P/00/001
Section 29

AUSTRALIA
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PATENT REQUEST : STANDARD PATENT

I/We, being the person(s) identified below as the Applicant(s), request the grant of a Standard Patent to the person(s) identified below as the Nominated Person(s), for an invention described in the accompanying complete specification.

Applicant(s) and Nominated Person(s): VOEST-ALPINE INDUSTRIEANLAGENBAU GmbH

Address: 44 TURMSTRASSE
A-4020 LINZ
AUSTRIA

Invention Title: CONVEYING ARRANGEMENT FOR THE DOSED CONVEYANCE OF BULK MATERIAL

Name(s) of Actual Inventor(s): DR FELIX WALLNER
DR LEOPOLD WERNER KEPPLINGER
CHRISTIAN BOHM

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Attorney Code: HA

BASIC CONVENTION APPLICATION DETAILS

Application No:	Country:	Application Date:
A 1388/92	AT	07 July 1992

Drawing number recommended to accompany the abstract: 1

DATED: 3 June 1993

VOEST-ALPINE INDUSTRIEANLAGENBAU GmbH

GRIFFITH HACK & CO.

Patent Attorney for and
on behalf of the Applicant

M 046181 030693

664748

P/00/008
Section 29(1)
Regulation 3.1(2)

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NOTICE OF ENTITLEMENT

We VOEST-ALPINE INDUSTRIEANLAGENBAU GmbH
A.R.B.N. 052 122 791

of 44 TURMSTRASSE
A-4020 LINZ
AUSTRIA

being the applicant in respect of an application for a patent for an invention entitled CONVEYING ARRANGEMENT FOR THE DOSED CONVEYANCE OF BULK MATERIAL (Application No. 39990/93), state the following:

1. The nominated person has, for the following reasons, gained entitlement from the actual inventors:

   THE ACTUAL INVENTORS ASSIGNED THE INVENTION TO THE NOMINATED PERSON, VOEST-ALPINE INDUSTRIEANLAGENBAU GmbH, and DEUTSCHE VOEST-ALPINE INDUSTRIEANLAGENBAU GmbH. DEUTSCHE VOEST-ALPINE INSTRIEANLAGENBAU GmbH THEN ASSIGNED ITS INTEREST IN THE INVENTION TO THE NOMINATED PERSON, VOEST-ALPINE INDUSTRIEANLAGENBAU GmbH.

2. The nominated person has, for the following reasons, gained entitlement from the basic applicant listed on the patent request:

   THE NOMINATED PERSON IS ONE OF THE TWO OF THE BASIC APPLICANTS. THE SECOND BASIC APPLICANT, DEUTSCHE VOEST-ALPINE INDUSTRIEANLAGENBAU GmbH ASSIGNED ITS INTEREST IN THE INVENTION TO THE NOMINATED PERSON, VOEST-ALPINE INDUSTRIEANLAGENBAU GmbH.

3. The basic application listed on the request form is the first application made in a Convention country in respect of the invention.

DATE: 4 October 1995

VOEST-ALPINE INDUSTRIEANLAGENBAU GmbH

GRIFFITH HACK & CO

Patent Attorney for and
on behalf of the applicant

AU9339990

(12) PATENT ABRIDGMENT (11) Document No. AU-B-39990/93
(19) AUSTRALIAN PATENT OFFICE (10) Acceptance No. 664748

(54) Title
CONVEYING ARRANGEMENT FOR THE DOSED CONVEYANCE OF BULK MATERIAL

International Patent Classification(s)
(51)[5] F27D 003/08 B65G 033/08

(21) Application No. : 39990/93 (22) Application Date : 03.06.93

(30) Priority Data

(31) Number	(32) Date	(33) Country
1388/92	07.07.92	AT AUSTRIA

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(71) Applicant(s)
VOEST-ALPINE INDUSTRIEANLAGENBAU GMBH

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DR. FELIX WALLNER; DR. LEOPOLD WERNER KEPPLINGER; CHRISTIAN BOHM

(74) Attorney or Agent
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(56) Prior Art Documents
US 4413812
US 4409023
DE 1238941

(57) Claim

1. A conveying arrangement for the dosed conveyance of bulk material, comprising a conveying channel including an entry opening and a discharge opening, and a conveyor worm provided in the conveying channel, extending at least from the entry opening of the conveying channel to the discharge opening and provided with a first flight formed by paddles and a second flight formed by a continuous helix and arranged downstream of the flight formed by the paddles and on the end associated with the discharge opening of the conveying channel, characterized in that, for the conveyance of bulk material, such as ore, coal, sponge iron, etc., from a first metallurgical vessel into a second metallurgical vessel, the flight formed by the paddles is arranged in an end region of the conveyor worm extending into the interior of the first metallurgical vessel, and that the continuous helix extends over at least half a convolution and at most two convolutions and the end of the continuous helix is arranged in the region of the discharge opening for the bulk material to be conveyed, which discharge opening is surrounded by a downwardly directed socket, said socket leading to said second metallurgical

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vessel and the end region of the conveyor worm that is provided with the helix being mounted on the end of the conveying channel via a bearing means provided on the pertaining end of the conveying channel.

2. A conveying arrangement for the dosed conveyance of bulk material from a first metallurgical vessel to a second metallurgical vessel, comprising:

a conveying channel including an upstream entry opening, a downstream discharge opening surrounded by a downwardly directed socket leading to the second metallurgical vessel, and an outer end; and

a conveyor worm provided in the conveying channel,

the conveyor worm extending at least from the entry opening of the conveying channel to the discharge opening and provided with:

a first flight formed by paddles and being arranged for extending into the interior of the first metallurgical vessel; and

a second flight formed by a continuous helix and arranged downstream of the flight formed by the paddles, the continuous helix extending over at least half a convolution and at most two convolutions, the end of the continuous helix being arranged in the region of the discharge opening for preventing the bulk material to be conveyed from flowing to the discharge opening.

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AUSTRALIA

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COMPLETE SPECIFICATION

STANDARD PATENT

Applicant(s):

VOEST-ALPINE INDUSTRIEANLAGENBAU GmbH

Invention Title:

CONVEYING ARRANGEMENT FOR THE DOSED CONVEYANCE OF BULK MATERIAL

The following statement is a full description of this invention, including the best method of performing it known to me/us:

The invention relates to a conveying arrangement for the dosed conveyance of bulk material, in particular for conveying ore, coal, etc., from one metallurgical vessel into another, comprising a conveying channel including an entry opening and a discharge opening, and a conveyor worm provided in the conveying channel, extending at least from the entry opening of the conveying channel to the discharge opening and provided with a flight formed by paddles.

An arrangement of this type is known from EP-B-0 048 008. The conveying means described there serves to convey hot sponge iron particles from a direct reduction shaft furnace into a melter gasifier. The flight of the known conveying means in its entirety is formed by consecutively arranged individual paddles, wherein a free space is provided between neighboring paddles, through which the bulk material can pass.

Worms of this type, socalled "paddle worms", have proved successful in that the bulk material is torn up again and again by the paddles such that it cannot agglomerate within the conveying channel, which, when using a one-part conveyor worm, i.e., a continuous helix, may lead to the formation of kind of a tube within the conveying channel, whereby the material to be conveyed gets stuck around the worm, the worm, thus, running idle. Another essential advantage of a paddle worm is to be seen in that in manufacture is substantially simpler and less expensive, in particular with large conveyor worm diameters of, e.g., 1 m, than of a worm comprising a flight formed by a continuous helix.

However, paddle worms also have disadvantages; thus, it is, for instance, necessary to extend the conveying channel over a given length - which is expensive, and complex in construction with cantilever-mounted conveyor worms -, since a short conveying channel may cause the bulk material to flow out

of the discharge opening of the conveying channel in an uncontrolled manner, because the bulk material, as mentioned above, automatically passes through the free space provided between the paddles, according to its bulk angle. In order to prevent jamming of the bulk material between the periphery of the paddles and the internal lining of the conveying channel - which is filled almost completely with bulk material in case of paddle worms - and to provide for sufficient passing space to the bulk material particles, it is necessary to provide a relatively large gap between the outer periphery of the paddles and the internal lining of the conveying channel. As a rule, this gap is substantially larger than the maximum grain diameter of the bulk material to be conveyed. Hence follows a high gas permeability, though.

If one is forced for structural reasons to configure the conveying channel particularly short , it will be necessary when using a paddle worm to equip the discharge opening with a separate blocking means to prevent the bulk material from automatically flowing out with the conveyor worm out of operation.

The invention aims at avoiding these disadvantages and difficulties and has as its object to provide a conveying arrangement of the initially defined type, which basically involves the same expenditures in terms of manufacture as a paddle worm and with which the above-mentioned tube formation within the conveying channel and the idle rotation of the worm are reliably prevented, wherein, however, a particularly short conveying channel and, thus, a very short conveyor worm will do, without requiring a separate blocking means provided at the discharge opening. Furthermore, the conveying arrangement according to the invention is to exhibit an elevated flow resistance against gas streaming through the conveying channel.

According to the present invention there is provided a conveying arrangement for the dosed conveyance of bulk material, comprising a conveying channel including an entry opening and a discharge opening, and a conveyor worm provided in the conveying channel, extending at least from the entry opening of the conveying channel to the discharge opening and provided with a first flight formed by paddles and a second flight formed by a continuous helix and arranged downstream of the flight formed by the paddles and on the end associated with the discharge opening of the conveying channel, characterized in that, for the conveyance of bulk material, such as ore, coal, sponge iron, etc., from a first metallurgical vessel into a second metallurgical vessel, the flight formed by the paddles is arranged in an end region of the conveyor worm extending into the interior of the first metallurgical vessel, and that the continuous helix extends over at least half a convolution and at most two convolutions and the end of the continuous helix is arranged in the region of the discharge opening for the bulk material to be conveyed, which discharge opening is surrounded by a downwardly directed socket, said socket leading to said second metallurgical vessel and the end region of the conveyor worm that is provided with the helix being mounted on the end of the conveying channel via a bearing means provided on the pertaining end of the conveying channel.

According to the present invention there is also provided a conveying arrangement for the dosed conveyance of bulk material from a first metallurgical vessel to a second metallurgical vessel, comprising:

a conveying channel including an upstream entry opening, a downstream discharge opening surrounded by a downwardly directed socket leading to the second metallurgical vessel, and

an outer end; and
a conveyor worm provided in the conveying channel,

the conveyor worm extending at least from the entry opening of the conveying channel to the discharge opening and provided with:

a first flight formed by paddles and being arranged for extending into the interior of the first metallurgical vessel; and

a second flight formed by a continuous helix and arranged downstream of the flight formed by the paddles, the continuous helix extending over at least half a convolution and at most two convolutions, the end of the continuous helix being arranged in the region of the discharge opening for preventing the bulk material to be conveyed from flowing to the discharge opening.

In accordance with the invention, this object is achieved in that the conveyor worm, on its end associated to the discharge opening of the conveying channel, comprises a flight that is formed by a continuous helix extending at least over half a convolution, which helix is followed by the flight formed by the paddles.

According to a preferred embodiment, a particularly high flow resistance against gas streaming through is achieved in that the flight formed by the continuous helix has a larger external diameter than the flight formed by the paddles and provided in the extension thereof, wherein the risk of bulk material getting jammed in the gap between the outer periphery of the conveyor worm and the internal wall of the conveying channel is avoided in that the flight in that part in which it is formed by a

continuous helix no longer is completely filled with bulk material, since the continuous flight does not exhibit any intermediate spaces which would facilitate the flow of the bulk material.

According to a preferred embodiment, an annular gap is provided between the outer periphery of the continuous helix and the internal wall of the conveying channel, the width of which gap approximately corresponds to the maximum grain diameter of the bulk material to be conveyed.

A very short conveying channel will do, if the continuous helix extends over the total length of the conveying channel, from the entry opening to the discharge opening of the same. This preferred embodiment also guarantees a great resistance against gas streaming through, thus reliably preventing the bulk material from automatically flowing to the discharge opening with the conveyor worm out of operation, in any position of the same.

Preferably, the continuous helix extends over at least three quarters of a convolution, preferably over one convolution and a half to two convolutions.

If bulk material is to be conveyed which may cause great wear by grains getting jammed, the flight formed by the paddles advantageously extends ~~as far as~~ into the interior of the conveying channel, preferably by half a convolution to one convolution and a quarter. The paddles, i.e., their intermediate spaces, provided within the conveying channel enable the grains of the bulk material to avoid the vicinity of the entry opening where the flight is completely filled with inflowing bulk material such that the grains are prevented from getting jammed between the outer periphery of the conveyor worm and the internal wall of the conveying channel.

By the invention it is possible to do with a particularly short conveying channel, the length of the conveying channel from the entry opening to the discharge opening preferably being equal to, or larger than,

a) the projection of the continuous helix directed on the axis of rotation of the the conveyor worm plus

b) the projection of the straight line laid at the bulk angle of the bulk material through the end of the helix located closer to the entry opening, on the axis of rotation of the conveyor worm, as far as the straight line extends upwardly to its point of intersection with the uppermost generatrix of the conveying channel.

The invention will be explained in more detail by way of several embodiments illustrated in the drawings, wherein:

Figs. 1 to 4 each illustrate an axial longitudinal section through a conveying arrangement according to one embodiment each.

In an approximately vertical side wall 1 of a direct reduction shaft furnace, which is formed by a refractory lining 2 and a steel shell 3 surrounding the same, a conveying means 4 is arranged at a right angle relative to this side wall 1. The

conveying means 4 comprises a conveying channel 6 having a circular cross section and armored with a steel internal lining 5 (or a lining of brickwork), and whose central axis 7 extends approximately at a right angle relative to the side wall 2. The internal lining 5 is surrounded by refractory material 2, which in turn is enclosed by a steel shell 8.

To the outer free end of the conveying channel 6, there are flanged a bearing means 9 and a driving means (not illustrated) for a cantelever-mounted conveyor worm 11 reaching through the conveying channel 6 into the interior 10 of the direct reduction shaft furnace. In the bottom of the conveying channel 6, a discharge opening 12 for the bulk material to be conveyed is provided, which is surrounded by a vertically downwardly oriented socket 13 to which a downpipe 14 is flanged.

The conveyor worm 11, by its worm shaft 15, extends in the direction towards the center of the direct reduction shaft furnace and includes a flight 16, 16' which is designed to taper from the entry opening 17, i.e., the mouth of the conveying channel 6 opening into the interior 10 of the direct reduction shaft furnace, towards the free end of the worm shaft 15 in order to ensure discharging of the bulk material uniformly over the cross sectional area of the direct reduction shaft furnace.

According to the invention, the flight 16, 16' of the conveyor worm is designed to vary over the length of the conveyor worm 11, i.e. the flight 16' on the end of the conveyor worm 11 associated to the discharge opening 12 of the conveying channel 6 is formed by a continuous helix 18, i.e., by a one-piece steel plate shaped to a helical surface that extends to the entry opening 17 by 1 3/4 convolutions in the embodiment illustrated in Fig. 1. Following this helix 18, the flight 16 is formed

by paddles 19 consecutively arranged in the manner of helical surfaces, neighboring paddles enclosing an intermediate space 20. A paddle 19 extends approximately over a quarter of a convolution; however, it could also have a slighter peripheral dimension, for instance, extending over only a sixth of a convolution.

The paddles 19 with their surfaces are located not exactly on the ideal helical surface, but slightly deviate therefrom, thus breaking up the bulk material present in the interior 10 of the direct reduction shaft furnace and preventing the bulk material from agglomerating at the paddles 19 or getting stuck within the flight 16.

As is apparent from Fig. 1, the bulk material enters the flight 16' formed by the continuous helix 18 at the entry opening such that the flight 16' is filled completely merely at its beginning, i.e., in the immediate vicinity of the entry opening 17. The continuous helix 18 - with the conveyor worm 11 out of operation - prevents the bulk material from flowing through from the entry opening 17 to the discharge opening 12. The continuous helix 18 forms an annular gap 21 by its outer periphery relative to the internal wall, i.e., to the internal lining 5 of the conveying channel 6, the width 21' of which annular gap approximately corresponds to the largest grain size of the bulk material to be conveyed. By this relatively narrow annular gap 21, a relatively large resistance against gas streaming through is created.

According to Fig. 2, the continuous helix 18 does not extend completely as far as to the entry opening 17, but terminates in front of the same after 1 1/2 convolutions such that the flight 16 formed by the paddles 19 reaches into the interior of the conveying channel 6 by an approximately 3/4 convolution. With this

embodiment, the flight 16', therefore, no longer is filled completely due to the conical pile forming, which is indicated by the straight line 22 with the bulk angle α

Due to this configuration, the danger of bulk material getting jammed between the outer periphery of the conveyor worm 11 and the internal lining 5 of the conveying channel 6 and, thus, the wear of the conveyor worm 11 are substantially reduced, since the flight is completely filled merely near the entry opening 17 and evasion of the grains is possible through the intermediate spaces 20 provided between the paddles 19. The external diameter of the flight 16 formed by the paddles 19 is dimensioned to be slighter than the external diameter of the flight 16' formed by the continuous helix, the wear of the paddles 19, thus, also being reduced.

As is apparent from Fig. 2, the conveying channel 6 has a lengt! 23 between the entry opening 17 and the discharge opening 12, which corresponds to the projection 24 of the continuous helix 18 on the axis of rotation 7 plus the projection 25 of the straight line 22 extending at the bulk angle α of the bulk material from the uppermost point 26 of the entry opening 17 of the conveying channel 6 to the end of the helix 18 located closer to the entry opening. This constitutes the minimum length that is suitable for the perfect functioning of the conveying means. This length also may be exceeded, which, however, is to be prevented for reasons of costs.

According to the embodiment illustrated in Fig. 3, the continuous helix 18 is dimensioned to be shorter than with the embodiment represented in Fig. 2, which has the advantage of a simpler manufacture. This is of importance with larger dimensions of the conveyor worm (e.g., shaft diameter of about 0.5 m, conveying

channel diameter of 1 m, conveyor worm length of about 8 m, thickness of the steel plate forming the continuous helix of about 4 cm).

Fig. 4 depicts a further embodiment, in which the continuous helix 18 only extends over half a convolution. With this variant, the bulk material is prevented from automatically flowing from the entry opening 17 to the discharge opening 12 only if the helix 18 is in the position illustrated in Fig. 4, i.e., in its lowermost position. If a rotation out of this position occurs, the bulk material will automatically flow from the entry opening 17 to the downpipe 14 without the conveyor worm 11 having to rotate itself, because the conical pile forming at the entry opening 17, which is indicated by the straight line 22, extends beyond the discharge opening 12. With this embodiment, the helix 18 functions as a blocking organ.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A conveying arrangement for the dosed conveyance of bulk material, comprising a conveying channel including an entry opening and a discharge opening, and a conveyor worm provided in the conveying channel, extending at least from the entry opening of the conveying channel to the discharge opening and provided with a first flight formed by paddles and a second flight formed by a continuous helix and arranged downstream of the flight formed by the paddles and on the end associated with the discharge opening of the conveying channel, characterized in that, for the conveyance of bulk material, such as ore, coal, sponge iron, etc., from a first metallurgical vessel into a second metallurgical vessel, the flight formed by the paddles is arranged in an end region of the conveyor worm extending into the interior of the first metallurgical vessel, and that the continuous helix extends over at least half a convolution and at most two convolutions and the end of the continuous helix is arranged in the region of the discharge opening for the bulk material to be conveyed, which discharge opening is surrounded by a downwardly directed socket, said socket leading to said second metallurgical vessel and the end region of the conveyor worm that is provided with the helix being mounted on the end of the conveying channel via a bearing means provided on the pertaining end of the conveying channel.

2. A conveying arrangement for the dosed conveyance of bulk material from a first metallurgical vessel to a second metallurgical vessel, comprising:

a conveying channel including an upstream entry opening, a downstream discharge opening surrounded by a downwardly directed socket leading to the second metallurgical vessel, and

an outer end; and

a conveyor worm provided in the conveying channel,

the conveyor worm extending at least from the entry opening of the conveying channel to the discharge opening and provided with:

a first flight formed by paddles and being arranged for extending into the interior of the first metallurgical vessel; and

a second flight formed by a continuous helix and arranged downstream of the flight formed by the paddles, the continuous helix extending over at least half a convolution and at most two convolutions, the end of the continuous helix being arranged in the region of the discharge opening for preventing the bulk material to be conveyed from flowing to the discharge opening.

3. A conveying arrangement as set forth in claim 1 or claim 2, wherein said first flight means formed by said paddles and provided in extension of said second flight means has a first flight external diameter and said second flight means formed by said continuous helix has a second flight external diameter, said second flight external diameter being larger than said first flight external diameter.

4. A conveying arrangement as set forth in claim 3, wherein said continuous helix has an outer periphery and said conveying channel has a conveying channel internal wall both defining an annular gap therebetween, said annular gap having a width approximately corresponding to the maximum grain diameter of said bulk material to be

conveyed.

5. A conveying arrangement as set forth in claim 1 or claim 2, wherein said continuous helix extends over the total length of said conveying channel from said entry opening to said discharge opening.

6. A conveying arrangement as set forth in claim 5, wherein said continuous helix extends over at least three quarters of a convolution.

7. A conveying arrangement as set forth in claim 6, wherein said continuous helix extends over one convolution and a half to two convolutions.

8. A conveying arrangement as set forth in claim 1 or claim 2, wherein said conveying channel has a conveying channel interior and said first flight means formed by said paddles extends into said conveying channel interior.

9. A conveying arrangement as set forth in claim 8, wherein said first flight means extends into said conveying channel interior by half a convolution to one convolution and a quarter.

10. A conveying arrangement as set forth in claim 1 or claim 2 having a conveying arrangement axis of rotation and a conveyor worm axis of rotation, and wherein said conveying channel has an uppermost generatrix and a length extending from said entry opening to said discharge opening that equals

the projection of said continuous helix directed on said conveying arrangement axis of rotation plus

the projection of a straight line laid at the bulk angle of said bulk material through the end of said continuous helix located closer to said entry opening, on

said conveyor worm axis of rotation, as far as said straight line extends upwardly to its point of intersection with said uppermost generatrix of said conveying channel.

11. A conveying arrangement as set forth in claim 1 or claim 2 having a conveying arrangement axis of rotation and a conveyor worm axis of rotation, and wherein said conveying channel has an uppermost generatrix and a length extending from said entry opening to said discharge opening that is larger than

the projection of said continuous helix directed on said conveying arrangement axis of rotation plus

the projection of a straight line laid at the bulk angle of said bulk material through the end of said continuous helix located closer to said entry opening, on said conveyor worm axis of rotation, as far as said straight line extends upwardly to its point of intersection with said uppermost generatrix of said conveying channel.

12. A conveying arrangement substantially as hereinbefore described with reference to the accompanying drawings.

DATED THIS 4TH DAY OF OCTOBER 1995
VOEST-ALPINE INDUSTRIEANLAGENBAU GMBH
By its Patent Attorneys:
GRIFFITH HACK & CO
Fellows Institute of Patent
Attorneys of Australia

ABSTRACT OF THE DISCLOSURE:

There is disclosed a conveying arrangement for the dosed conveyance of bulk material from one metallurgical vessel into another. A conveying channel has an entry opening and a discharge opening. A conveyor worm is provided in the conveying channel, extending at least from the entry opening to the discharge opening and including a flight formed by paddles.

In order to be able to configure the conveyor worm as short as possible and to provide for an elevated resistance against gas streaming through the conveying channel, the conveyor worm, on its end associated to the discharge opening, has a flight that is formed by a continuous helix extending at least over half a convolution. The flight formed by the paddles follows upon this continuous helix.

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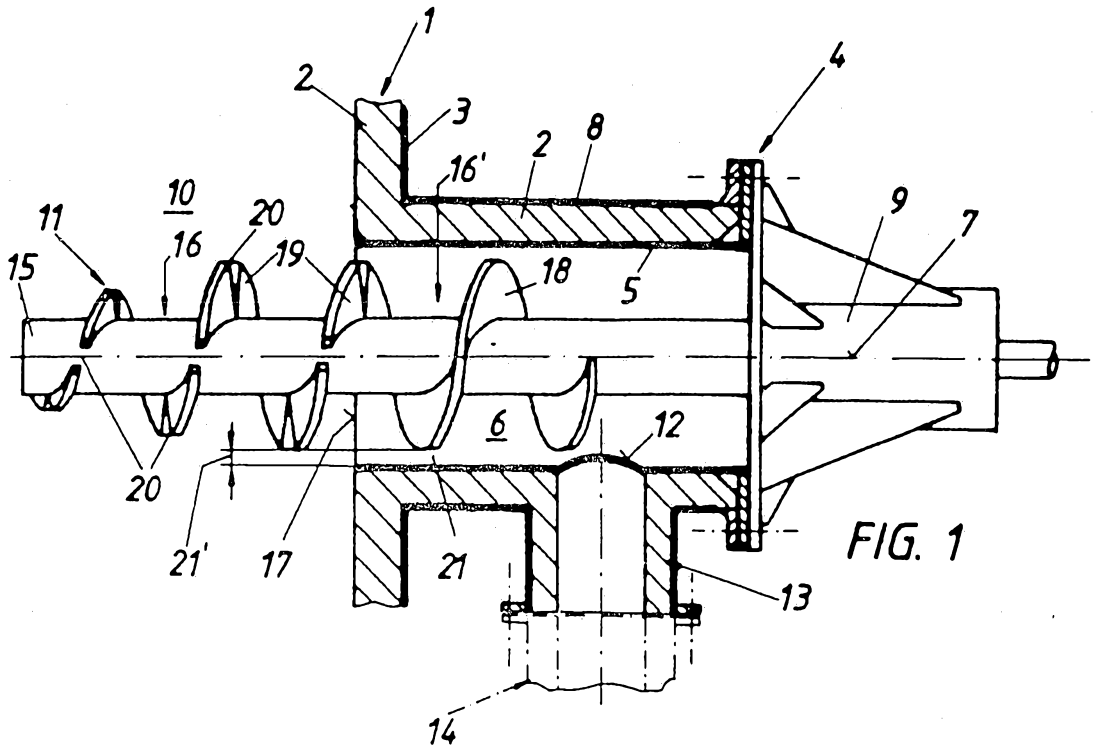

FIG. 1

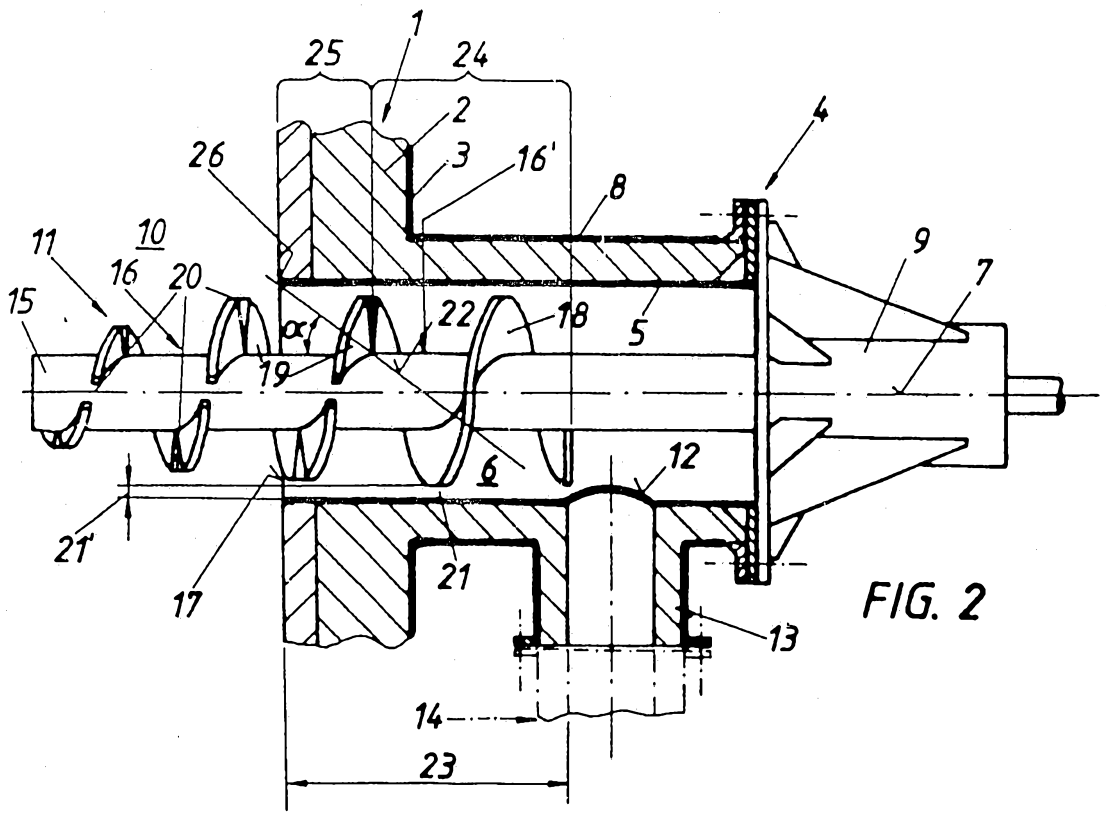

FIG. 2

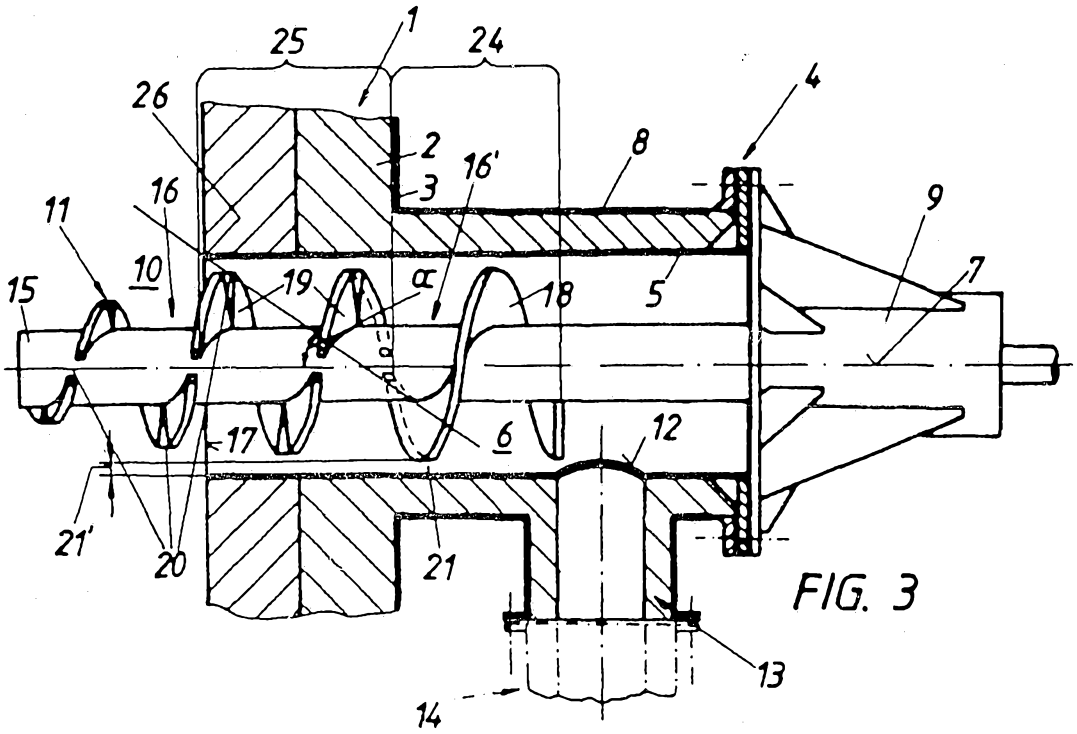
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FIG. 3

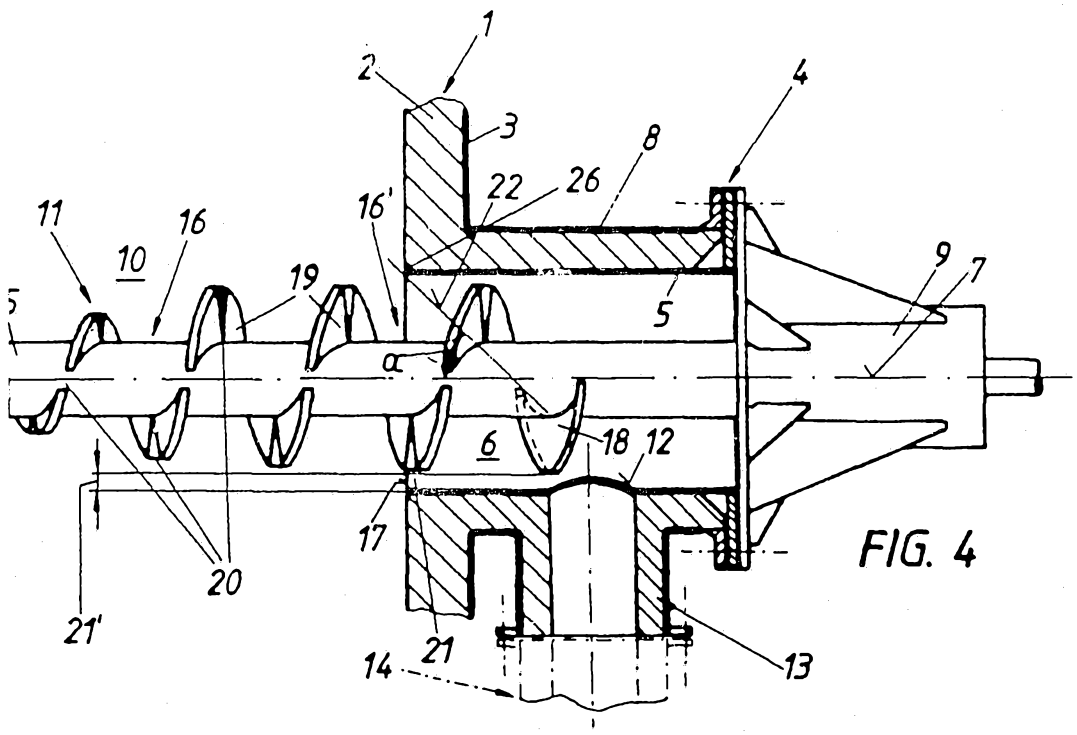
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FIG. 4