

PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(PCT Rule 71.1)

To:

Alfa Laval Attorneys
Alfa Laval Corporate AB
Group Patent
P.O. Box 73
221 00 Lund
SUEDE

Date of mailing
(day/month/year)

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Applicant's or agent's file reference
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IMPORTANT NOTIFICATION

International application No.
PCT/EP2020/075986

International filing date (day/month/year)
17.09.2020

Priority date (day/month/year)
24.09.2019

Applicant
Alfa Laval Corporate AB

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary report on patentability and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary report on patentability. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

The applicant's attention is drawn to Article 33(5), which provides that the criteria of novelty, inventive step and industrial applicability described in Article 33(2) to (4) merely serve the purposes of international preliminary examination and that "any Contracting State may apply additional or different criteria for the purposes of deciding whether, in that State, the claimed inventions is patentable or not" (see also Article 27(5)). Such additional criteria may relate, for example, to exemptions from patentability, requirements for enabling disclosure, clarity and support for the claims.

Name and mailing address of the international
preliminary examining authority:



European Patent Office P.B. 5818 Patentlaan 2
NL-2280 HV Rijswijk - Pays Bas
Tel. +31 70 340 - 2040
Fax: +31 70 340 - 3016

Authorized Officer

Dekker, Monique

Tel. +31 70 340-4046



PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference S 4422-WO-PCT	FOR FURTHER ACTION		See Form PCT/IPEA/416
International application No. PCT/EP2020/075986	International filing date (day/month/year) 17.09.2020	Priority date (day/month/year) 24.09.2019	
International Patent Classification (IPC) or national classification and IPC INV. C02F11/121			
Applicant Alfa Laval Corporate AB			
1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36. 2. This REPORT consists of a total of <u>6</u> sheets, including this cover sheet. 3. This report is also accompanied by ANNEXES, comprising: a. ☒ (sent to the applicant and to the International Bureau) a total of <u>8</u> sheets, as follows: ☒ sheets of the description, claims and/or drawings which have been amended and/or sheets containing rectifications authorized by this Authority, unless those sheets were superseded or cancelled, and any accompanying letters (see Rules 46.5, 66.8, 70.16, 91.2, and Section 607 of the Administrative Instructions). ☐ sheets containing rectifications, where the decision was made by this Authority not to take them into account because they were not authorized by or notified to this Authority at the time when this Authority began to draw up this report, and any accompanying letters (Rules 66.4bis, 70.2(e), 70.16 and 91.2). ☐ superseded sheets and any accompanying letters, where this Authority either considers that the superseding sheets contain an amendment that goes beyond the disclosure in the international application as filed, or the superseding sheets were not accompanied by a letter indicating the basis for the amendments in the application as filed, as indicated in item 4 of Box No. I and the Supplemental Box (see Rule 70.16(b)). b. ☐ (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing, in the form of an Annex C/ST.25 text file, as indicated in the Supplemental Box Relating to Sequence Listing (see paragraph 3ter of Annex C of the Administrative Instructions).			
4. This report contains indications relating to the following items: ☒ Box No. I Basis of the report ☐ Box No. II Priority ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability ☐ Box No. IV Lack of unity of invention ☒ Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement ☐ Box No. VI Certain documents cited ☐ Box No. VII Certain defects in the international application ☐ Box No. VIII Certain observations on the international application			
Date of submission of the demand 07.05.2021		Date of completion of this report 05.01.2022	
Name and mailing address of the international preliminary examining authority:  European Patent Office P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Fax: +31 70 340 - 3016		Authorized officer Janssens, Christophe Telephone No. +31 70 340-8929 	

Box No. I Basis of the report

1. With regard to the **language**, this report is based on
- ☒ the international application in the language in which it was filed
 - ☐ a translation of the international application into , which is the language of a translation furnished for the purposes of:
 - ☐ international search (under Rules 12.3(a) and 23.1(b))
 - ☐ publication of the international application (under Rule 12.4(a))
 - ☐ international preliminary examination (under Rules 55.2(a) and/or 55.3(a) and (b))
2. With regard to the **elements*** of the international application, this report is based on (*replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report*):

Description, Pages

1-11 as originally filed

Claims, Numbers

1-15 filed with the letter of 23-06-2021

Drawings, Sheets

1/8-8/8 as originally filed

- ☐ a sequence listing - see Supplemental Box Relating to Sequence Listing.
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since either they are considered to go beyond the disclosure as filed, or they were not accompanied by a letter indicating the basis for the amendments in the application as filed, as indicated in the Supplemental Box (Rules 70.2(c) and (c-bis)):
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
5. ☐ This report has been established:
- ☐ taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rules 66.1(d-bis) and 70.2(e)).
 - ☐ without taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91(Rules 66.4bis and 70.2(e)).

**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/EP2020/075986

6. ☒ With regard to top-up searches (Rules 66.1 *ter* and 70.2(f)):
- ☒ A top-up search was carried out by this Authority on 26.05.2021 (all discovered documents are listed in the Supplemental Box Relating to Top-up Search).
 - ☐ Additional relevant documents have been discovered during the top-up search.
 - ☐ No top-up search was carried out by this Authority because it would serve no useful purpose.
7. ☐ Supplementary international search report(s) from Authority(ies) has/have been received and taken into account in establishing this report (Rule 45bis.8(b) and (c)).

* If item 4 applies, some or all of those sheets may be marked "superseded".

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	<u>1-15</u>
	No: Claims	
Inventive step (IS)	Yes: Claims	<u>1-15</u>
	No: Claims	
Industrial applicability (IA)	Yes: Claims	<u>1-15</u>
	No: Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1 Reference is made to the following documents:

- D1 US 2005/252668 A1 (POUTRE BENOIT J [US]) 17 November 2005 (2005-11-17)
- D2 EP 1 464 628 A1 (EDZ BAU GMBH ERDBAUER DORMEYER [DE]) 6 October 2004 (2004-10-06)
- D3 CA 2 024 780 A1 (KOMLINE SANDERSON ENG CORP [US]) 7 March 1992 (1992-03-07)
- D4 US 5 135 651 A (AUSTIN ERIC P [GB] ET AL) 4 August 1992 (1992-08-04)
- D5 US 4 729 836 A (ICKINGER GEORG [AT] ET AL) 8 March 1988 (1988-03-08)
- D6 US 4 857 193 A (CLEMENTS BRICE P [US] ET AL) 15 August 1989 (1989-08-15)

2 None of the above mentioned documents discloses all the features of independent claim 1.

2.1 The document D1 discloses a plow for being moved and driven in soil. Those types of plows are commonly made of stainless steel. Plows of stainless steel are heavy and are not suitable for being used in a sludge dewatering system comprising a perforated conveyor belt.

2.2 The document D2 discloses a sludge dewatering system, but only mentions that the plow has the shape of a goose foot ("Gänsefusschäre"). This is a general name for a type of plow, any specific details upon the plow are not given.

2.3 The documents D3-D6 disclose plows which cause the sludge to be dewatered to be swept inwardly. The structure of the flow defined by claim 1 is however such that the sludge to be dewatered is swept outwardly.

2.4 The document D4 can be regarded as the closest prior art and discloses (see in particular figs. 2-4):

A plow (12) for a sludge dewatering system comprising a perforated conveyor belt (10), the plow (12) comprising:
a blade, the blade comprising:
a leading edge (19),
a first wing (21) swept downward in a vertical direction and outward in a first horizontal direction relative to the leading edge (19), and
a second wing (not visible in fig. 3, see fig. 4) swept downward in the vertical direction and outward in a second horizontal direction relative to the leading edge (19), the second horizontal direction being opposite of the first horizontal direction,
wherein:
the first wing (21) comprises an angled front surface that angles upwards in the vertical direction and outward in the first horizontal direction relative to the leading edge (19); and
the second wing comprises an angled front surface that angles upwards in the vertical direction and outward in the second horizontal direction relative to the leading edge (19).

2.5 The subject-matter of claim 1 therefore differs from this known plow in that the first and second wing comprise front surfaces that angle downwards in the vertical direction. The subject-matter of claim 1 is therefore new in view of the document D4 (Article 33(2) PCT).

2.6 The effect of this difference is that sludge will fall on a clear part of the conveyor belt. When using the plow of D4, sludge will be turned over and fall upon other sludge in the transversal direction. The specific shape of the plow therefore enhances the dewatering. The objective technical problem may therefore be regarded as how to enhance the dewatering efficiency.

- 2.7 The solution proposed by claim 1 should be regarded as being inventive (Article 33(3) PCT). The only document that shows a plow with wings comprising front surfaces that angle downwards in the vertical direction is the document D1. The combination of D4 with this document D1 is however very unlikely, because D1 is from a different technical field (plowing earth). The prior art therefore does not hint to modifying the orientation of the angle front surfaces in the way defined by claim 1.
- 3 A similar reasoning also applies for the independent claims 12 and 15, which respectively define a method of dewatering a flow of sludge using the plow defined by claim 1 and a sludge dewatering system comprising the plow defined by claim 1. The claims 2-11 and 13-14 are dependent on claim 1 or claim 12. The subject-matter of the claims 2-15 is therefore being regarded as new (Article 33(2) PCT) and inventive (Article 33(3) PCT).

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European Patent Office
80298 Munich
Germany

Alfa Laval Corporate AB
Group Patent
Alfa Laval Attorneys, No. 578
P.O. Box 73
SE-221 00 LUND
Sweden
Visit: Rudeboksvägen 1
Tel: +46 46 36 65 00
Fax: +46 46 36 71 56

International application PCT/EP2020/075986

Applicant: Alfa Laval Corporate AB

Demand for preliminary examination (Chapter II)

In response to the written opinion of the International Preliminary Examining Authority, an amended set of claims 1-15 is hereby filed replacing the claims 1-15 currently on file. The amended claims have been submitted in a clean version and in a marked-up version, both provided with reference numerals.

The independent claims 1, 12 and 15 have been amended by removing the feature "*wherein the plow (120,220) including a polymeric material*" and adding the feature "*wherein: the first wing (224) comprises an angled front surface (231) that angles downward in the vertical direction (228) and outward in the first horizontal direction (229) relative to the leading edge (226); and the second wing (225) comprises an angled front surface (232) that angles downward in the vertical direction (228) and outward in the second horizontal direction (230) relative to the leading edge (226).*"

The added feature is based on claim 3 as originally filed which has thus been deleted. A new claim 3 has been included based on the deleted feature "*wherein the plow (120,220) including a polymeric material*".

Claim 1 has additionally been amended by stating that *the sludge dewatering system (100) comprising a perforated conveyor belt (103)*. This has basis in claim 15 as originally filed. Thus, all amendments are encompassed by the application as filed.

Novelty (Art 33(2) PCT)

Six documents have been cited in the written opinion of the International Preliminary Examining Authority:

Document D1 (US 2005/252668 A1) relates to an agricultural tillage sweep. The agricultural sweep of D1 is intended for being moved and driven through soil and not for being static and having watery sludge being flowed towards it. The agricultural tillage sweep and must thus be made of a more rigid material (such as steel). It is therefore also not intended for being used together with a perforated conveyor belt. The plow according to the present invention should be made of a lighter material such as polymeric material to be able to be used together with the perforated conveyor belt and be able to maintaining one or more bottom surfaces of the plow in contact with the perforated conveyor belt. The applicant thus does not consider the agricultural tillage sweep of D1 to be suitable for dewatering using a perforated conveyor belt.

Concerning claim 12 and 15, the applicant considers that the document D1 in additional fails to disclose the provision of a plow in combination with a perforated conveyor belt. Thus, claim 12 and 15 differ even more from D1.

Document D2 (EP 1464628 A1) relates to an apparatus for drying of sludge. It features a plow (48). However, there are no details of the plow except the word "Gänsefusssschare". The applicant is therefore of the opinion that document D2 does not disclose the plow according to claim 1.

Concerning claim 12 and 15, the applicant considers that the document D2 also fails to disclose the provision of a plow in combination with a perforated conveyor belt. According to D2, the plows are moving and the sludge is positioned on a fixed floor. Thus, claims 12 and 15 differ even more from D2.

Document D3 (CA 2024780) relates to an apparatus for enhancing dewatering of sludge. It features a plow (30), however, the plow differs from the claimed plow according to independent claims 1, 12 and 15 by being inwardly swept, i.e., it does not feature any outwardly swept wings.

Document D4 (US 5135651) relates to a sludge dewatering system having a row of deflectors each having a leading edge and a pair of diverging and upwardly concave walls.

The applicant is of the opinion that claims 1, 12 and 15 are not disclosed in document D4 since according to the presently claimed invention, the plow comprises angled front surfaces that angles downward in the vertical direction and outward in the horizontal direction relative to the leading edge (226), whereas the deflector of D4 comprises *"a pair of diverging walls extending onwards from the leading edge to impart a transverse motion to the sludge and extending upwardly to provide a concave undersurface to impart an overturning motion to the sludge"*, see column 1, line 36-40. The diverging walls/surfaces thus angle upwards in the vertical direction relative to the leading edge and not downwards as according to the present invention.

Document D5 (US 4729836) relates to a flexible chicane system for liquid solid separation system having a plurality of flow turners in the form of plow portions preferably made of plastic. The plow portion differs from the claimed plow according to independent claims 1, 12 and 15 by being inwardly swept, i.e. it does not feature any outwardly swept wings.

Document D6 (US 4857193) relates to a floating chicane system for liquid-solid separation equipment having flow turners preferably made of plastic. The flow turner differs from the claimed plow according to independent claims 1, 12 and 15 by being inwardly swept, i.e. it does not feature any outwardly swept wings.

Inventive step (Art 33(3) PCT)

Using document D4 as the closest prior art, the difference can be found to be that the diverging walls/surfaces angle upwards in the vertical direction relative to the leading edge and not downwards as according to the present invention.

The technical effect of the upwardly extending walls is according to column 1, line 36-40 D4 that *"a pair of diverging walls extending onwards from the leading edge to impart a transverse motion to the sludge and extending upwardly to provide a concave undersurface to impart an overturning motion to the sludge"*

The sludge is thus according to D4 overturned in a transverse motion, i.e., the sludge flowing onto the deflectors is deflected to the side and only some sludge which reaches the concave part of the wall is turned over. The sludge which is turned over is not falling onto a clear part of the conveyor belt, but is falling onto other sludge in the transversal direction.

According to the present invention page 9, lines 23-30, “one or more portions of the sludge 311 turn over as the portions of sludge 311 flow from the leading side 238 to the trailing side 239 of the plow 220 (see page 9, lines 22-23). In one example, one or more portions of the sludge 311 rotate in a rotational direction RD as the one or more portions of the sludge 311 flow from the leading side 238 to the trailing side 239. One or more portions of the sludge 311 turn over as the one or more portions (1) flow along the leading edge 226 and/or the angled front surfaces 231, 232; (2) flow past the stem 222; (3) flow past the trailing edges 241, 244; and/or (4) drop from the blade 223 to the perforated conveyor belt 103. In one example, one or more portions of the sludge 311 rotate in the rotational direction RD to turn over as the one or more portions flow along the angled front surface 231 of the first wing 224 and/or the angled front surface 232 of the second wing 225.”

Substantially all of the sludge flowing onto the blade is thus flowing over the angled front surfaces and turned over at the trailing edge onto a clear part of the conveyor belt. This is a different and improved technical effect compared to D4 as it allows for a much more efficient dewatering of the sludge.

It is submitted that the skilled person would not be inspired to combine the teachings of documents D4 and D1. In D1 dewatering is not mentioned. Although the sweep itself may be considered to have similar features as the presently claimed plow and allow a turning over of the soil, the applicant considers that the problem solved by agricultural sweeps is to aerate and soften the soil, not dewater it. On the contrary the problem solved by the plow according to the present invention is to dewater the sludge, not to aerate or soften the sludge.

Using the problem solution approach, it is thus only with the benefit of hindsight that the skilled person would consider document D1 for arriving at the presently claimed invention. It evidently fails the so called “could-would” approach found in the EPO Guidelines for Examination G-VII 5.3 since although the skilled person could modify D4 according to the teachings of D1, there is no reason why the skilled person would do so as there is no indication in D1 that it would solve the defined problem.

Additionally, as a secondary indication, the applicant considers it is worth mentioning that the present invention has already had significant commercial success and is offered to customers under the trademark “Dri-Boost_plow™” and described to customers on the Alfa Laval website:

<https://corporate.alfalaval.com/dri-boost-plow-for-belt-filter>

Final remarks

In view of the above comments, the claims 1-15 can be considered fulfilling the requirements of both novelty and inventive step.

It is therefore believed that a positive International Report on Patentability may be issued.

Yours sincerely,

Alfa Laval Attorneys, No. 578
Andreas LEIJON

Claims

1. A plow (120,220) for a sludge dewatering system (100), the sludge dewatering system (100) comprising a perforated conveyor belt (103), the plow (120,220) comprising:
 - a blade (223), the blade (223) comprising:
 - a leading edge (226),
 - a first wing (224) swept downward in a vertical direction (228) and outward in a first horizontal direction (229) relative to the leading edge (226), and
 - a second wing (225) swept downward in the vertical direction (228) and outward in a second horizontal direction (230) relative to the leading edge (226), the second horizontal direction (230) being opposite of the first horizontal direction (229),
 wherein:
 - the first wing (224) comprises an angled front surface (231) that angles downward in the vertical direction (228) and outward in the first horizontal direction (229) relative to the leading edge (226); and
 - the second wing (225) comprises an angled front surface (232) that angles downward in the vertical direction (228) and outward in the second horizontal direction (230) relative to the leading edge (226).
2. The plow (120,220) of claim 1, wherein the leading edge (226) comprises a sharp edge or a curved surface disposed at an angle relative to a horizontal plane.
3. The plow (120,220) of claim 1, wherein the plow (120,220) including a polymeric material.
4. The plow (120,220) of claim 1, wherein the leading edge (226) is on a leading side of the blade (223), and the blade (223) further comprises a cavity (247) on a trailing side of the blade (223) that is behind the first wing (224) and the second wing (225), and between the first wing (224) and the second wing (225).
5. The plow (120,220) of claim 1, wherein an outer edge (236) of the angled front surface (231) of the first wing (224) and an outer edge (237) of the angled front surface (232) of the second wing (225) define a first angle (A1) measured therebetween in a horizontal plane, the first angle (A1) being within a range of 45 degrees to 90 degrees
6. The plow (120,220) of claim 5, wherein each angled front surface (231) of the first wing (224) and the second wing (225) defines a second angle (A2) measured between the outer edge (236,237) and an inner edge (234,235) of each respective angled front surface (231,232) in a vertical plane, the second angle

(A2) being within a range of 15 degrees to 70 degrees.

7. The plow (120,220) of claim 1, wherein the first wing (224) comprises a trailing edge (241), and the second wing (225) comprises a trailing edge (244).

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8. The plow (120,220) of claim 7, wherein the first wing (224) comprises an angled back surface (240) and a bottom surface (252), and the second wing (225) comprises an angled back surface (243) and a bottom surface (253).

10 9. The plow (120,220) of claim 8, further comprising a plurality of ribs (246) disposed on the angled back surface of the first wing (224) and the angled back surface of the second wing (225).

10. The plow (120,220) of claim 9, wherein:

15 each rib (246) of the plurality of ribs (246) comprises a bottom surface (254) that is coplanar with the bottom surface (252) of the first wing (224) and the bottom surface (253) of the second wing (225).

11. The plow (120,220) of claim 1, further comprising a stem (222) connected to the blade (223).

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12. A method of dewatering a flow of sludge, the method including flowing, using a perforated conveyor belt (103), sludge into a leading side of a plow (120,220), the plow (120,220) comprising a blade (223), the blade (223) comprising:

a leading edge (226),

25 a first wing (224) swept downward in a vertical direction (228) and outward in a first horizontal direction (229) relative to the leading edge (226), and

a second wing (225) swept downward in the vertical direction (228) and outward in a second horizontal direction (230) relative to the leading edge (226), the second horizontal direction (230) being opposite of the first horizontal direction (229),

30 wherein:

the first wing (224) comprises an angled front surface (231) that angles downward in the vertical direction (228) and outward in the first horizontal direction (229) relative to the leading edge (226); and

the second wing (225) comprises an angled front surface (232) that angles downward in the vertical direction (228) and outward in the second horizontal direction (230) relative to the leading edge (226).

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13. The method of claim 12, further including flowing the sludge from the perforated conveyor belt

(103) and upward along a first angled front surface (231) and a second angled front surface (232) of the plow (120,220).

14. The method of claim 13, further including flowing the sludge past one or more trailing edges (241,244) of the plow (120,220) and dropping the sludge onto the perforated conveyor belt (103) on a trailing side of the plow (120,220).

15. A sludge dewatering system (100) comprising a perforated conveyor belt (103) and a plow (120,220), the plow (120,220) comprising a blade (223), the blade (223) comprising:

a leading edge (226),

a first wing (224) swept downward in a vertical direction (228) and outward in a first horizontal direction (229) relative to the leading edge (226), and

a second wing (225) swept downward in the vertical direction (228) and outward in a second horizontal direction (230) relative to the leading edge (226), the second horizontal direction (230) being opposite of the first horizontal direction (229),

wherein:

the first wing (224) comprises an angled front surface (231) that angles downward in the vertical direction (228) and outward in the first horizontal direction (229) relative to the leading edge (226); and

the second wing (225) comprises an angled front surface (232) that angles downward in the vertical direction (228) and outward in the second horizontal direction (230) relative to the leading edge (226).