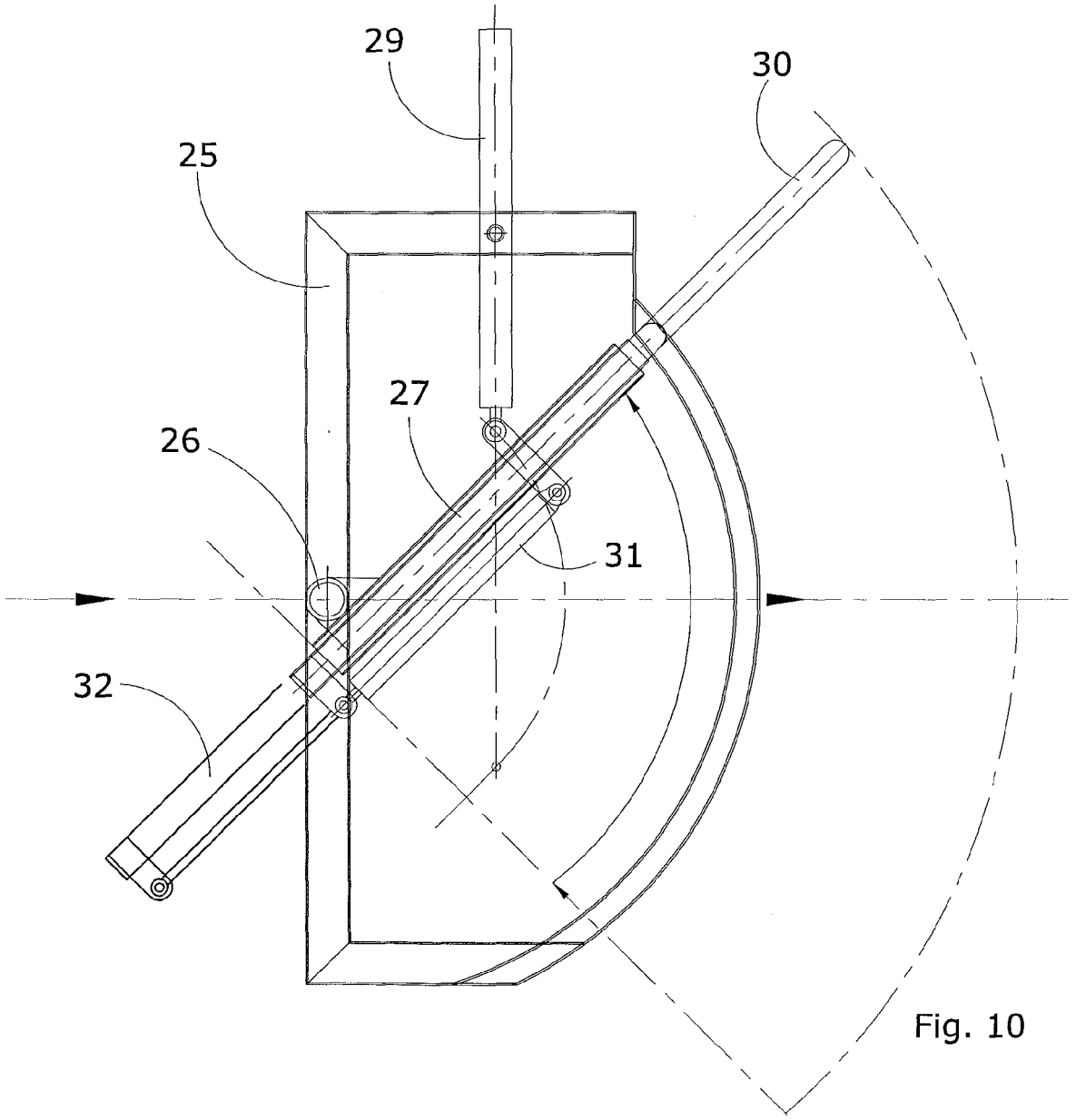

Fig. 10

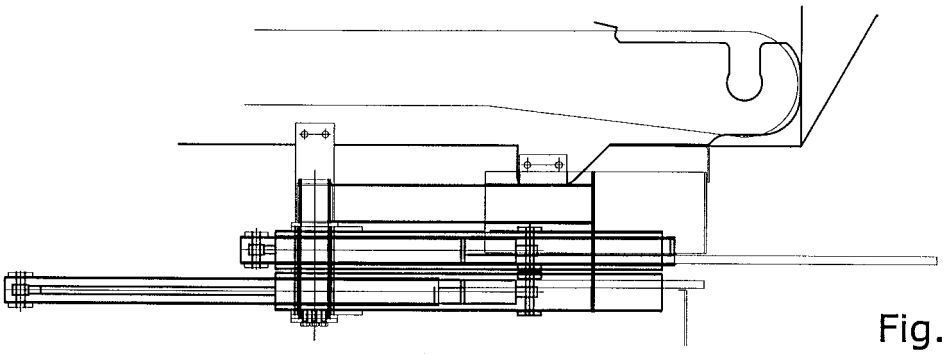

Fig. 11

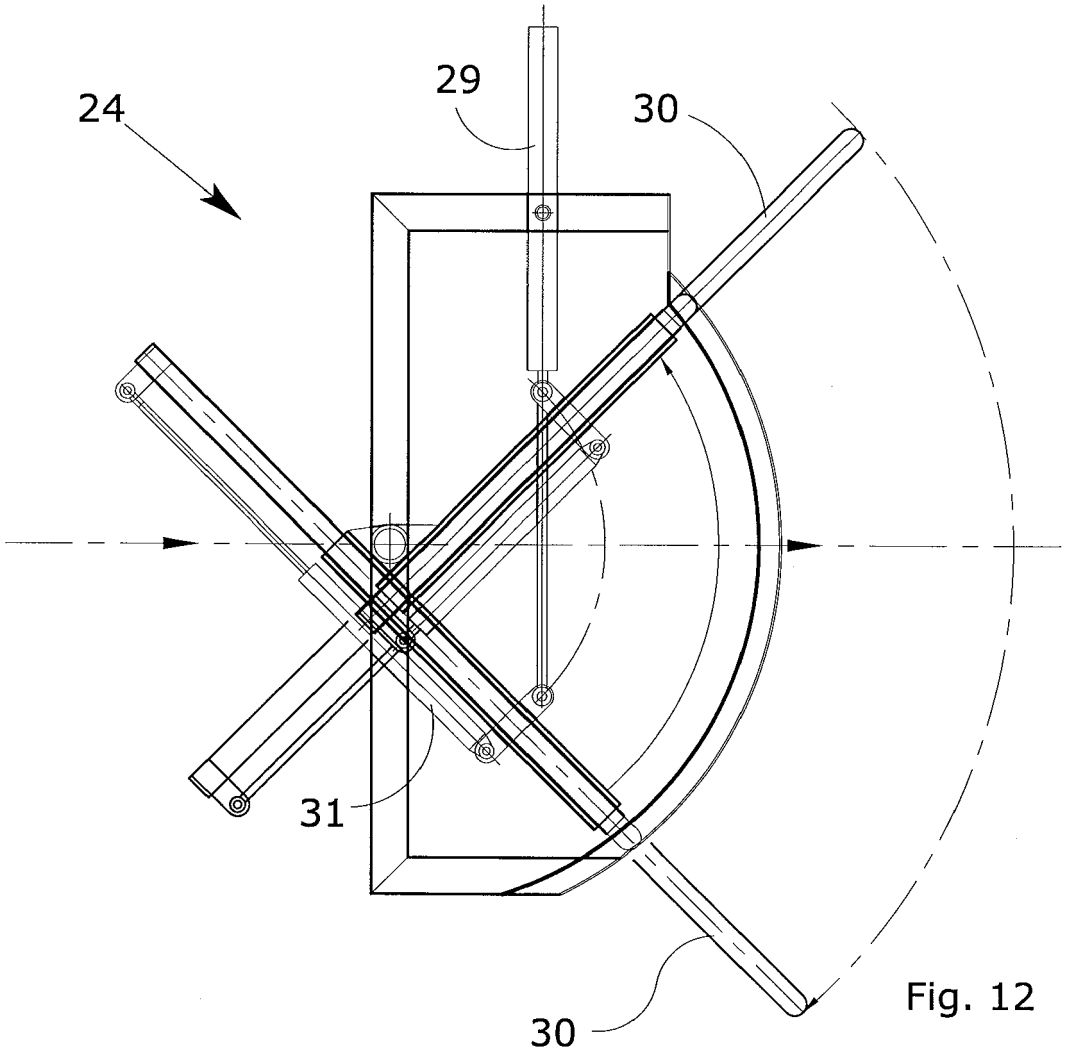

Fig. 12

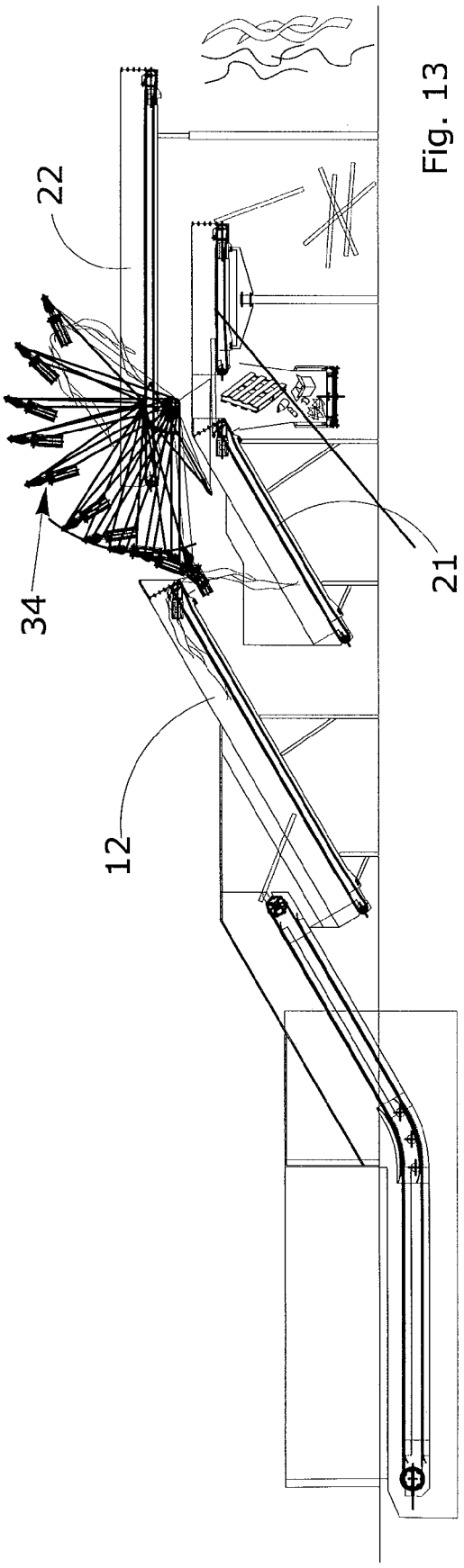

Fig. 13

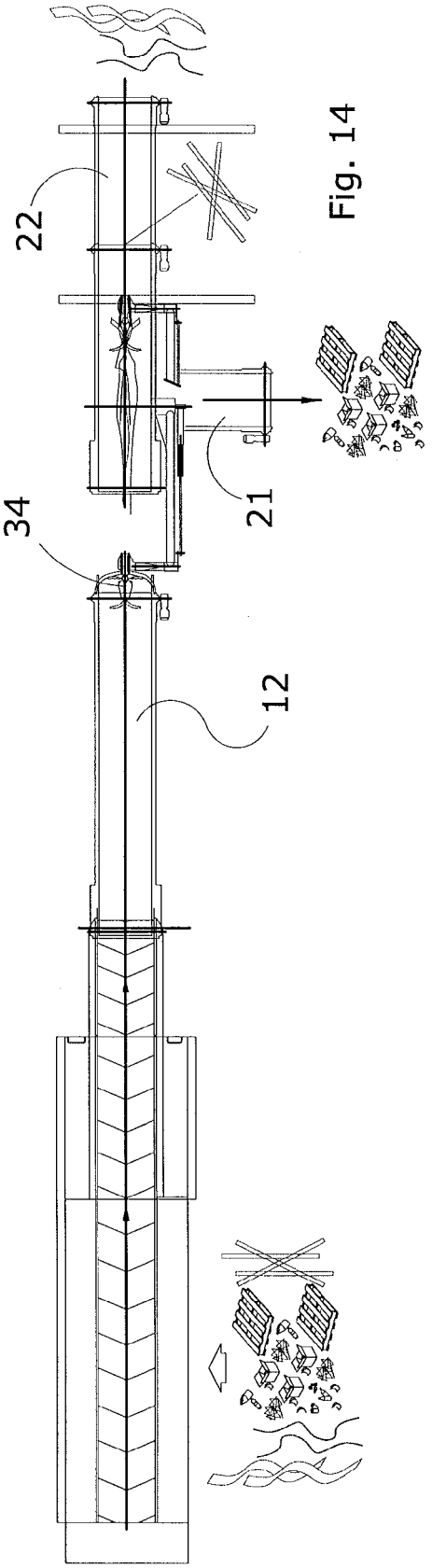

Fig. 14

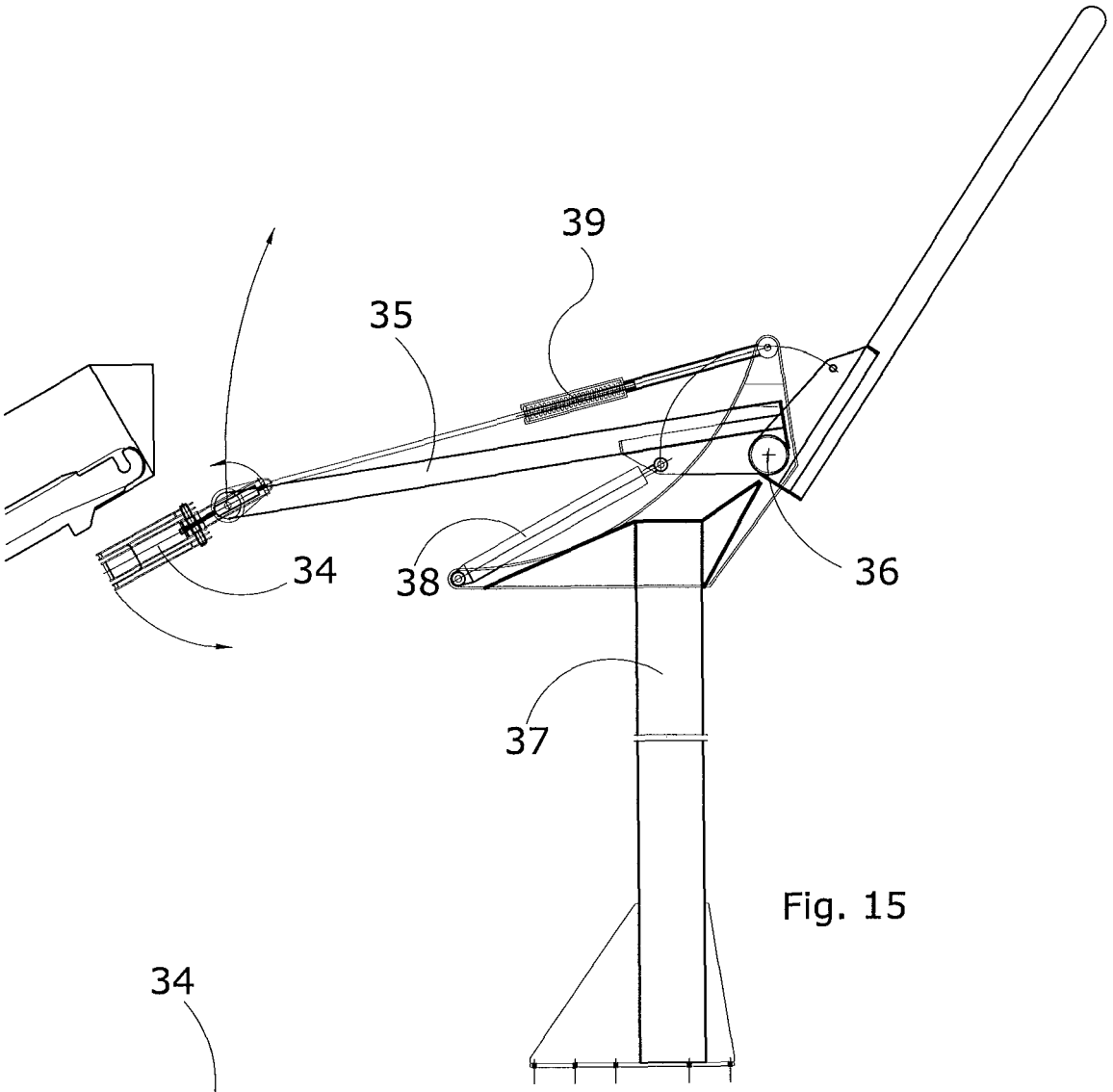

Fig. 15

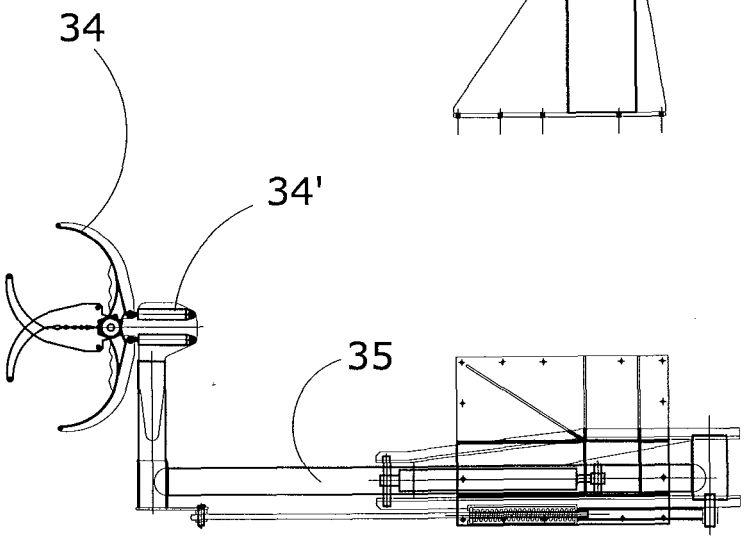

Fig. 16

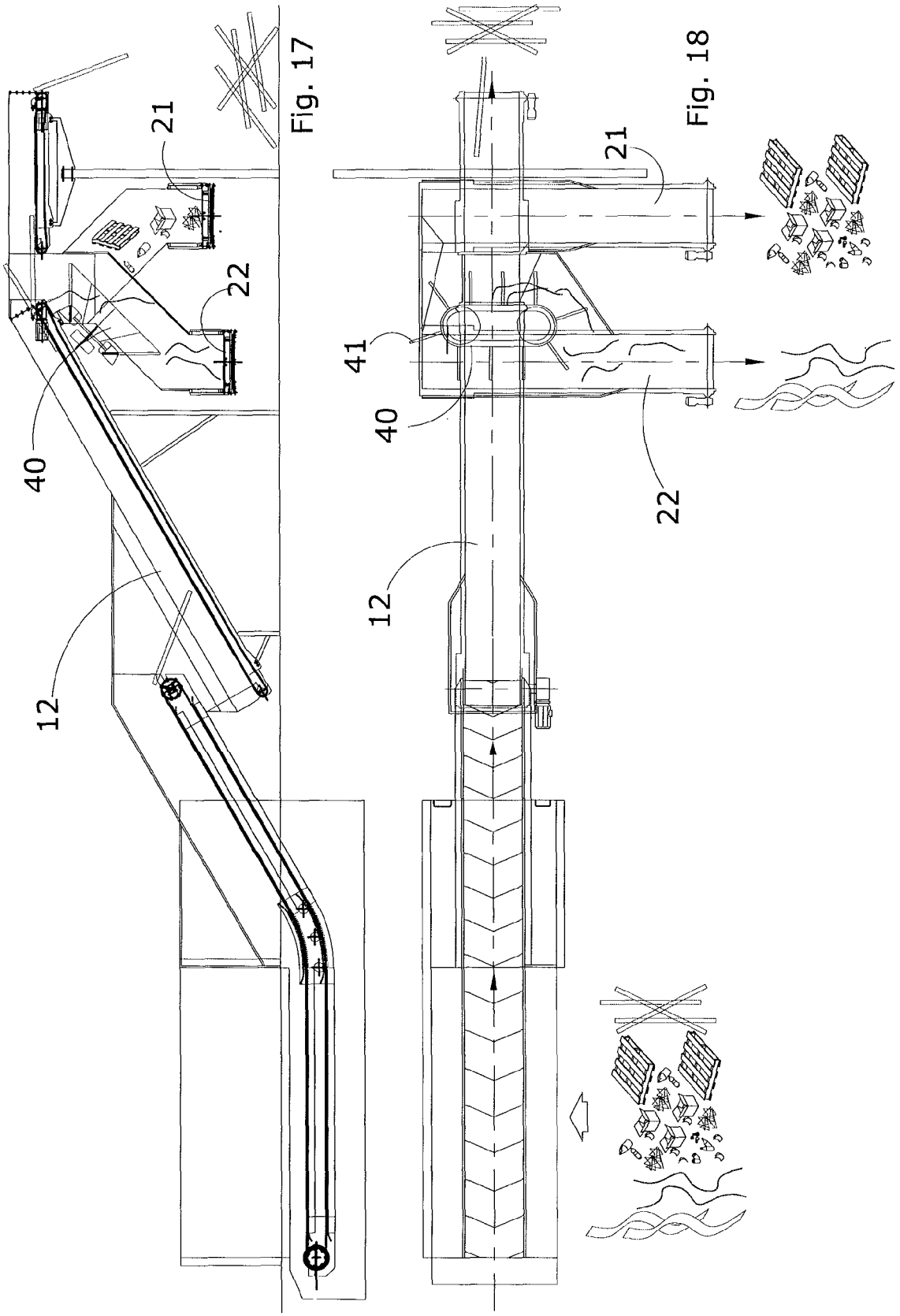

Fig. 17

Fig. 18

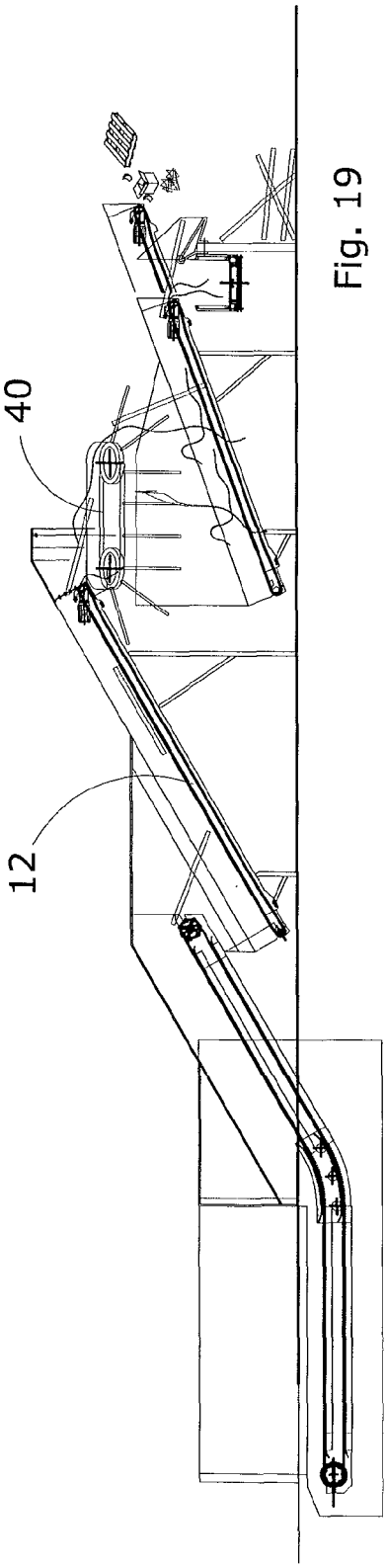

Fig. 19

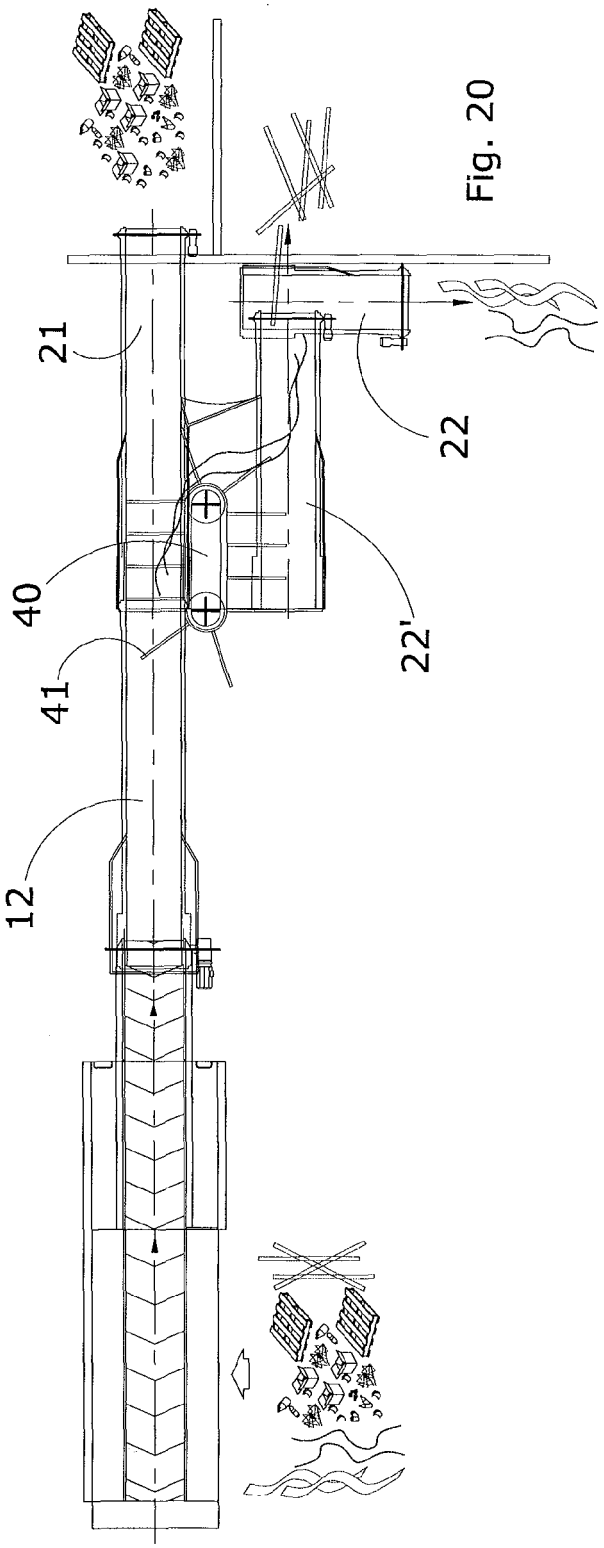

Fig. 20

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EUROPEAN SEARCH REPORT

Application Number
EP 08 15 4326

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X	US 2006/180522 A1 (LEGTENBERG HERMANNUS J M [NL]) 17 August 2006 (2006-08-17)	1	INV. B07B13/00
A	* abstract; claim 1; figure 1 *	2-15	B07B13/05
X	US 3 651 938 A (SUELLENTROP FRED F JR ET AL) 28 March 1972 (1972-03-28)	1	
A	* claim 1; figure 1 *	2-15	
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X	EP 0 492 259 A (LINDEMANN MASCHFAB GMBH [DE]) 1 July 1992 (1992-07-01)	1	
A	* claims 1,5,9; figures 10,16 *	2-15	

TECHNICAL FIELDS SEARCHED (IPC)

B07B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	18 July 2008	Devilers, Erick

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1

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