(19) DANMARK

(10) **DK/EP 2032264 T4**

Patent- og Varemærkestyrelsen

(12) Oversættelse af ændret europæisk patentskrift

(51) Int.Cl.: ***B 04 B 1/20 (2006.01)*** ***F 16 H 37/08 (2006.01)***

(45) Oversættelsen bekendtgjort den: **2019-09-16**

(80) Dato for Den Europæiske Patentmyndigheds bekendtgørelse om opretholdelse af patentet i ændret form: **2019-06-26**

(86) Europæisk ansøgning nr.: **07765567.8**

(86) Europæisk indleveringsdag: **2007-06-22**

(87) Den europæiske ansøgnings publiceringsdag: **2009-03-11**

(86) International ansøgning nr.: **EP2007056255**

(87) Internationalt publikationsnr.: **WO2007147893**

(30) Prioritet: **2006-06-23 DE 102006028804**

(84) Designerede stater: **AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC MT NL PL PT RO SE SI SK TR**

(73) Patenthaver: **GEA Mechanical Equipment GmbH, Werner-Habig-Strasse 1, 59302 Oelde, Tyskland**

(72) Opfinder: **OVERBERG, Martin, Lördemannweg 4, 33442 Herzebrock-Clarholz, Tyskland**

(74) Fuldmægtig i Danmark: **Patrade A/S, Ceresbyen 75, 8000 Århus C, Danmark**

(54) Benævnelse: **Snekkecentrifuge med driveaggregat**

(56) Fremdragne publikationer:
EP-A1- 1 056 545
DE-C1- 4 310 158
Flottweg GmbH & Co. KGaA: "Innovative Zentrifugen-Technik", Flottweg Separation Technology - Prospekt, April 2005,
DE-A1- 2 811 887
DE-U1- 9 409 109
JP-A- 61 197 062

Helical conveyor centrifuge having a drive device

Description

The invention relates to a helical conveyor centrifuge according to the preamble to Claim 1.

Such a centrifuge can be configured as a solid-bowl helical conveyor centrifuge or as a sieve-bowl helical conveyor centrifuge. DE 94 09 109 U1 discloses a centrifuge of the generic type having infinitely variable control of the differential speed between drum and broach.

Also cited as part of the prior art is WO 94/23223, which shows a planetary gearing which is used to drive helical conveyor centrifuges.

From the magazine "Antriebstechnik 37 (1998, p. 39), a multistage differential gear drive is known, which has established itself as a gearing for driving decanters, since it allows a relatively good adjustment of differential speeds. As the preliminary stage it has a two-stage planetary gearing arrangement, which is configured as a four-shaft gearing, one shaft being secured during operation. The problem here is that, in order to cover a greater range of adjustable differential speeds, it is necessary to use a variety of variable speed and secondary motors or a variety of gear ratios, which makes standardization more difficult and, during operation, if a substantial change is made to the set differential speed, may possibly necessitate a change of secondary motor.

Further cited as part of the prior art is DE 28 11 887 C3. According to this, two structurally mutually separate gearings are used as the gearing arrangement, which is relatively complex.

As part of the technological background, DE 198 06 374 C1, US 3,343,786, US 2,867,378 and WO 02/081094 are also cited.

EP 0 798 046 A1 discloses a centrifuge drive having two motors – a main motor and a variable speed motor – and a three-stage gearing, the first two gear stages being configured as epicyclic gear stages. At three shafts, a torque is either introduced into the gearing or is taken off therefrom. The output of the variable speed motor here flows first into the first gear stage, from there into the second gear stage and from there to the downstream gear stage, so that the variable speed motor is necessarily designed for relatively large outputs. The gearing additionally poses the problem that it is relatively difficult to set small differential speeds in a precise manner.

The invention follows a different route. It has the object of providing a helical conveyor centrifuge in which a relatively large differential speed can be set without an exchange of secondary motor, the aim being to be able to set even small differential speeds in a relatively simple and precise manner.

The invention achieves this object by virtue of the subject of Claims 1 and 2.

It is particularly advantageous that the second motor for driving the second gear stage of the first gearing can remain the same for different differential speed ranges.

Moreover, the drawback familiar from the prior art that belt slippage, in the case of relatively small differential speeds, leads to unpredictable results, is avoided. Instead, the subject of the invention also allows a relatively precise setting of small differential speeds between drum and screw.

Moreover, the design according to the invention is of simple and compact construction.

A presetting of the differential speed range can be realized in a simple manner by exchanging the belt drive for the first gear stage.

The accurate setting within the respective region is then effected by regulating or controlling the motor speed of the second motor.

The measure that the first gear stage is driven via three drive shafts (for example, via belt drives or directly and with two or three motors) means that no epicyclic power is generated and the number of belts can hence be kept low, so that the load upon the shafts in this region is low.

The housing is driven by a first mortor as the main motor, so that an epicyclic gearing is realized. The main motor also preferably drives the first gear stage doubly, whereas, via a second motor as the variable speed motor, a torque is introduced into the second gear stage, so that the screw is driven by the variable speed motor and by the main motor, whereas only the main motor rotates the drum.

It is particularly expedient to split the power necessary for the screw drive between the secondary motor and the drum motor.

The variable speed motor then projects its speed range onto a small differential speed range.

The desired differential speed can hence be set with high accuracy. In terms of power, the variable speed motor and the associated frequency converter can be accurately designed for the range of adjustment which is necessary from a process engineering perspective and are thus not dimensioned unnecessarily large. The remaining power is supplied by the drum motor. In an advantageous embodiment, this leads to better overall efficiency.

This splitting of the power between the two motors is managed in accordance with the movable differential speed ranges by varying the belt transmission ratio with the exchangeable pulleys.

Advantageous embodiments of the invention can be derived from the sub-claims.

The invention is explained in greater detail below on the basis of illustrative embodiments with reference to the drawing, wherein

fig. 1 shows a schematic representation of a solid-bowl helical conveyor centrifuge with its drive;

fig. 2 shows a detail enlargement from fig. 1;

fig. 3a shows a diagram of the structure of the first two gear stages for the centrifuge from fig. 1;

fig. 3b shows a diagram of the structure of an alternative embodiment of the first two gear stages for a centrifuge in the style of fig. 1;

fig. 4 shows a sectional view of a gearing arrangement in the style of fig. 1 and 3a;

fig. 5,6 and 8 show schematic representations of alternative embodiments of the invention in the style of the representation of fig. 2;

fig. 7 shows an embodiment not covered by claim 1; and

fig. 9 shows a chart for illustrating various differential speed ranges which can be realized with the gearing arrangement of fig. 1.

Below, fig. 1, 2 and 3a shall be described first.

Fig. 1 and 2 show a solid-bowl helical conveyor centrifuge comprising a rotatable drum 1, with preferably horizontal rotation axis, and a likewise rotatable screw 2, which is disposed within the drum 1 and has a centrifuge drive 3 for rotating the drum 1 and the screw 2. The drum is disposed between drum bearings 10a, 10b, which are respectively arranged on the drive side and facing away from the drive.

The centrifuge drive 3 has a first motor 4 – also referred to as the main motor – and a second motor 5 – also referred to as the variable speed motor – as well as a gearing arrangement disposed between the motors 4, 5 and also between the drum 1 and the screw 2.

The gearing arrangement preferably comprises only a single gearing 6 having three or more gear stages 7, 8, 9, which are arranged downstream of the motors 4, 5, in the embodiment chosen here the first two gear stages 7, 8 and the third gear stage 9 being disposed on the two axial sides of the drive-side drum bearing 10. Alternative embodiments, for example having all gear stages 7, 8, 9 within (fig. 5) or outside (fig. 6) the drum bearing 10 (relative to the drum 1), are likewise feasible.

The design of the gearing 6 is here such that between the rotation speed of the drum 1 and the rotation speed of the screw 2 during operation, a differential speed can be set.

The first gear stage 7 and the second gear stage 8 of the gearing 6 are respectively configured in the style of a planetary gearing, the first gear stage 7 forming a type of preliminary stage and the second gear stage 8 forming a type of main stage, which are both disposed in a common housing 12 (see also fig. 3a). The first and the second gear stage 7, 8 are designed in the style of an epicyclic gear, the housing 12 being co-driven, which in turn drives the drum 1, the latter being connected in a rotationally secure manner to the housing 12, preferably via a hollow shaft 13.

The first gear stage 7 has in the housing 12 a sun gear 14 on a sun gear shaft 15, planetary gears 16 on planetary gear axles 17, which are combined to form a planet carrier 33, and an outer ring gear 18.

The second gear stage 8 also has – likewise within the housing 12 – a sun gear 19 on a sun gear shaft 20, planetary gears 21 on planetary gear axles 22, which are combined to form a planet carrier 40, and an outer ring gear 23.

The first motor 4 drives directly (not represented) or indirectly (via a first wrap drive 24 having a belt pulley 25 on its motor shaft 26, a belt 27 and a belt pulley 28, which is coupled in a rotationally secure manner to the housing 12 and the planetary gear axles 17 of the planetary gears 16 of the first gear stage 7, so that it here also forms the planet carrier 33) the housing 12 and the planetary gears 16. The belt pulley 28 can also – as can be seen in fig. 3 – be configured in one piece with the housing 12 or be configured on the outer periphery thereof.

In addition, the first motor 4 drives directly or indirectly (for example, via a second belt drive 29 having a belt pulley 30 on its motor shaft 26, a belt 31 and a belt pulley 32) the (hollow) shaft 15 for the sun gear 14 of the first gear stage 7.

The second motor 5 drives directly or indirectly (for example, via a third belt drive 34 having a belt pulley 35 on the motor shaft 36 of the second motor 5, having a belt 37 and a belt pulley 38) the sun gear shaft 20 of the sun gear 19 of the second gear stage 8.

If the first motor 4 drives the drum elsewhere, the two belt drives could run via back-gearing arrangements.

In addition, the ring gear 18 is coupled via an intermediate piece to a ring gear 23 of the second gear stage 8 such that it is rotationally secure relative to an intermediate shaft 39, and is configured in one piece with said ring gear 23.

The planetary gear axles 22 of the planetary gears 21 of the second gear stage 12 drive via the planet carrier 40 an intermediate shaft 41 for the third gear stage 9, which (as a simple and, once again, multiple output gear stage) drives the screw 2 (here indicated purely schematically).

Between the housing 12 and the intermediate shaft 41, a differential speed adjustable by the first and second gear stages 7, 8 can be realized, which, on the one hand, is determined by the rotation speed of the sun gear shaft 20 of the second gear stage 8 and, on the other hand, by the rotation speed of the intermediate shaft 39.

For the setting of the differential speed, the rotation speed of the sun gear shaft 20 of the sun gear 19 of the second gear stage 8 is brought with the second motor 5 to a defined speed.

The rotation speed of the intermediate shaft 39 is here determined by the rotation speed of the sun gear shaft 15 of the sun gear 14 of the first gear stage 7 and is thus also dependent on the output speed of the first (drum) motor.

Both the sun gear shaft 15 and the housing 12 have a speed different from zero, the rotation speed of the housing 12 being fixedly coupled to the rotation speed of the sun gear shaft 15.

It is also advantageous that the first two gear stages 7, 8 are disposed within the common (rotatable) housing 12, since this can be realized cost-effectively and is of compact construction.

The sun gear shaft 20 could, where appropriate, also be set at zero. In this way, a drive having just a single motor could be realized (fig. 7, which is not covered by Claim 1).

Alternatively, it could also be conceivable, according to the embodiment of figure 2, to drive the sun gear shaft 15 with a third motor (not represented here).

The design whereby the sun gear shaft 15 and the planetary gear axles 17 of the first gear stage 7, as well as the housing 12, are driven with the first motor 4 is, however, cheaper and simpler.

In normal operation, all the wrap gearings 24, 29, 34, as well as the first (drum) motor 4 and the (secondary) motor 5, feed power into the rotary system (drum and screw). Loss-suffering rotation and braking powers are thereby prevented.

In addition, the first gear stage 7 forms a type of preliminary stage, which acts with the second gear stage 8 as a kind of master primary gear stage.

According to the arrangement of fig. 1 and 2, as a result of the preliminary stage situated outside the drive-side drum bearing 10a, a dynamically rigid attachment to the rotary system is possible.

The first two gear stages 7, 8 can, however, also be arranged fully together (where appropriate, with further stages) between the drive-side drum bearing 10a and the drum 1 (fig. 5) or relative to the drum 1 outside the drive-side drum bearing 10a.

As an advantage of the designs of fig. 1 to 8, however, it should also be mentioned that the dependence of the differential speed upon the slippage and upon the load state of the decanter is low.

Moreover, the secondary motor 5 can remain the same for different differential speeds. The power which is additionally needed at higher differential speeds derives from the first (main) motor 4, which generally has greater reserves.

A changing of the belts or belt pulleys enables the predefined differential speed range to be easily adjusted.

Mutually, where appropriate also partially overlapping differential speed ranges which can be realized with the invention are represented, by way of example, in fig. 9. It can here be seen that respectively, for instance by exchange of the belt pulley 32 and/or of the other belt pulley of this belt drive, four differential speed ranges “1, 2, 3 and 4”, for example, can be suitably preset in a very simple manner, which, in particular, can be tailored to the variable speed motor, within the ranges, by regulation or controlling of the motors 4 and 5 (in particular of the motor 5), the differential speed being able to be altered during operation within the given band widths.

The belt pulley 32 or the belt drive 29 of the first motor generally serves for the presetting (for example, with an exchangeable pulley) of the differential speed range in accordance with figure 9.

By contrast, the second motor 5 serves as the variable speed drive. The drum rotation speed is set via the first belt drive or the first wrap drive 24. The intermediate shaft 41 as the output shaft simultaneously serves as the input shaft for the third gear stage 9, which can be realized in a wide variety of ways.

Figure 3b shows an alternative embodiment of the invention, in which the belt pulley 32 of the belt drive 29 of the first motor 4 is coupled not to the sun gear shaft 15 but to the ring gear 18 of the first gear stage 7 and drives the latter. In a further divergence from figure 3a, the sun gear shaft 15 is correspondingly coupled via an intermediate piece 42 to the ring gear 23 of the second gear stage 8.

Otherwise the structure of fig. 3b corresponds to the structure of figure 3a or 1.

In contrast to known differential gearings, the belt pulley 38 of fig. 1 for a leading screw 2 according to fig. 3a and 3b is driven oppositely to the rotational direction of the drum. In order to ensure that the screw 2 – together with an eccentric gearing – leads, no reversal of the rotational direction takes place in the second gear stage 8 of the gearing 6.

In the version of figures 1, 2 and 3a (and in those of fig. 5 and 6), the differential speed is proportional to the speed difference between the sun gear shafts 15 and 20. Since the sun gear shaft 20 of the second stage here rotates oppositely to the drum 1, the speed difference between the sun gear shaft 15 and sun gear shaft 20 of the first and the second gear stage 7, 8 is increased if the sun gear shaft 15 of the first gear stage 7 is brought to a rotation speed between zero and the drum speed or greater than the drum speed, since the sun gear shaft 15 is jointly driven by the main motor 4. The differential speed thereby increases in the desired manner.

In the version of figure 3b, this effect is made stronger than in the version of figure 3a, so that the latter version is preferred.

According to fig. 8, a torque is likewise introduced into the first and second gear stages at three shafts, the first belt pulley 28 driving the ring gear 18 and the second belt pulley driving the sun gear 15, however, and the planetary gear axles 16 of the first gear stage being coupled to the planetary gear axles 22 of the second gear stage 8. The variable speed motor 5 in turn drives the sun gear shaft 20 of the second gear stage 8, whereas the ring gear 23 of the second gear stage 8 drives the intermediate shaft 41 for the third gear stage 9.

In this design, no rotation speed reversal takes place, which, in combination with a planetary gearing of conventional construction, results in a leading screw.

Reference symbols

drum	1
screw	2
centrifuge drive	3
motor	4
motor	5
gearing	6
first gear stage	7
second gear stage	8
third gear stage	9
drum bearings	10a, 10b
housing	12
hollow shaft	13
sun gear	14
shaft	15
planetary gears	16
planetary gear axle	17
ring gear	18
sun gear	19
shaft	20
planetary gears	21
planetary gear axle	22
ring gear	23
belt drive	24
belt pulley	25
motor shaft	26
belt	27
belt pulley	28
belt drive	29

Patentkrav

1. Snekkecentrifuge, især en fuldkappe- eller sigtekappesnekkecentrifuge, omfattende:

a) en roterbar tromle (1),

b) en roterbar snekke (2) placeret inde i tromlen (1),

c) et centrifugedrev (3) til at rotere tromlen (1) og snekken (2) og udformet, så en differentialomdrejningshastighed mellem tromle (1) og snekke (2) kan indstilles,

d) hvori centrifugens drev (3) har følgende:

i. en første motor (4) og en anden motor (5), og

ii. et geararrangement, som er placeret mellem motorerne (4, 5) og desuden mellem tromlen (1) og snekken (2), og som har et gear (6) arrangeret nedstrøms for motorerne (4, 5) og med et første, et andet og mindst et tredje geartrin (7, 8, 9),

e) det første geartrin er konfigureret i stil med en planetarisk gearing og har et solgear (14), planetgear (16) og planetariske gearaksler (17) på en planetbærer (33) samt et ringgear (18), og

f) det andet geartrin er konfigureret i stil med en planetarisk gearing og har ligeledes et solgear (19), planetgear (21), planetgearaksler (22) på en planetbærer (40) og et ringgear (23),

g) hvori der ved tilsammen mindst fire aksler indføres drejningsmomenter i det første geartrin (7) og det andet geartrin (8), eller udtages fra disse to geartrin, og

h) hvori de første og andre geartrin (7, 8) drives tilsammen drives med mindst tre aksler, **kendetegnet ved, at**

i) den første motor (4) først tilfører et drejningsmoment til huset (12) og dernæst ved to aksler tilfører det første geartrin (7) et drejningsmoment, og

j) den anden motor (5), som en motor med variabel hastighed, tilfører et drejningsmoment til det andet geartrin (8),

k) hvor hovedmotoren (4) drives direkte eller via en gearforbindelse, såsom et omviklingsdrev

i. huset (12),

ii. planetbæreren (33) i det første geartrin (7), og

iii. solgearakslen (15) i det første geartrin (7), og

l) hvor den anden motor, som motoren med variabel hastighed (5),

i. driver solgearakslen (20) i det andet geartrin (8).

2. Snekkecentrifuge, især en fuldkappe- eller sigtekappesnekkecentrifuge, omfattende:

a) en roterbar tromle (1),

b) en roterbar snekke (2) placeret inde i tromlen (1),

c) et centrifugedrev (3) til at rotere tromlen (1) og snekken (2) og udformet, så en differentialomdrejningshastighed mellem tromle (1) og snekke (2) kan indstilles,

d) hvori centrifugens drev (3) har følgende:

i. en første motor (4) og en anden motor (5), og

ii. et geararrangement, som er placeret mellem motorerne (4, 5) og desuden mellem tromlen (1) og snekken (2), og som har et gear (6) arrangeret nedstrøms for motorerne (4, 5) og med et første, et andet og mindst et tredje geartrin (7, 8, 9),

e) det første geartrin er konfigureret i stil med en planetarisk gearing og har et solgear (14), planetgear (16) og planetariske gearaksler (17) på en planetbærer (33) samt et ringgear (18), og

f) det andet geartrin er konfigureret i stil med en planetarisk gearing og har ligeledes et solgear (19), planetgear (21), planetgearaksler (22) på en planetbærer (40) og et ringgear (23),

g) hvori der ved tilsammen mindst fire aksler indføres drejningsmomenter i det første geartrin (7) og det andet geartrin (8), eller udtages fra disse to geartrin, og

h) hvori de første og andre geartrin (7, 8) drives tilsammen drives med mindst tre aksler, **kendetegnet ved at**

i) den første motor (4) først tilfører et drejningsmoment til huset (12) og dernæst ved to aksler tilfører det første geartrin (7) et drejningsmoment, og

j) den anden motor (5), som en motor med variabel hastighed, tilfører et drejningsmoment til det andet geartrin (8),

k) hvor hovedmotoren (4) drives direkte eller via en gearforbindelse, såsom et omviklingsdrev

i. huset (12),

ii. ringgearet (18) i det første geartrin (7),

iii. planetbæreren (33) i det første geartrin (7), og

l) den anden motor, som motoren med variabel hastighed (5),

i. driver solgearakslen (20) i det andet geartrin.

3. Snekkecentrifuge ifølge krav 1 eller 2, **kendetegnet ved, at** de første og andre geartrin (7, 8) er placeret i et fælles, roterbart hus (12).

4. Snekkecentrifuge ifølge krav 3, **kendetegnet ved, at** huset (12) er forbundet med tromlen (1) på rotationsfast måde.

5. Snekkecentrifuge ifølge et af de foregående krav, **kendetegnet ved, at** snekken (2) drives i fællesskab af motoren (5) med variabel hastighed og af hovedmotoren (4), hvorimod hovedmotoren (4) alene roterer tromlen.

6. Snekkecentrifuge ifølge et af de foregående krav, **kendetegnet ved, at** de første og andre geartrin (7, 8) er koblet direkte til hinanden.

7. Snekkecentrifuge ifølge et af de foregående krav, **kendetegnet ved, at** den anden motor (5) driver direkte solhjulsakslen (20) af det andet geartrin (12).

8. Snekkecentrifuge ifølge et af de foregående krav, **kendetegnet ved, at** de første og andre geartrin (7, 8) og huset (12) drives af tre omslyngningsdrev (24, 29, 34).

9. Snekkecentrifuge ifølge et af de foregående krav, **kendetegnet ved, at** den første motor (4) driver via et første omslyngningsdrev (24) det roterbare hus (12) og det første geartrins (7) planetbærer (33).

10. Snekkecentrifuge ifølge et af de foregående krav, **kendetegnet ved, at** den første motor (5) driver via et andet omslyngningsdrev (29) solhjulsakslen (15) af det første geartrin (7).

11. Snekkecentrifuge ifølge et af de foregående krav, **kendetegnet ved, at** den første motor (4) driver via det andet omslyngningsdrev (29) ringhjulet (18) af det første geartrin (7).

12. Snekkecentrifuge ifølge et af de foregående krav, **kendetegnet ved, at** det første geartrins (7) ringhjul (18) og det andet geartrins (8) ringhjul (23) er forbundet sammenkoblet som en mellemaksel (39) eller rotationsfast.

13. Snekkecentrifuge ifølge et af de foregående krav, **kendetegnet ved, at** det første geartrins (7) solhjulsaksel (15) er rotationsfast forbundet til det andet geartrins (8) ringhjul (23).

14. Snekkecentrifuge ifølge et af de foregående krav, **kendetegnet ved, at** den anden motor (5) driver solhjulsakslen (20) af det andet geartrin med variabel hastighed for indstilling af differentialomdrejningshastigheden.

15. Snekkecentrifuge ifølge et af de foregående krav, **kendetegnet ved, at** det andet geartrins (8) planetgearaksler (22) via en planetbærer (40) og i givet fald en mellemaksel (41) driver det tredje geartrin (9), som afgiver et drejningsmoment til snekken (2) og driver sidstnævnte.

16. Snekkecentrifuge ifølge et af de foregående krav, **kendetegnet ved, at** det andet omslyngningsdrev har mindst en eller to remskiver (32), som er indrettet til at blive udskiftet.

17. Snekkecentrifuge ifølge krav 16, **kendetegnet ved, at** remskiven (32) også danner planetbæreren (33) af det første geartrin (7).

18. Snekkecentrifuge ifølge et af krav 16 og 17, **kendetegnet ved, at** en af det første remdrevs remskiver (28) er udformet i ét med huset (12).

19. Snekkecentrifuge ifølge et af de foregående krav 16 til 18, **kendetegnet ved, at** en af det første remdrevs remskiver (28) er udformet direkte på husets (12) udvendige periferi.

20. Snekkecentrifuge ifølge et af de foregående krav, **kendetegnet ved, at** de første to geartrin (7, 8) er placeret mellem et på drivsiden anbragt tromleleje (10a) og tromlen (1).

21. Snekkecentrifuge ifølge et af de foregående krav 1 til 20, **kendetegnet ved, at** de første to geartrin (7, 8) er placeret i forhold til tromlen (1) uden for et på drivsiden anbragt tromleleje (10a) af tromlen (1).

22. Snekkecentrifuge ifølge et af de foregående krav 16 til 18 og 21, **kendetegnet ved, at** den første remskive (28) driver ringhjulet (18), og den anden remskive driver solhjulet (15) af det første geartrin, og at det første geartrins planetgearaksler (16) er koblet til det andet geartrins (8) planetgearaksler (22), hvor den anden motor (5) på sin side driver det andet

geartrins (18) solhjulsaksel (20), hvorimod det andet geartrins ringhjul (23) driver det tredje geartrins (9) mellemaksel (41).

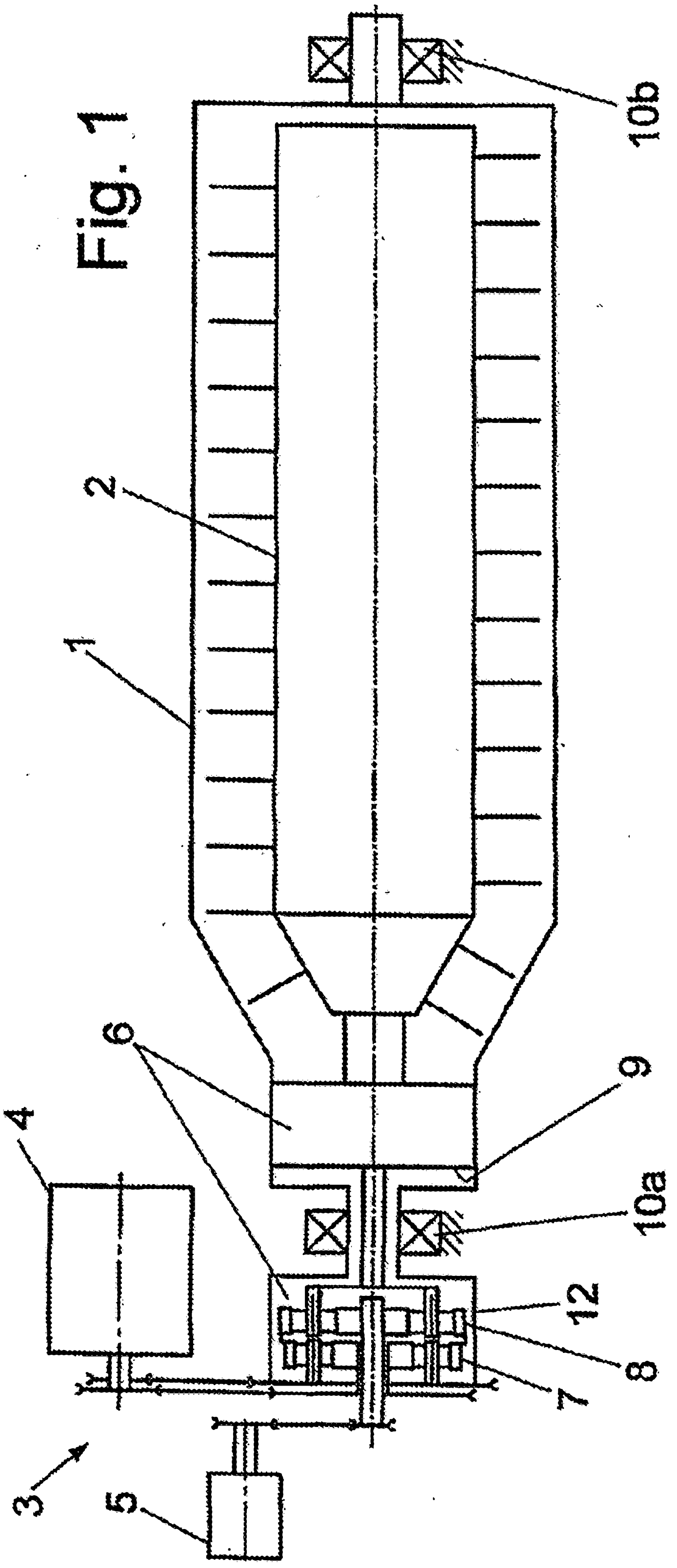
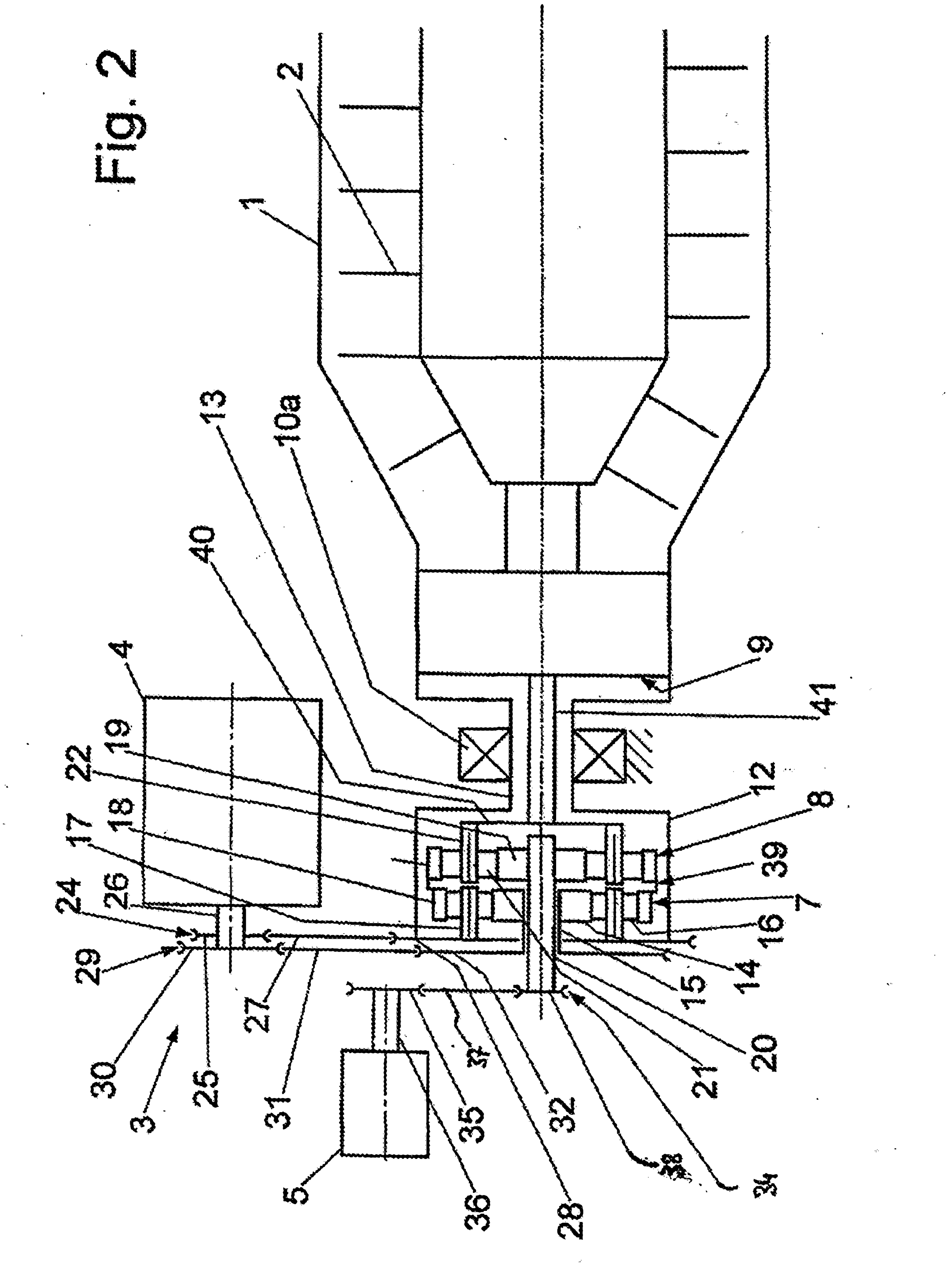
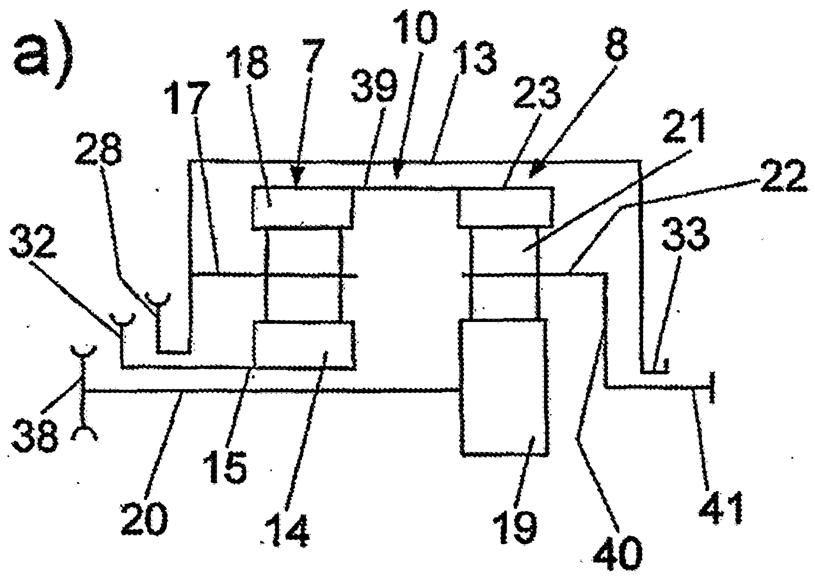


Fig. 1

Fig. 2


1
2
3
4
5
7
8
9
10a
12
13
14
15
16
17
18
19
20
21
22
24
25
26
27
28
29
30
31
32
35
36
39
40
41


a)
10
7
18
39
13
8
23
17
21
28
22
32
33
38
15
20
14
19
40
41

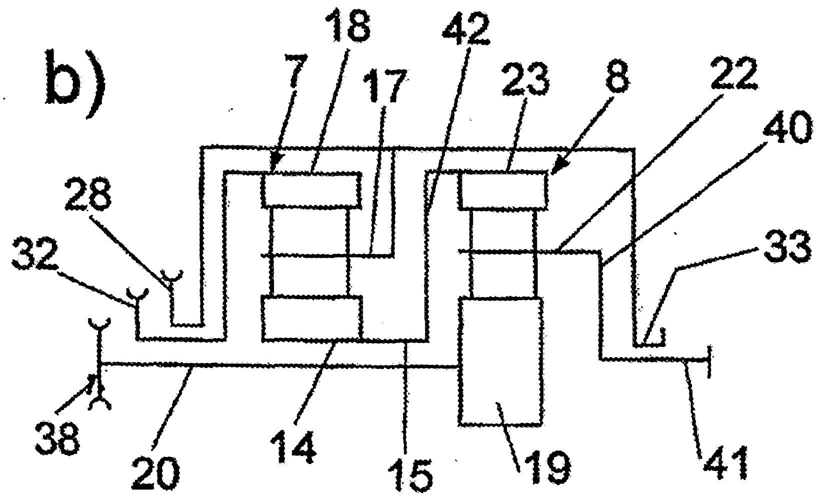

b)
18
42
7
17
23
8
22
40
28
32
33
38
20
14
15
19
41

Fig. 3

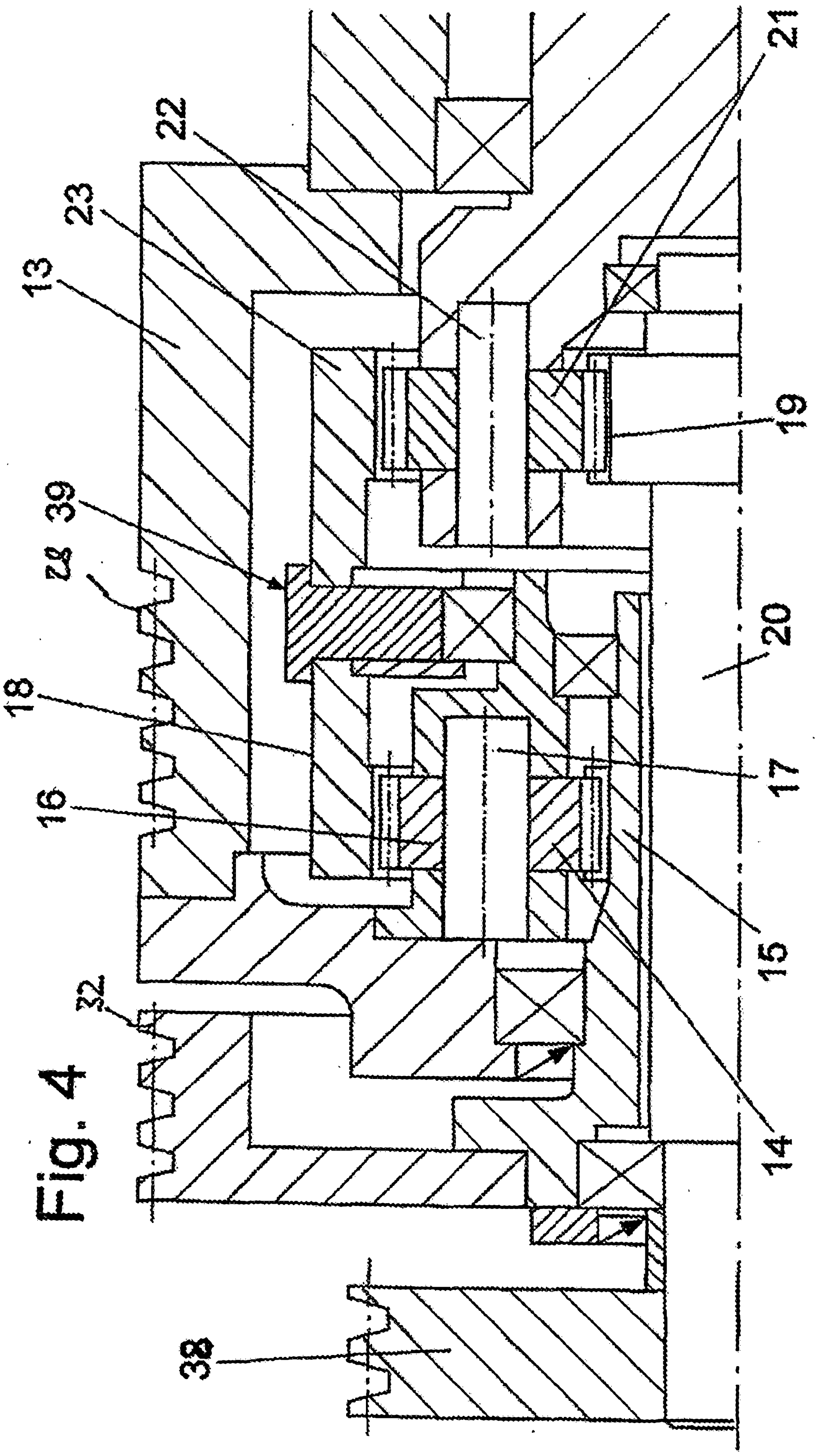


Fig. 4

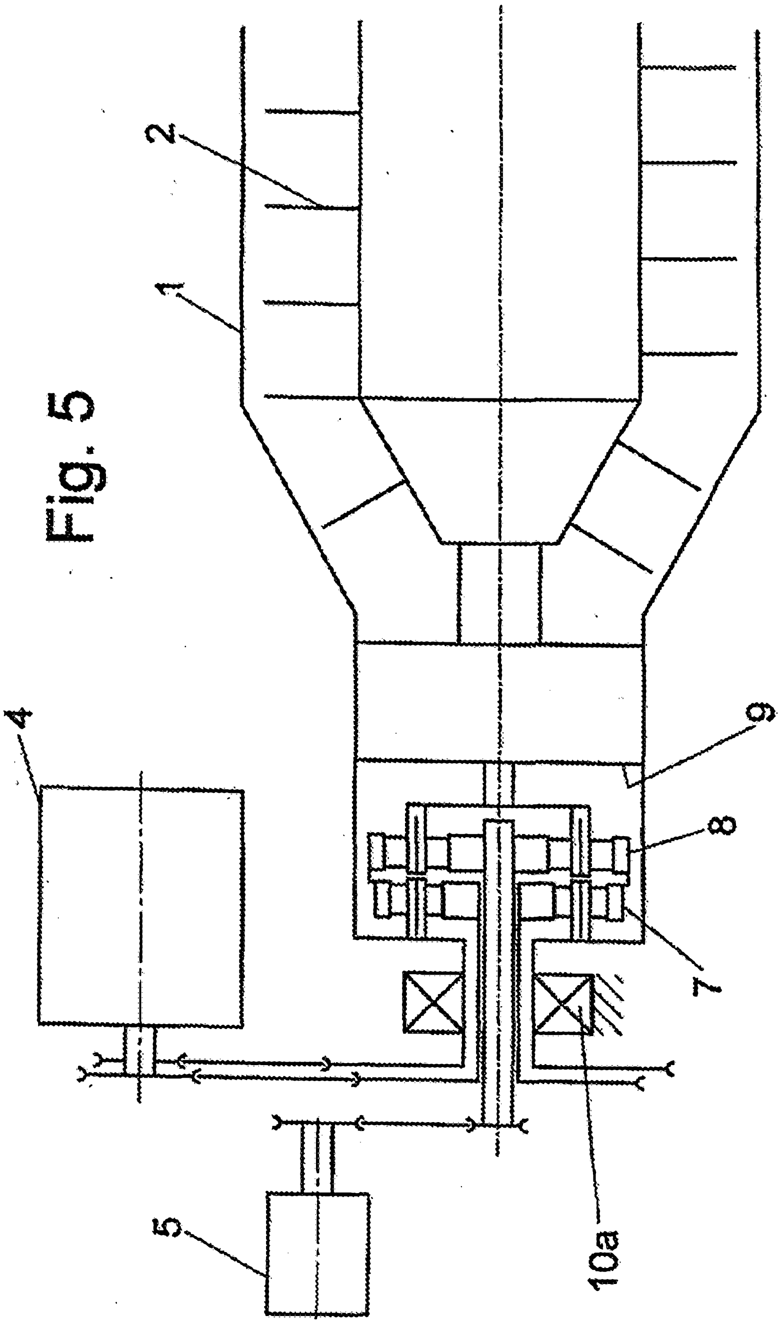
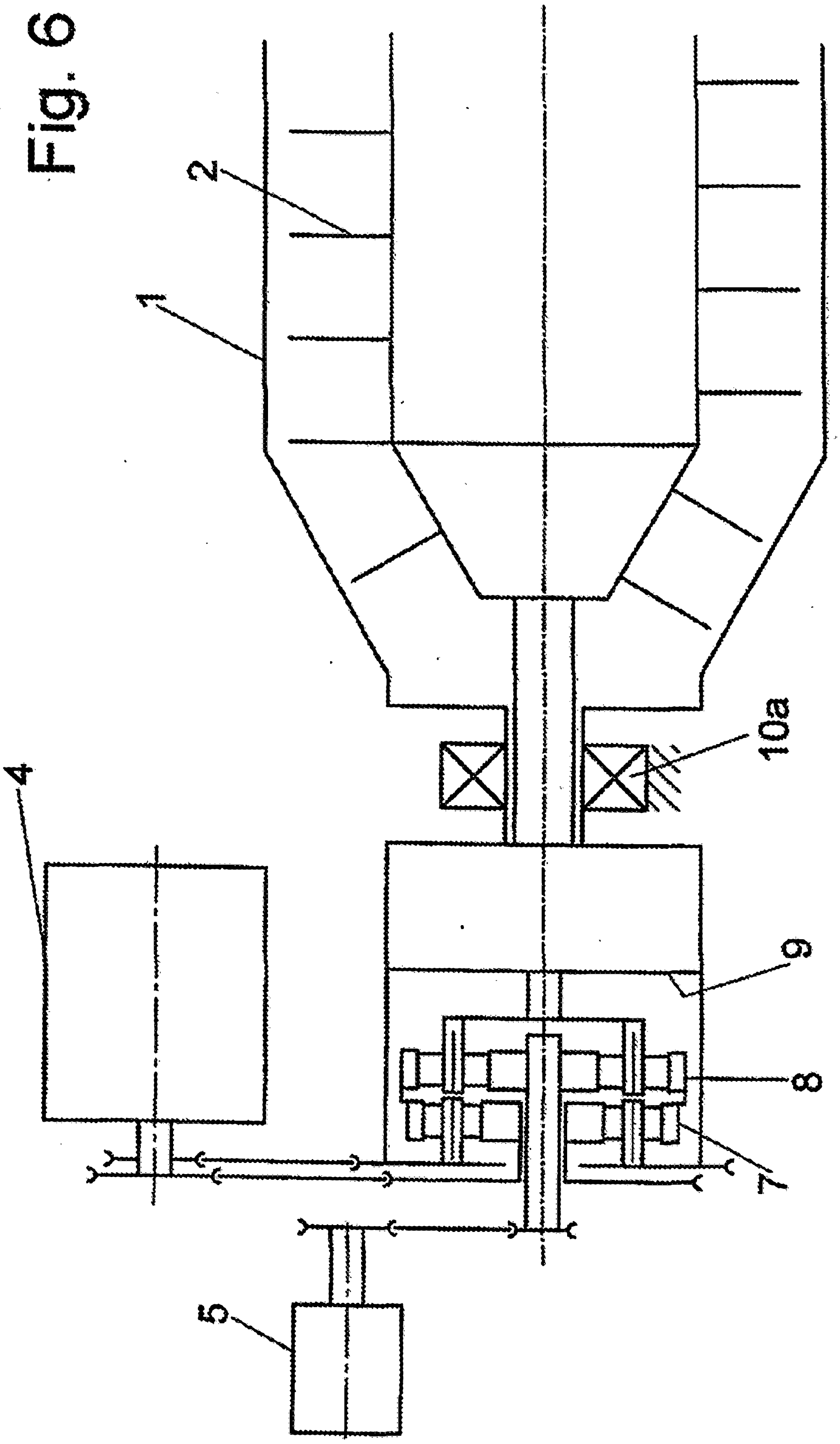


Fig. 5

Fig. 6



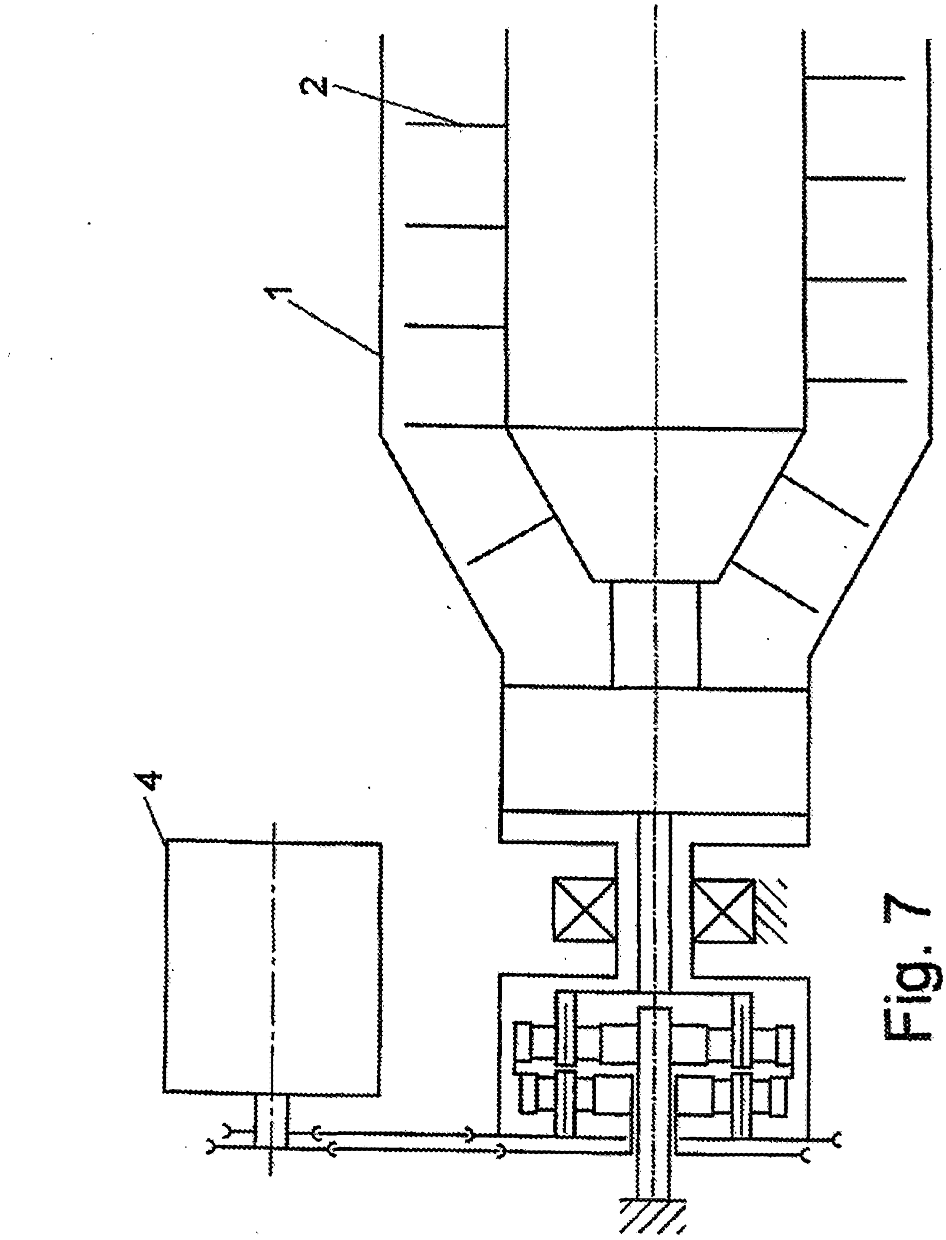


Fig. 7

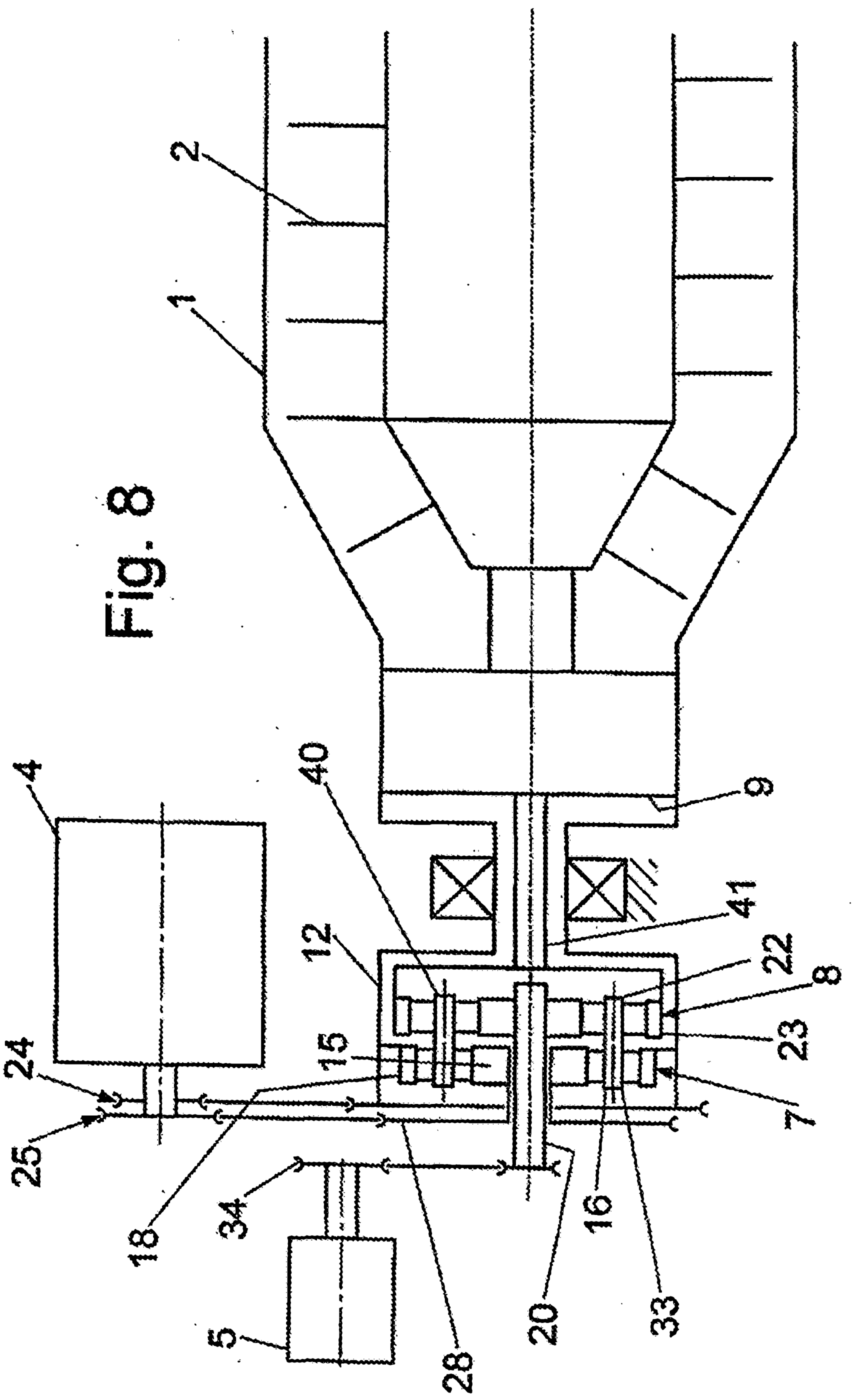


Fig. 8

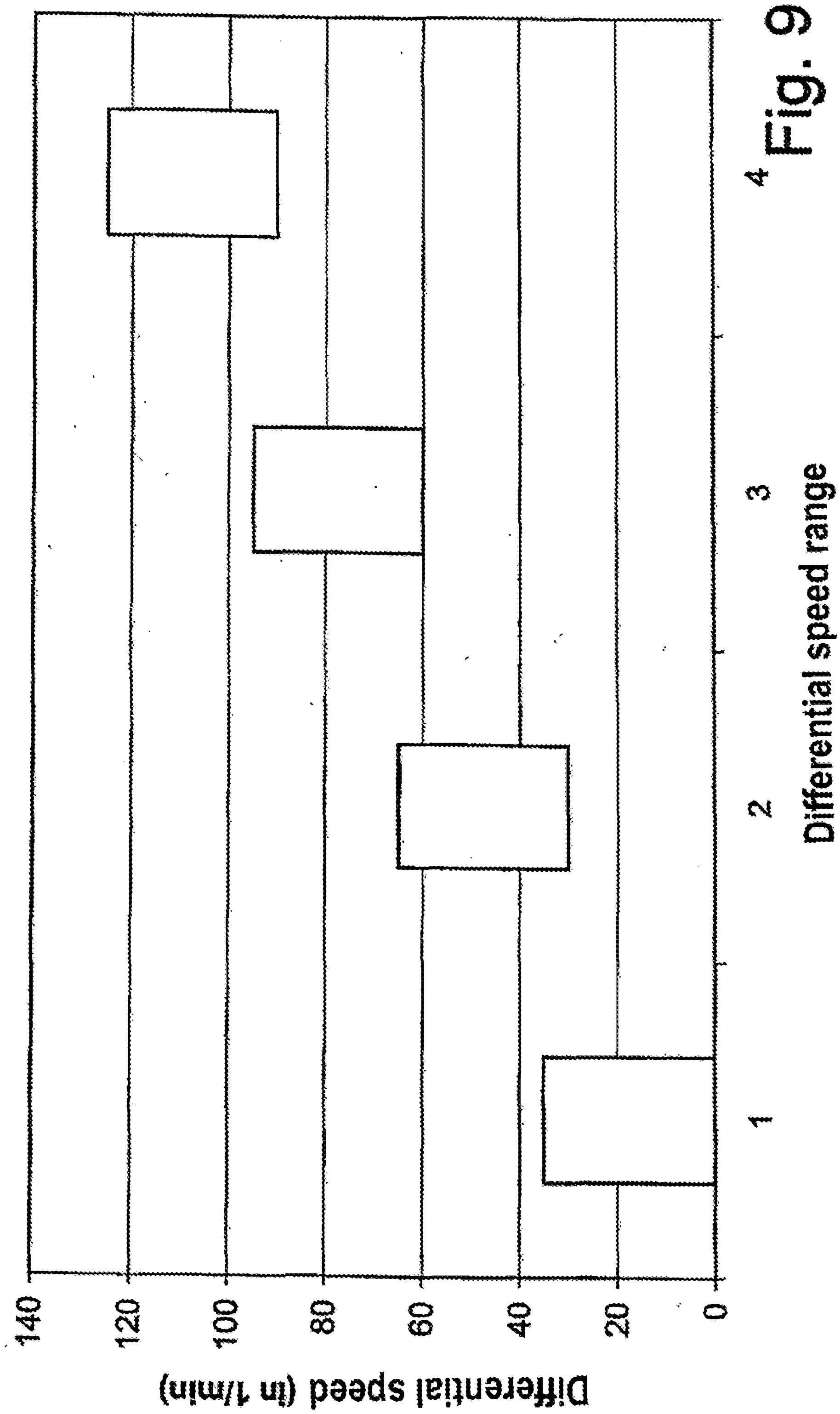

Differential speed (in 1/min)
140
120
100
80
60
40
20
0
1
2
3
4
Differential speed range

Fig. 9