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(54) **A MIXING APPARATUS**

(57) The present invention relates to a mixing apparatus for building materials having a mixing container (10) comprising two compartments (12, 14) separated by a delimiting wall (20). The delimiting wall has an opening (22) restricting the flow of the contents from the first compartment where they enter the container to the second compartment where extraction occurs. This ensures that the contents have spent enough time inside the first compartment, where mixing occurs, to be thoroughly combined before being extracted.

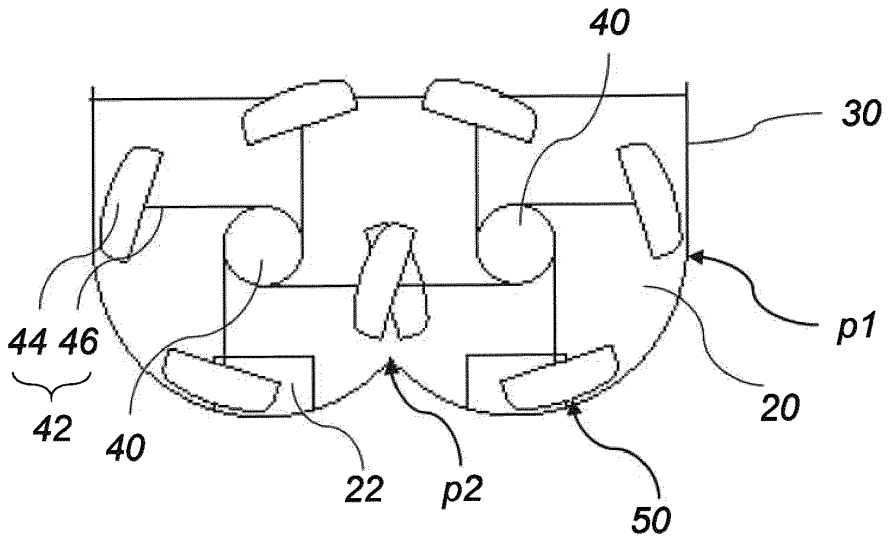

Fig. 3

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Description

Technical Field

[0001] The present disclosure relates to a building material mixing apparatus, and especially to functional components of a mixing container.

Background

[0002] In the field of construction and land preparation, there are building materials consisting of one or more components that need to be mixed before use e.g. concrete. Large construction sites that use large amounts of such materials typically need to bring in several batches using special mixing trucks. This solution has some drawbacks, the trucks are susceptible to delays as they transport the material from an outside location to the site. The material in the mixing trucks often can't be stored without stirring leading to timing challenges. The material is supplied in batches, which often is less desirable compared to having a continuous supply on demand, also, the properties of different batches might vary.

[0003] An alternative to using mixing trucks that ship building materials from an outside plant to a construction site is to have all material components on site and mix them when needed in a mobile building material mixer. For this solution to be implemented, the site manager needs to sacrifice a substantial amount of space for the mobile mixer and the piles of component materials. Having to load the mixer using more heavy machinery takes up even more space and man-hours. This way of loading the mixer is therefore not ideal since the use of heavy machinery such as front loaders is something that should typically be minimized from a safety and efficiency standpoint on busy, spatially compact building sites.

[0004] Moreover, measuring the component materials in e.g. front loader scoops is not very accurate and can lead to inconsistencies when it comes to the mixed product.

[0005] Since the purpose of a building material mixer is to mix building materials, it is crucial that it does its job well and consistently meaning that the material extracted from it should be evenly mixed and not have heterogenous concentrations of the component materials. Ideally, the mixer should be able to reproduce a finished mixed product consistently given the same input materials.

[0006] Consequently, there is a need for a building material mixing apparatus that may provide an improved supply of mixed building material at a construction site.

Summary

[0007] It is an object of the present invention to provide an improved solution that alleviates the mentioned drawbacks with present state of the art. Furthermore it is an object to provide a continuous supply of consistently mixed building materials on site and on demand. The invention is defined by the appended independent claims, with embodiments being set forth in the appended dependent claims, in the following description and in the drawings.

[0008] According to an aspect of the inventive concept, there is provided a mixing apparatus for mixing building materials, the mixing apparatus comprising: a container comprising mixing members, characterized by the container comprising a mixing space delimited into two compartments by a wall, the wall having an opening allowing the material being mixed to flow along a longitudinal extension of the container from a first compartment to a second compartment, the first compartment being where the components to be mixed enter the container, and the second compartment being where the mixed building material is extracted from the mixing container.

[0009] The key concept of this invention is that the opening in the delimiting wall limits the flow of building materials being mixed from the first compartment to the second compartment thereby increasing the time the component materials spend in the first compartment, where they are mixed before they enter the second compartment where they may be extracted. Without this wall, it may be possible for some of the component materials to flow to the area where they are extracted before they are thoroughly mixed, thus compromising the product. Further, by separating the two compartments such that the building material to be mixed only passes through the opening when being moved from the first compartment to the second compartment, a more continuous mixing may be performed, also enabling a more continuous extraction of mixed building material. The wall may be arranged in a plane perpendicular to the axis of the longitudinal extension of the container. When in normal use, the longitudinal extension of the container may be in a substantially horizontal plane. Gravity would thereby not substantially affect the flow of the building material in the container.

[0010] In one embodiment, the mixing members may be attached to an axle, the axle being oriented along an axis of the longitudinal extension, the axle being configured to rotate around said axis during use. An advantage of this embodiment is that one primary movement, the rotation of the axle, may cause a plurality of mixing members to move relative to the building material. The building material may thereby be mixed at several locations at once.

[0011] In one embodiment, the mixing members may be configured to move the materials being mixed toward the area of extraction. This may be achieved by a combination of the shape of the mixing members and the way they move relative to the building material being mixed. This may for example be achieved by having mixing members formed in an angle to the axis of the longitudinal extension, such that building material being in contact with a particular mixing member is moved in direction towards the area of extraction. If the building material

being mixed are such that it does not flow easily by nature, it may risk getting stuck in the first compartment for too long. Using mixing members directing the building material may mitigate this issue.

[0012] In one embodiment, the opening in the delimiting wall may have an area of between 100 and 3000 cm^2, preferably between 500 and 2000 cm^2, more preferably between 700 and 1500 cm^2. The dimensions of the opening may influence the rate of flow of materials between the compartments mentioned above. A smaller opening may have a lower rate of flow compared to a larger, similarly shaped opening centered at the same location. Decreasing the size of the opening may cause the components of the building material to spend more time in the first compartment before reaching the extraction area. A smaller opening may therefore cause the building material to be mixed for a longer time before being extracted. On the other hand, if the building material being mixed is such that it does not flow easily by nature, a small opening may cause them to get stuck in in the first compartment for too long after being well mixed and ready for extraction. In such case a small opening may limit the rate of production of extractable material and a larger opening may be desired. The size of the opening may be based on the type of building material to be mixed. In one embodiment, the size of the opening may be adjustable.

[0013] In one embodiment, the size of the opening in the delimiting wall may be expressed in percent of the total area of the delimiting wall. The opening may have a size corresponding to less than 30%, less than 20% or less than 10% of the total area of the delimiting wall.

[0014] In one embodiment, the opening may be located in a lower portion of the delimiting wall. "Lower portion of the delimiting wall" may refer to the general area of the delimiting wall that would be in contact with the building material in the mixing container if said container would only be partially full. Partially full may mean, for example if the surface level of the building material is lower than the axle mentioned in a previous embodiment. If the surface level of the building material being mixed is below the openings lowest point, there will be no flow into the second compartment, and a portion of the components may be stuck in the first compartment. Therefore there may be an advantage of having the opening in the lower part of the wall.

[0015] In one embodiment, the container may have a bottom surface, and the opening may be arranged adjacent said bottom surface. By placing the opening adjacent the bottom surface it may be meant that the opening may be partly delimited by said bottom surface. It may thereby be ensured that building material being mixed may be moved completely to the second compartment.

[0016] In one embodiment, the mixing members may be attached to an axle, the axle being oriented along an axis of the longitudinal extension, the axle being configured to rotate around said axis during use, wherein the shape of the container is such that the mixing member's radially most distant part from the longitudinal axis of the axle around which it may rotate is essentially flush against the inside of the container for a part of the rotation. During this part of the rotation, little to no material may flow around the mixing member on the side that is very close to the containers inner wall, thus displacing more material compared to if it was allowed to flow around the mixing member to a larger extent. This may improve the directing of the flow of the building material to be mixed.

[0017] In one embodiment, the components of the building material may be configured to enter the container by means of an automatic feeding system. An example of such an automatic feeding system may be implemented using one or more conveyer belts configured to transport the respective right proportions of component material from storage containers, where said components may be transported to the first compartment of the container. This may improve the control of the relative proportions of the components of the building material as well as provide a more even, continuous influx to the container compared to loading the container with e.g. front loaders in batches.

[0018] In one embodiment, the mixing apparatus may comprise a sensor unit configured to be used for control of the influx of building material components to the container. The advantage of having a sensor unit that measures a parameter relating to the state of the mixing apparatus is that the desired influx of component materials may depend on this parameter. By knowing the value of this parameter, the influx of component materials may be adjusted accordingly. E.g. reducing the influx when the amount of material in the container is above an upper threshold and increasing the influx when the amount of material in the container is below a lower threshold. If the amount of building material to be mixed in the container is too low, there may be a risk that building material moves to the second compartment and the area of extraction before it is completely mixed. Further, if the amount of building material in the container is too high, the amount may reach a limit of the mixing capability of the mixing apparatus. The sensor unit may further be used for control of the extraction of mixed building material at the area of extraction. E.g. if the amount of material in the container is below the lower threshold, extraction of material at the area of extraction may be disabled. The extraction of material may thereafter again be enabled when the amount of material in the container is above a third threshold being between the first and second thresholds.

[0019] In one embodiment, the sensor unit may be configured to measure the amount of building material in the container. The measured amount of building material in the container may be used for controlling the influx of component materials and/or extraction of mixed material as discussed above.

[0020] In one embodiment, the sensor unit may be configured to measure the weight of the container. An advantage of a weight sensor is that it may give a meaningful reading even though the contents in the container

may not be evenly distributed.

[0021] In one embodiment, the sensor unit may be configured to measure the surface level of the building material in the container. An advantage of a sensor that measures the surface level of the building material in order to determine the amount of material in the container may be that it does not depend on the density of the contents.

[0022] In one embodiment, the relative positioning of the influx of the components with respect to each other and to the container may be such that they enter the mixing container at the first compartments half associated with its distal side with respect to the delimiting wall.

[0023] The relative location of the influx of the components with respect to each other and the container may lead to different mixing properties. For example in the case where the components of concrete are being mixed, a better result may be achieved when all component materials enter the container at the first compartment's distal side relative to the delimiting wall. When the component water enters the container at the first compartment's proximal side relative to the delimiting wall and the remaining component materials enter the container at the first compartment's distal side relative to the delimiting wall, an undesired effect may occur; the water may flow straight through the opening into the second compartment while the remaining, solid and granulated component materials remain in the first compartment. If the user were to extract the contents from the second compartment in this situation, they would receive a compromised product.

[0024] In one embodiment, the building material to be mixed may be concrete, and the component water may be entered into the first compartment at a location closer to the delimiting wall than the other components.

[0025] In one embodiment, the building material to be mixed may be concrete. While most of the description above refers to the mixing apparatus being used for mixing concrete on building sites, it may also be used within the field of land preparation. On building sites dealing with land preparation, sometimes specific mixtures of e.g. soil, sand and gravel may be needed, or other building material comprising solid, semisolid or liquid components. The mixing apparatus may be applied in this scenario, however the size of the opening in the delimiting wall might need to be adjusted.

Brief Description of the Drawings

[0026] The invention will in the following be described in more detail with reference to the enclosed drawings, wherein:

Fig. 1 shows a top view of a mixing apparatus according to an embodiment of the invention.

Fig. 2 shows a cross sectional side view of a mixing apparatus according to an embodiment of the invention.

Fig. 3 shows a cross sectional side view of a first compartment (12) of a mixing apparatus according to an embodiment of the invention.

Description of Embodiments

[0027] The present invention will be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. In the drawings, like numbers refer to like elements.

[0028] The invention comprises a mixing apparatus comprising a container 10 having a longitudinal extension along a longitudinal axis X. The container is delimited by a delimiting wall 20 having at least one opening 22. In the illustrated embodiment the delimiting wall 20 comprises two openings 22, as seen in fig. 3. The delimiting wall 20 forms a first compartment 12 and a second compartment 14 of the container 10.

[0029] The opening 22 in the delimiting wall 20 limits the rate of flow of material from the first compartment 12 where the material components to be mixed enter the container and the second compartment 14 where the mixed material is extracted. This ensures that the material components have spent enough time being mixed before being extracted, thereby improving the homogeneity of the extracted building material. The first compartment 12 comprises moving mixing members 42 configured to mix the component building materials. The second compartment 14 also comprises moving mixing members 42. This ensures that the mixed building material is being mixed until extracted. In the case where the building material is e.g. concrete, this allows for a buffer of material ready for extraction, since the mixing prevents the concrete from solidifying. The second compartment 14, which contains the mixed building material during use, is larger than the first compartment 12. Delimiting the container 10 in this way allows for a larger proportion of mixed material ready for extraction to material being mixed.

[0030] There is a rotatable axle 40, extending along the direction of the axis of the containers elongation X through the delimiting wall 20. The embodiment disclosed in Figs. 1-3 comprises a dual setup comprising two of these rotatable axles 40 with mounted mixing members 42. These two axles 40 rotate around their central axis, a1 and a2 respectively, during use. The mixing members 42 have a portion 46 configured to direct the material being mixed in a direction toward the area of extraction 60. The mixing members 42 has an elongated member 44. This elongated member extends in a substantially radially outward direction from the axis around

which it rotates, a1 or a2. The portion 46 is attached to the end of this elongated member 44. The elongated members 44 are typically formed as arms extending between the respective axle 40 and the mixing portions 46.

[0031] The shape of the container 10 is such that the mixing members' 46 radially most distant point 50 from the axis a1, a2 about which they rotate is essentially flush against the container's inner wall 30 for a segment of the revolution. In this embodiment, this segment is between points p1 and p2, as seen in fig. 3. This design aspect combined with the fact that the embodiment in fig.3 comprises two rotating axles 40 results in the bottom of the container's wall 30 being shaped like two rounded valleys. There are two openings 22 in the delimiting wall 20 of the embodiment in fig.3, one on each side associated with each valley in the bottom part of the container's wall 30. The location of these openings 22 are such that their bottom side is essentially flush against the lowest part of the valley they are associated with. This low positioning of the openings 22 in the delimiting wall 20 allows for reliable flow of building materials into the second compartment. In this embodiment with dual rotating axles, having two openings as described above is more preferable compared to only having a single opening on one side since building material could get stuck in the valley without an opening.

[0032] The area of the openings 22 in the embodiment shown in fig.3 are such that they are large enough to allow the contents of the first compartment 12 to flow through them into the second compartment 14 without getting stuck in the first compartment 12 and compromising the rate of production of mixed material, yet their area is not so large that they allow the materials being mixed to flow into the second compartment 14 before being ready for extraction.

[0033] The illustrated embodiment also features two areas of extraction 60, as seen in fig.1. The reason for this is essentially the same as to why the embodiment has two openings 22 in the delimiting wall, it is a consequence of the shape of the bottom side of the container's wall 30. They are located on the second compartment's distal wall with respect to the delimiting wall. There is one area of extraction 60 on each side associated with a valley. The location of these areas of extraction 60 are such that their bottom side is essentially flush against the lowest part of the valley of the side that they are on. If they were located higher on the same wall, material could not be extracted if the surface level of the contents of the second side were lower than lowest part of the area of extraction.

[0034] In order to monitor the amount of content in the mixing container, it is mounted on weight sensors 70. The component materials enter the container by means of an automatic feeding system. In the embodiment shown in fig.2, the automatic feeding system features conveyer belts 80 that deliver an influx of component building materials at a desired location. The readings of the weight sensor are used as input data to this system to ensure that the contents of the container is kept within a certain range.

[0035] In the drawings and specification, there have been disclosed preferred embodiments and examples of the invention and, although specific terms are employed, they are used in a generic and descriptive sense only and not for the purpose of limitation, the scope of the invention being set forth in the following claims.

Claims

1. A mixing apparatus for mixing building materials, the mixing apparatus comprising: a container (10) comprising mixing members (42) configured to mix the building material, **characterized by** the container (10) comprising a mixing space delimited into two compartments by a wall (20), the wall having an opening (22) allowing the building material being mixed to flow along a longitudinal extension (X) of the container from a first compartment (12) to a second compartment (14), the first compartment being where components to be mixed enter the container, and the second compartment comprising an area of extraction where the mixed building material is extracted from the container.

2. The mixing apparatus according to claim 1, wherein the mixing members (42) are attached to an axle (40), the axle being oriented along the axis of the longitudinal extension (X), the axle being configured to rotate around said axis during use.

3. The mixing apparatus according to claim 1 or 2, wherein the mixing members (42) are configured to direct the materials being mixed toward the area of extraction.

4. The mixing apparatus according to any previous claim wherein the area of the opening (22) is between 100 and 3000 cm^2, preferably between 500 and 2000 cm^2, more preferably between 700 and 1500 cm^2.

5. The mixing apparatus according to any previous claim wherein the opening is located in the delimiting wall's lower half.

6. The mixing apparatus according to claim 3, wherein the shape of the container (10) is such that the mixing member's (42) radially most distant part (50) from the longitudinal axis (X) is essentially flush against the inside of the container (30) for a part of the rotation.

7. The mixing apparatus according to any previous claim, wherein the components of the building material are configured to enter the container by means of an automatic feeding system.

8. The mixing apparatus according to any previous claim, further comprising a sensor unit (70) configured to be used for control of the influx of components of the building material.

9. The mixing apparatus according to claim 8, wherein the sensor unit (70) is configured to measure an amount of building material in the container (10).

10. The mixing apparatus according to claim 8 or 9, wherein the sensor unit (70) is configured to measure the weight of the container.

11. The mixing apparatus according to claim 8 or 9, wherein the sensor unit (70) is configured to measure the surface level of the building material in the container.

12. The mixing apparatus according to any previous claim, wherein the relative positioning of the influx of the components with respect to each other and with respect to the container are such that they enter the mixing container at the first compartment's half associated with its distal side with respect to the delimiting wall (22).

13. The mixing apparatus according to any previous claim, wherein the building material being mixed is concrete.

14. The mixing apparatus according to any previous claims, wherein the opening (22) is of a size corresponding to less than 30%, less than 20% or less than 10% of the total size of the wall (20).

15. The mixing apparatus according to any previous claims, wherein the wall (20) extends in a plane substantially perpendicular to the longitudinal extension of the container (10).

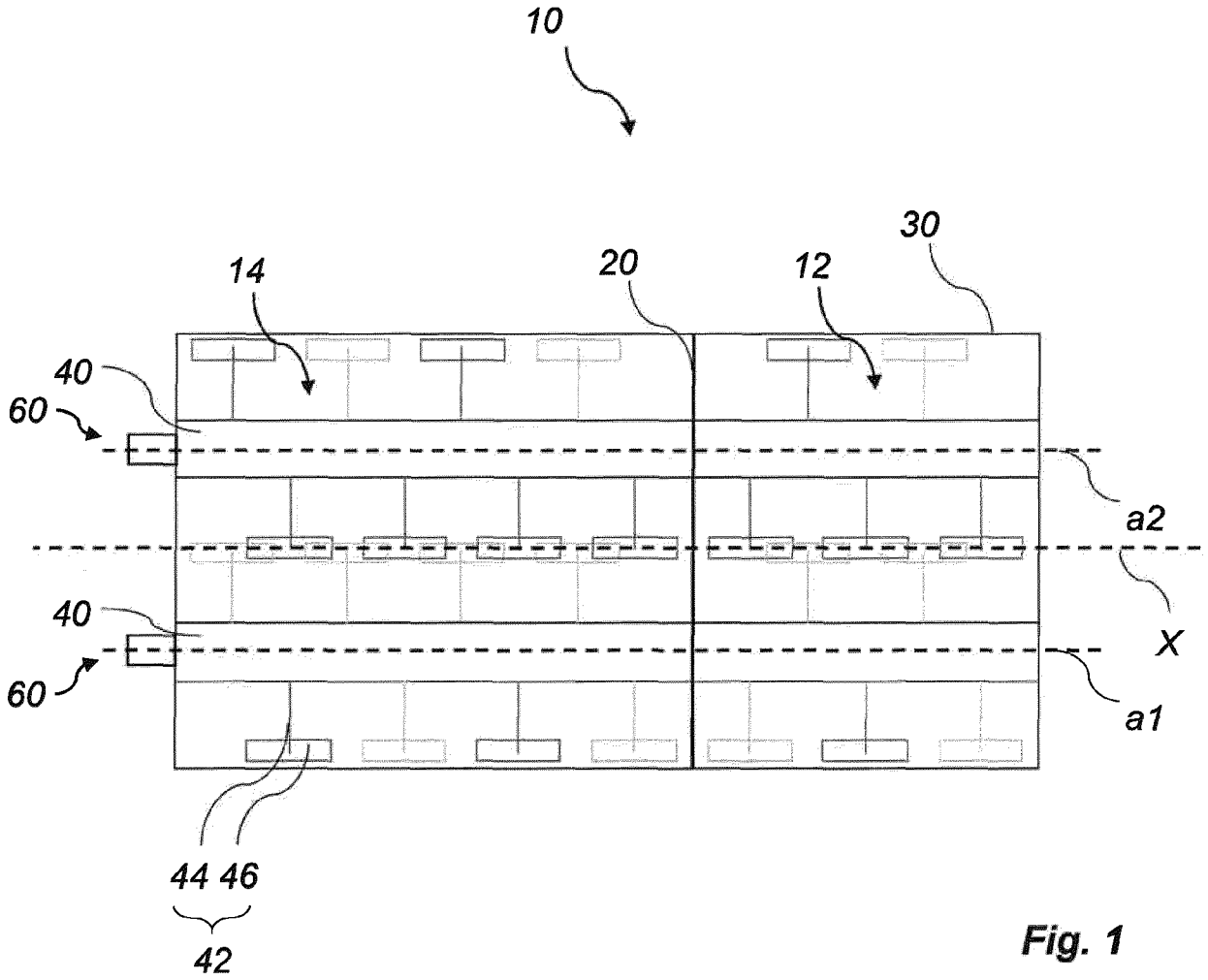

Fig. 1

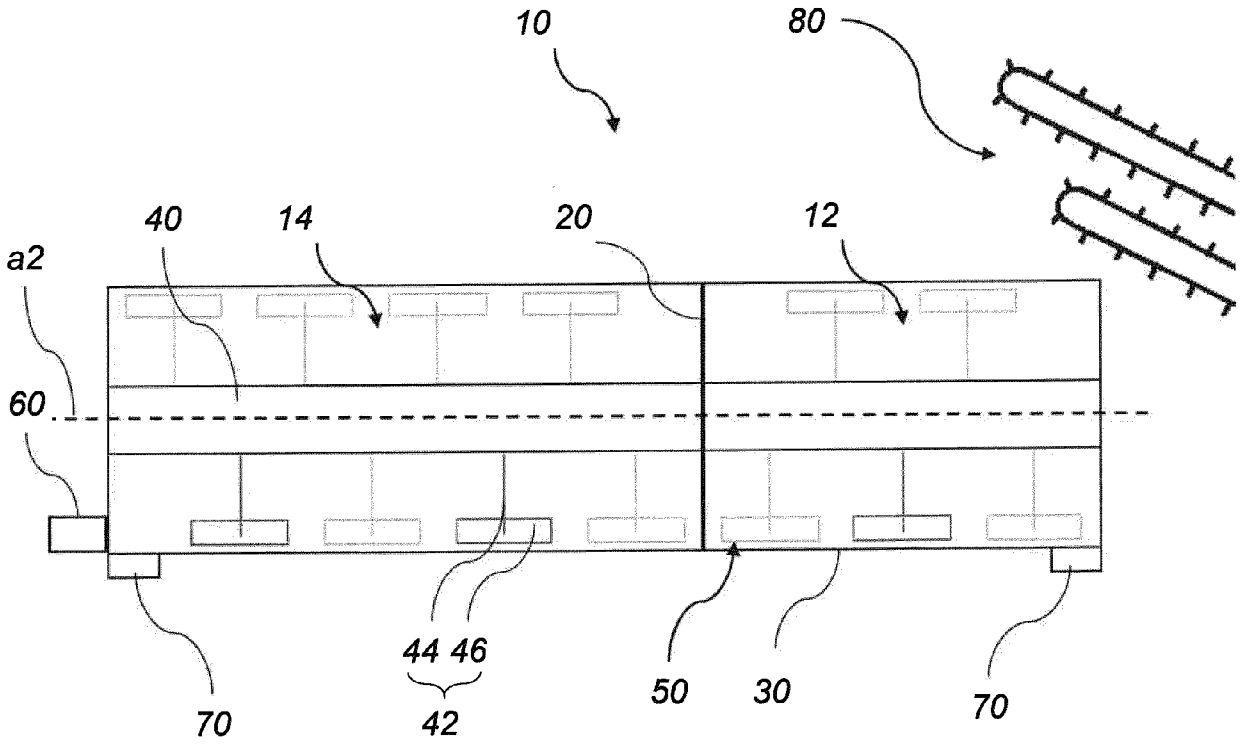

Fig. 2

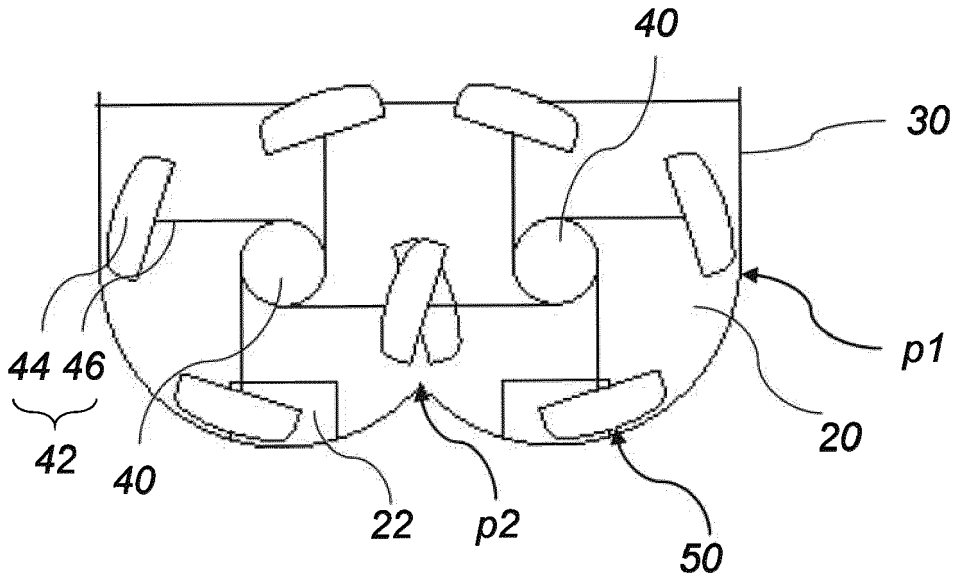

Fig. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 23 21 4683

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	JP S61 20742 U (UNKNOWN) 6 February 1986 (1986-02-06) * figure 1 * * the whole document *	1-7, 12-15	INV. B28C5/12 B01F27/60 B01F27/702 B01F35/21
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X	US 5 083 506 A (HORN DARRELL C [US] ET AL) 28 January 1992 (1992-01-28) * figures 1-8 * * column 3, line 43 - column 6, line 58 *	1-7,12, 14,15	
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TECHNICAL FIELDS SEARCHED (IPC)

B28C
B01F

~~The present search report has been drawn up for all claims~~

Place of search	Date of completion of the search	Examiner
The Hague	14 May 2024	Voltz, Eric

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

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Application Number
EP 23 21 4683

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

1-7, 12-15

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

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LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 23 21 4683

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-7, 12-15

A mixing apparatus with conveying mixing members.

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2. claims: 8-11

A mixing apparatus with a sensor unit.

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 23 21 4683

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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14-05-2024

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82