Office de la Propriété Intellectuelle du Canada
Un organisme d'Industrie Canada

Canadian Intellectual Property Office
An agency of Industry Canada

CA 2317014 C 2004/09/28

(11)(21) 2 317 014

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(86) Date de dépôt PCT/PCT Filing Date: 1999/10/18
(87) Date publication PCT/PCT Publication Date: 2000/05/11
(45) Date de délivrance/Issue Date: 2004/09/28
(85) Entrée phase nationale/National Entry: 2000/06/27
(86) N° demande PCT/PCT Application No.: EP 1999/007879
(87) N° publication PCT/PCT Publication No.: 2000/026540
(30) Priorité/Priority: 1998/10/29 (198 49 805.5) DE

(51) Cl.Int.^{7}/Int.Cl.^{7} F04C 11/00, F04C 2/18

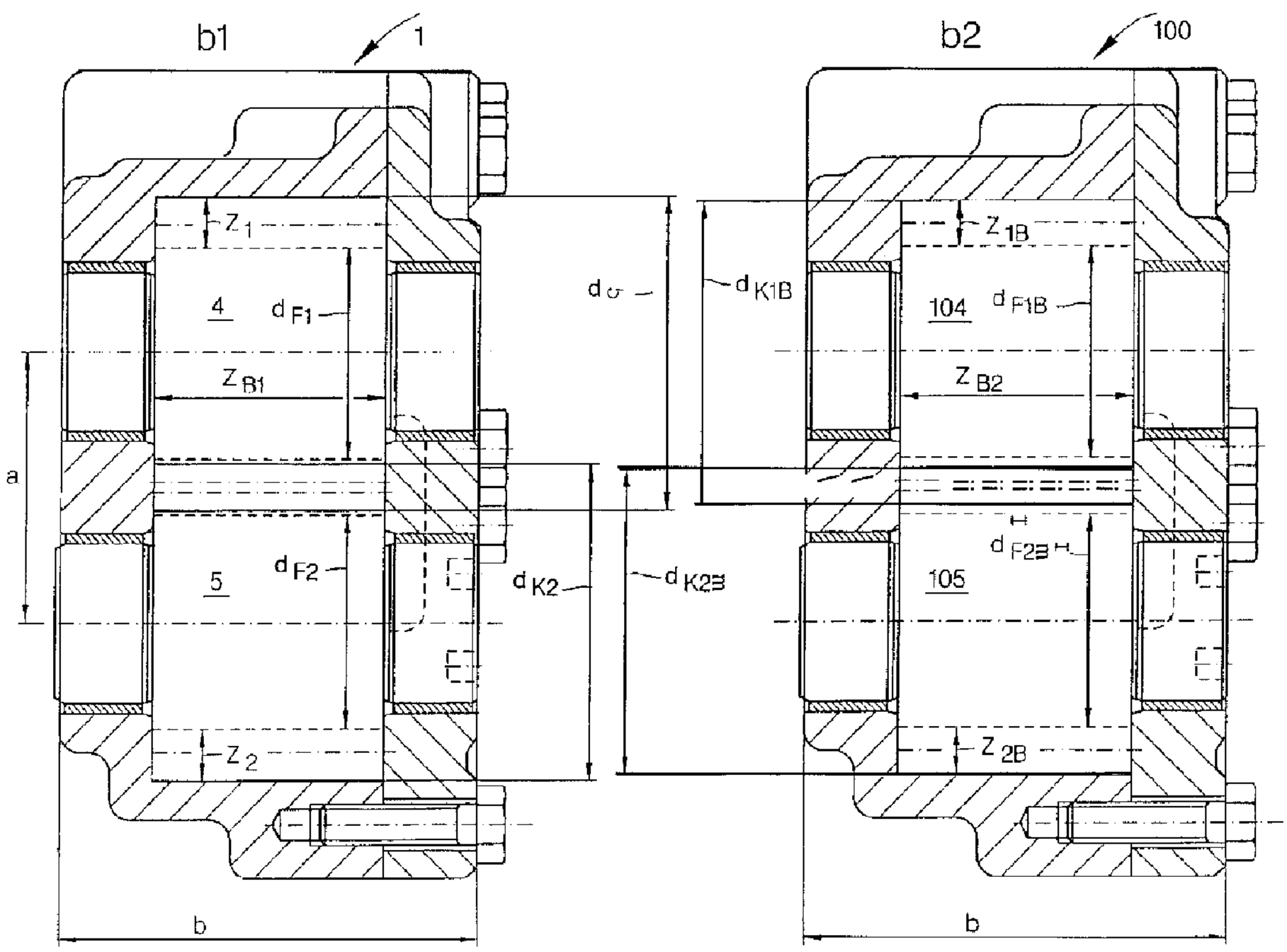
(72) Inventeur/Inventor:
KORNER, TILLMANN, DE

(73) Propriétaire/Owner:
VOITH TURBO GMBH & CO. KG, DE

(74) Agent: GOWLING LAFLEUR HENDERSON LLP

(54) Titre : GAMME DE MOTEURS A AIR COMPRIME AYANT DIFFERENTS COUPLES THEORIQUEMENT CEDES ET PROCEDE DE PRODUCTION DES DIFFERENTS MOTEURS A AIR COMPRIME DE LA GAMME

(54) Title: SERIES FOR COMPRESSED AIR MOTORS WITH TORQUE WHICH CAN BE THEORETICALLY OUTPUT IN A VARIED MANNER AND A METHOD FOR PRODUCING THE INDIVIDUAL COMPRESSED MOTORS OF SAID SERIES



(57) Abrégé/Abstract:
The invention relates to a series for compressed air motors provided for different volumetric displacements comprising at least two compressed air motors (1, 100). Each compressed air motor has at least two intermeshing displacement elements (45, 104, 105), one first displacement element (4, 104), and a second displacement element (5, 105) provided in the form of toothed

CA 2317014 C 2004/09/28

(11)(21) 2 317 014

(13) C

(57) Abrégé(suite)/Abstract(continued):
wheels. The individual compressed air motors of the series comprise a) essentially identical dimensions for the center distance (a) between the theoretical axes or the theoretical axes of rotation of both displacement elements and b) one essentially identical teeth width (zb1, zb2) in the form of an essentially identical axial extension of the teeth elements. The individual compressed air motors differ from one another at least with regard to the size of the diameter of the addendum circle (dk1, dk2, dk1b, dk2b) of at least one of both displacement elements.

PCT

WELTORGANISATION FÜR GEISTIGES EIGENTUM
Internationales Büro

INTERNATIONALE ANMELDUNG VERÖFFENTLICHT NACH DEM VERTRAG ÜBER DIE INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES PATENTWESENS (PCT)

(51) Internationale Patentklassifikation [7] :
F04C 11/00, 2/18

A1

(11) Internationale Veröffentlichungsnummer: **WO 00/26540**

(43) Internationales Veröffentlichungsdatum: 11. Mai 2000 (11.05.00)

(21) Internationales Aktenzeichen: PCT/EP99/07879

(22) Internationales Anmeldedatum: 18. Oktober 1999 (18.10.99)

(30) Prioritätsdaten:
198 49 805.5 29. Oktober 1998 (29.10.98) DE

(71) Anmelder *(für alle Bestimmungsstaaten ausser US)*: VOITH TURBO GMBH & CO. KG [DE/DE]; Alexanderstrasse 2, D–89522 Heidenheim (DE).

(72) Erfinder; und
(75) Erfinder/Anmelder *(nur für US)*: KÖRNER, Tillmann [DE/DE]; Weikersbergstrasse 42, D–89551 Zang (DE).

(74) Anwalt: WEITZEL & PARTNER; Friedenstrasse 10, D–89522 Heidenheim (DE).

(81) Bestimmungsstaaten: CA, CZ, JP, KR, US, europäisches Patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

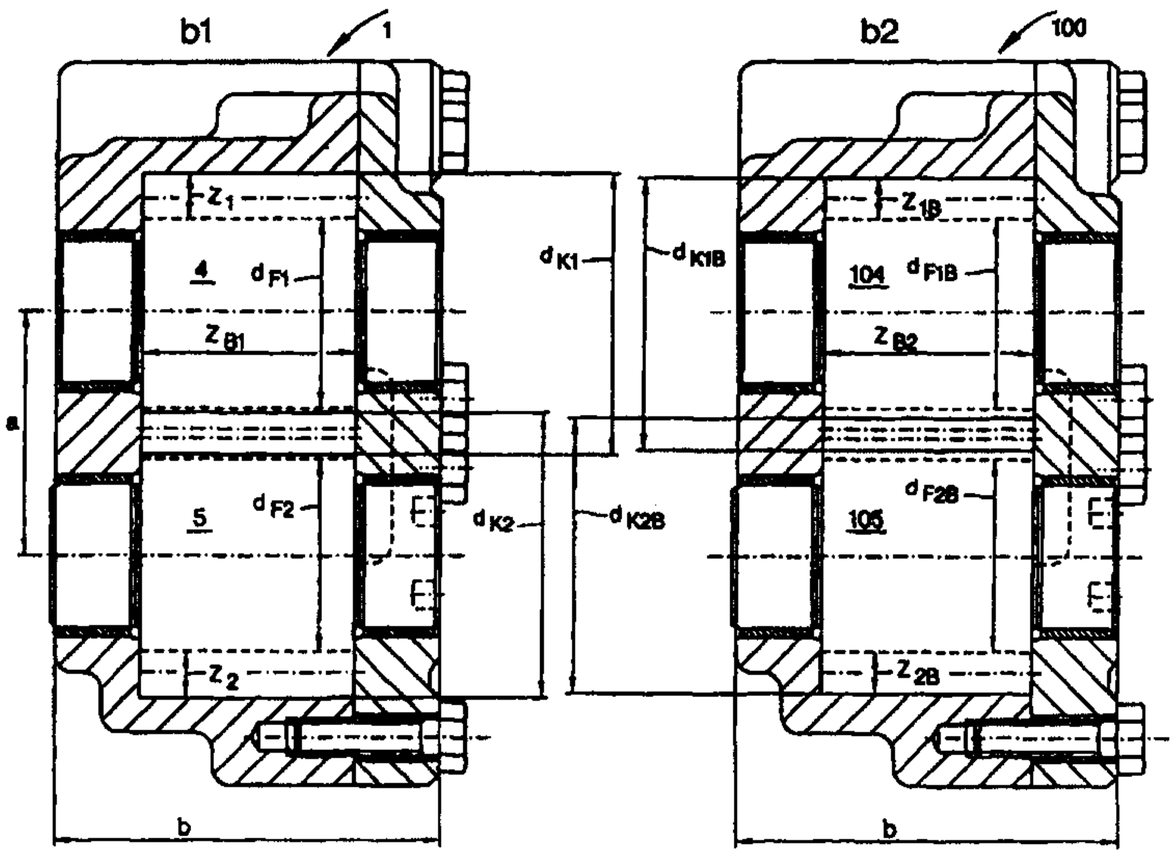
Veröffentlicht
Mit internationalem Recherchenbericht.

(54) Title: SERIES FOR COMPRESSED AIR MOTORS WITH TORQUE WHICH CAN BE THEORETICALLY OUTPUT IN A VARIED MANNER AND A METHOD FOR PRODUCING THE INDIVIDUAL COMPRESSED AIR MOTORS OF SAID SERIES

(54) Bezeichnung: BAUREIHE FÜR ZAHNRADMOTOREN MIT UNTERSCHIEDLICH THEORETISCH ABGEHBAREM DREHMOMENT UND VERFAHREN ZUR HERSTELLUNG DER EINZELNEN ZAHNRADMOTOREN DER BAUREIHE

(57) Abstract

The invention relates to a series for compressed air motors provided for different volumetric displacements comprising at least two compressed air motors (1, 100). Each compressed air motor has at least two intermeshing displacement elements (45, 104, 105), one first displacement element (4, 104), and a second displacement element (5, 105) provided in the form of toothed wheels. The individual compressed air motors of the series comprise a) essentially identical dimensions for the center distance (a) between the theoretical axes or the theoretical axes of rotation of both displacement elements and b) one essentially identical teeth width (zb1, zb2) in the form of an essentially identical axial extension of the teeth elements. The individual compressed air motors differ from one another at least with regard to the size of the diameter of the addendum circle (dk1, dk2, dk1b, dk2b) of at least one of both displacement elements.



(57) Zusammenfassung

Die Erfindung betrifft eine Baureihe für Zahnradmotoren für unterschiedliche Fördervolumina mit wenigstens zwei Zahnradmotoren (1, 100). Jeder Zahnradmotor weist wenigstens zwei miteinander kämmende Verdrängerelemente (45, 104, 105), ein erstes Verdrängerelement (4, 104) und ein zweites Verdrängerelement (5, 105), in Form von Zahnrädern auf. Die einzelnen Zahnradmotoren der Baureihe weisen a) im wesentlichen identische Abmessungen für den Achsabstand (a) zwischen den theoretischen Achsen bzw. den theoretischen Rotationsachsen der beiden Verdrängerelemente und b) eine im wesentlichen identische Verzahnungsbreite (zb1, zb2) in Form einer im wesentlichen identischen axialen Erstreckung der Verzahnungselemente auf. Die einzelnen Zahnradmotoren unterscheiden sich wenigstens hinsichtlich der Grösse des Kopfkreisdurchmessers (dk1, dk2, dk1b, dk2b) wenigstens eines der beiden Verdrängerelemente voneinander.

Series for Gear Motors with Differing Theoretically Outgoing Torque and Method for Manufacturing the Individual Gear Motors of the Series

The invention is relative to a series [line] for gear motors with differing theoretically outgoing torque [torque that can theoretically be delivered, released] and to a method of manufacturing the individual gear motors of the series.

Hydraulic motors in the form of gear motors that convert the energy impressed on a current of liquid into a rotary movement with a certain torque and in which at least two gears meshing with each other and running with a narrow slot in a housing are used as displacing elements are known in a plurality of designs. As regards the type of displacing elements, two types are distinguished:

a) Gear motors with external gearing [toothing],

b) Gear motors with internal gearing.

See also in this connection Dubbel: Taschenbuch für den Maschinenbau [German - Pocketbook for Machine Construction], 18th edition, H4 to H5.

The main characteristics of hydraulic motors are the theoretically outgoing final torque and the output speed range. However, the geometric displacement volume, also absorption volume, and the nominal pressure of hydraulic motors also play a significant part in the selection of individual hydraulic motors. Due to the very different areas of application and requirements

of use resulting therefrom, hydraulic motors are offered for different theoretically outgoing torques. They are offered as a rule in series in which the individual hydraulic motors of a series preferably have the same design but can differ significantly from each other in their characteristic values and dimensions and a corresponding increase in theoretically outgoing torque due to a change in the geometric displacement volume, e.g., an increase in absorption volume is associated with an enlargement of the construction size. An influencing of the displacement volume can be carried out in analogy with the influencing of the output volume, equivalent to the displacement volume, in pumps as in W. Gutbrod: "Förderstrom von Aussen- und Innenzahnradpumpen und seine Ungleichförmigkeit", [German = "The Output Current of External and Internal Gear Pumps and Its Nonuniformity"], DE-Z [probably = German journal]: Olhydraulik und Pneumatic 18 (1975) No. 2, pp. 97 - 104 and others by reducing or enlarging the tip circle of one of the two displacing elements. The enlargement of the possible theoretical geometrical displacement volume takes place thereby, e.g., in rather large intervals in groups and the essential distinguishing feature between the groups resides in the different radial dimensions of the displacing elements and axial interval of the gears. Within the group an elevation of the possible output volume takes place in smaller steps by enlarging the gearing width, that is, the extension of the gearing in axial direction. This has the result that the individual motors in drive [train] lines are not freely exchangeable as a rule if the requirements of use are changed since the

latter differ sharply as regards the required construction space and similarities between the individual types can hardly be determined.

The invention therefore has the basic problem of creating a series for gear motors for differing theoretically outgoing torques and therewith different geometric displacement volumes that are suitable for different requirements of use in which series the individual motors have as many constructive features in common as possible and differ solely by slight modifications from each other. The hydraulic motors themselves are to be kept as small as possible as regards the required construction space and there should be the possibility of replacement with a hydraulic motor with a greater or lesser geometric displacement volume in hydrostatic systems without the entire drive chain having to be replaced or modified. In particular, modifications by altering the speed (= i of the drive chain) should be avoided.

It is an object of the present invention to obviate or mitigate at least one of the above-mentioned disadvantages of the prior art.

Accordingly, in one of its aspects, the present invention provides a series of gear motors for differing output volumes, comprising:

a series of at least two individual gear motors;

each of said individual gear motors having a housing with at least two intermeshing displacing elements including a first displacing element and a second displacing element in the form of gears located therein;

each of said individual gear motors of said series comprise having substantially identical dimensions for the axial interval between the theoretical axes, and between the theoretical axes of rotation of said at least two intermeshing displacing elements and a substantially identical gearing width in the form of a substantially identical axial extension of the gearing elements; and

each of said individual gear motors differing from each other at least as regards the size of the tip circle diameter of at least one of said first displacing element and said second displacing element.

In another of its aspects, the present invention provides a method of manufacturing gear motors of a motor series comprising:

forming a series of basic gear motor units with a certain axial interval between the geometric axes or the theoretical axes of rotation of at least two displacing elements, with a certain defined axial extension of the gearing and with a certain tip circle diameter of the individual displacing elements, each of said basic gear motor units having a housing wherein said at least two displacing elements are located therein, said basic gear motor units differing from each other at least as regards the size of the tip circle diameter of at least one of said at least two displacing elements; and

a motor with a lesser output volume reducing the gearing height by removing material from the basic gear motor unit thereby forming a gear.

A series of gear motors for differing theoretically outgoing torques and therewith differing geometric displacement volumes comprises at least two gear motors. Each gear motor comprises at least two gears meshing with one another as displacing elements. The invention provides that each gear motor in the series has the following construction features that are essentially identical as regards the dimension:

a) Axial [shaft - German "Achse" = axis, axle and shaft] interval a between the geometric axes [shafts] of the two gears meshing with one another and of the theoretical axes of rotation of the two gears meshing with one another;

b) Gearing width, that is, extension of the gearing in axial direction.

That is, there is no difference as regards the axial interval and the gearing width between the individual gear motors.

The differing theoretically outgoing torques and therewith different geometric displacement volumes are adjusted in accordance with the invention in gear motors of a series with the same axial interval between the individual displacing elements and a constant gearing width over the cog height. It is sufficient thereby if at least one of the two gears meshing with one another is changed as regards its tip [addendum] circle diameter from one motor to the next motor in the series; however, in designs with only two gears meshing with one another it is preferable if the tip circle diameters of both gears are appropriately changed. This is preferably achieved by using a high gearing [See next sentence].

The inventor realized that relatively high output volumes can be achieved when using so-called high gearings since the sensitivity of the displacement volume over the tip circle diameter or the tip circle radius is significantly higher than in the case of normal gearings. Even slight changes in the tip circle are sufficient to achieve a corresponding increase of the output volume. The volumetric increase in radial direction of the individual gear motor in the

direction of the geometric the axes of the displacing elements or of the axes of symmetry of the displacing elements is relatively slight. This statement also applies in an analogous manner to a diminution of the tip circle diameter or tip circle radius of an individual displacing element. The axial construction length remains constant for all gear motors of the series. A change of the construction unit size takes place only in radial direction during which only a lesser increase in volume for the entire gear motor construction unit is realized on account of the high sensitivity of displacement volume over the tip circle radius. The uniform axial construction length of the gear motor construction unit makes it possible to replace the gear motor arranged in a drive chain in accordance with the requirements of use on the theoretically outgoing torque and therewith displacement volume with another gear motor of this series that is designed for greater or lesser output volumes without the entire drive chain having to be replaced or readapted to the hydraulic motor to be used.

In an especially preferred embodiment of the gear motor series a constant transverse pitch p is assigned to the particular displacing elements, that is, gears of the individual hydraulic motors in the series, in the case of an axial interval that can be predefined and is constant for all hydraulic motors in the series, that is, the modulus as dimensional factor of the gearing is also constant for all gear motors so that there is the possibility of developing the displacing elements for the individual gear motors with differing output volumes from a motor arrangement with a unified basic displacing element as described, e.g., in claim 8, in which the basic gearing is designed for a maximum theoretical displacement

volume of at least one of the two displacing elements as a high gearing and for lesser or minimal displacement volume the gearing or the individual gearing elements are reduced in size [by removing metal] or, in particular, milled down correspondingly to a smaller tip circle diameter. This procedure makes it possible to create a series for gear motors with different displacement volumes which are especially compact and very standardized as regards the individual elements used. The high degree of standardization results in a diminution of the manufacturing cost, which for its part is reflected in the [total] cost.

The design of the basic construction unit for the maximum theoretical displacement volume and therewith maximum theoretically outgoing torque as regards the individual gears meshing with each other takes place in accordance with the fundamentals for interpreting the geometry of gear pairs. This applies to the general instance that influence is exerted only on the cog height, regardless of the form, and to the especially advantageous embodiment in which, starting from a displacing element designed for maximum displacement volume, lesser displacement volumes can be realized by shortening the cog height, that is, removing material.

The solution of the invention can be used in gear motors with

a) external gearing,

b) internal gearing.

It is immaterial thereby whether the gear motors are single-stage or multistage gear motors.

In gear motors with externally cogged displacing elements both displacing elements are preferably designed and constructed to be similar in their size and gearing geometry whereas in the case of dual-stage or multistage gear motors displacing elements with a differing design as regards geometry and dimensions are used.

The gearing itself is designed as an involute gearing. It should always be taken into consideration thereby that even upon a change of the tip circle diameters between the individual displacement elements of the individual motors of the series a seal is realized between the suction chamber and the pressure chamber as a result of the contacting of the flanks in order to assure the full functionality of the gear motor.

The solution in accordance with the invention is explained in the following with reference made to the figures.

Figures 1a1.and 1a2 show by way of example a design of a gear motor of a gear motor series designed in accordance with the invention in two views.

Figures 1b1 and 1b2 show opposing views of two possible designs for gear motors of a motor series designed in accordance with the invention using a single-stage gear motor with external gearing. Figure 1b1 shows a gear motor for high transferrable torques and figure 1b2 shows a gear motor for low transferrable torques.

Figures 2a and 2b each show a section of the intermeshing gearing of the displacing elements of the motors shown in figures 1a and 1b.

Figure 3 shows an application of the solution of the invention for multistage gear motors with external gearing.

Figure 1a1 shows a section through a gear motor 1 of a series for gear motors designed in accordance with the invention and for differing theoretically outgoing torques. This motor comprises housing 2 limited on its front by cover 3. The two displacing elements - a first displacing element 4 and a second displacing element 5, are arranged in the housing. Displacing elements 4 and 5 are designed as externally cogged gears in the form of spur gears meshing with each other. Both run with a close tolerance in housing 2. The first displacing element 4 is mounted on drive shaft 6. Drive shaft 6 is mounted for its part via bearing 7,8 in housing 2 and cover 3 terminating the housing. Moreover, gear motor 1 comprises connection 8 for the output of the displaced operating agent and comprises pressure connection 9. Both pressure connection 9 and connection 8 are coupled to corresponding spaces, 8.1 and 9.1. The operating agent passes via pressure connection 9 into the pressure chamber and produces a moment on the displacing elements that brings about a rotation of the latter and entrainment of the operating agent between the individual gearing elements. The second displacing element is driven via cog engagement 4/5. The hydraulic liquid is transported to connection 8 in the cog gaps of the displacing elements,

cog gaps 4.1 of the first displacing element and cog gaps 4.2 of the second displacing element and removed from there.

In addition, there is the possibility of designing to motor 1 with axial compensation of play. This can take place by a one-sided loading of the bearing of the displacing elements or by loading both sides with operating pressure. This has the advantage that the axial play of the individual gears can be reduced in a pressure-dependent manner.

The theoretically outgoing torque, that can be adjusted as a function of the displacement volume, is described in accordance with the invention by the displacement volume formed by the individual gearings of displacing elements 4 and 5 and of inner wall 10 of housing 2 and [is described] by the pressure of the operating agent on the pressure connection, that is, by the so-called cog spaces 4.1,5.1 between two adjacent cog elements 4A, 4B and 5A, 5B of individual displacing elements 4,5 as shown in a non-dimensionally correct manner in figure 1a1 in view I-I corresponding to figure 1a2.

Both displacing elements 4,5 are designed identically for the embodiment according to figure 1a, that is, they have the same geometric dimensions. Axes R1 of rotation and symmetry for displacing element 4 and R2 for displacing element 5 have a certain interval, that is, the axial interval a in the instance shown. The extension of the construction unit gear motor 1 in axial direction is characterized by dimension b.

It is apparent from figures 1b1, 1b2 for a possible embodiment of a gear motor 1 and a further gear motor 100 from the gear motor series of the invention

that the interval of the theoretical axes of rotation and axes of symmetry R1, R2, which is also designated as axial interval a, and the axial extension b are identical for both motors. Axial interval a, which is determined as a rule by the interval of the axes [shafts] on which the individual displacing elements are mounted, can also be understood as the interval between two rotating shafts, as is the case when the second displacing element is connected to a shaft in such a manner that it is adapted to rotate in unison [with said shaft]. At least the first displacing element is connected to the drive shaft in such a manner that it rotates in unison with it.

The significant difference between the two gear motors 1 and 100 of the gear motor series is that the displacing elements have different tip circle diameters. Figure 1b2 shows in this regard a design with reduced displacer or displacement volumes in comparison to gear motor 1 in accordance with figure 1b1. To this end [in addition,] displacing elements 4,5 for gear motor 1 and 104, 105 for gear motor 100 are designed as a high gearing. The tip circle diameter d_{K1B}, d_{K2B} for displacing elements 104 and 105 is less than tip circle diameter d_{K1}, d_{K2} of gearing elements 4A, 4B of gear motor 1. Root circle diameters [root diameters] $d_{F1B,}$ $d_{F2B,}$ d_{F1}, d_{F2} for the individual displacing elements 104, 105 and 4,5 of gear motors 100 and 1 are identically designed. Due to the difference in form of cog height z_{1B}, $z_{1B,}$ z_1 and z_2 resulting therefrom, different sizes therefore result for the possible displaceable volume between two adjacent cog elements 104A, 104B respectively 4A respectively 4B and 105A, 105B respectively 5A, 5B at the same axial extension and therewith gearing width Z_{B1} and Z_{B2}.

The design shown with two identically designed displacing elements 4,5 respectively 104 and 105 represents an especially preferred design. This design makes it possible, starting with a gear motor design with displacing elements 4,5 in accordance with figures 1a and 1b, to develop displacing elements 104, 105 of gear motor 100 by means of a simple working of the displacing elements. This can take place, as already explained, by simply milling down the individual gearing elements and reducing therewith the cog height. Even the housing must also be provided with the ??? [sic] bore (milled out area)for the gears.

The gearing shown is a straight-cog gearing or radially serrated gearing [spur gearing]. These gearings are preferably designed as an involute gearing. However, it is also conceivable that the gearing of the individual gearing elements can be designed in a manner complementary to each other as a spiral [helical] gearing. Such a design is distinguished by a very low development of noise at large and small displacement volumes. The face contact ratio and transverse contact ratio obtained is then still more than 2 in both instances.

Figures 2a and 2b illustrate sections of an object in figures 1b1 and 1b2 on an enlarged scale viewed from the right.. The latter serve to illustrate the intermeshing of the individual gearing elements of the individual displacing elements 4,5 and 104, 105. For the sake of clarification the geometric magnitudes for the characterization of a gearing are entered once again. Base circle diameters d_4, d_{104}, are shown as well as tip circle diameters $d_{K1b,}$ d_{K2B}, d_{K1}, d_{k2} and root circle diameters d_{F1B}, d_{F2B}, d_{F1}, d_{F2} and cog heights z_{1B}, z_{2B}, z_1 and z_2.

The individual displacing elements 4,5 and 104, 105 exhibit an identical pitch p for both embodiments in accordance with figures 2a and 1B.

The design of the displacing elements of a motor of a motor series with identical dimensions and with identical geometric design makes possible an especially standardized manufacture of the individual motors of the motor series. The gearings themselves can all be manufactured identically.

Figure 3 shows a view in a sectional representation of gear motor 200 with external gearing in the form of a dual-flow gear motor. This pump comprises three displacing elements, a first displacing element 204 and two other displacing elements 205.1 and 205.2. The latter are located and mounted in housing 202 with a preferably axially designed housing cover 203. Gear motor 200 comprises two suction connections 209.1 and 209.2 as well as two pressure connections 208.1 and 208.2. These connections are connected respectively to corresponding suction chambers 211.1, 211.2 and to pressure chambers 212.1 and 212.2. The suction chambers and pressure chambers are formed in the area of the intermeshing displacing elements. Displacing elements 204, 205.1 and 205.2 function as drive elements. Displacement elements 205.1 and 205.2 are mounted on an output shaft in such a manner that they rotate at least indirectly in unison with it. In the instance presented the displacing elements are designed with different dimensions. In particular, they differ as regards their tip circle diameter d_K, the root circle diameter d_F and the base circle diameter d. The two second displacing elements 205.1 and 205.2 are preferably identically designed as regards their geometric dimensions in the axial and radial direction, as shown in

figure 3. However, designs are also conceivable that have different second displacing elements 205.1 and 205.2. However, the form shown in figure 3 is preferably selected since it allows a very high degree of standardization. The direction of passage of the operating agent [material] is indicated by arrows. It is apparent therefrom that two different directions of flow and therewith transport directions are made possible with this gear motor 200; however, the same directions of rotation of the output [power take-off] are achieved.

In a gear motor series of gear motors with external gearing according to figure 3, which series is in accordance with the invention, axial intervals A1 and A2 between the individual gear motors of the motor series are maintained constant and only the gearing height is changed in a manner analogous to that described in figures 1 and 2. The individual gear motors of the gear motor series designed in accordance with the invention can thus likewise be developed in a simple manner from a gear motor in accordance with figure 3 with a basic configuration for displacing elements 204 respectively 205.1 and 205.2. The individual gearings are also designed as high gearings in this instance too, which has the advantage of achieving the widest possible scatter [spread] of the theoretical output volumes while constantly assuring the operation of the gear motor, in particular the seal between the suction chamber and the pressure chamber.

The embodiments shown in figures 1 to 3 constitute preferred embodiments of gear motors of a gear motor series in accordance with the invention. However, modifications that make use of the solution of the invention

are also conceivable. The concrete design as a function of the requirements of use is left to the determination of an expert in the art.

What is claimed is:

1. A series of gear motors for differing output volumes, comprising:

a series of at least two individual gear motors;

each of said individual gear motors having a housing with at least two intermeshing displacing elements including a first displacing element and a second displacing element in the form of gears located therein;

each of said individual gear motors of said series comprise having substantially identical dimensions for the axial interval between the theoretical axes, and between the theoretical axes of rotation of said at least two intermeshing displacing elements and a substantially identical gearing width in the form of a substantially identical axial extension of the gearing elements; and

each of said individual gear motors differing from each other at least as regards the size of the tip circle diameter of at least one of said first displacing element and said second displacing element.

2. The series for gear motors for differing output volumes according to claim 1, in which each of said at least two intermeshing displacing elements of said individual gear motors and/or of said individual gear motors of said series are designed in such a geometrical manner that the gearing can be described by a constant transverse pitch p.

3. The series according to any one of claims 1-2, in which each of said individual gear motors is designed as a two-stage gear motor, and includes at least a further, third displacing element that meshes with one of said at least two intermeshing displacing elements; and of said at least two intermeshing displacing elements at least two have different tip circle diameters.

4. The series according to any one of claims 1-3, in which said first displacing element is designed as a gear with internal gearing and said second displacing element is designed as a pinion with external gearing meshing with the latter.

5. The series according to any one of claims 1-4, in which said first displacing element and said second displacing element are designed as spiral gears.

6. The series of gear motors with differing output volumes according to any one of claims 1-5, in which said at least two intermeshing displacing elements are designed as gears with external gearing.

7. The series according to claim 3, in which each of said at least two intermeshing displacing elements of each said individual gear motors of said series exhibit substantially identical dimensions and geometric design.

8. A method of manufacturing gear motors of a motor series comprising:

forming a series of basic gear motor units with a certain axial interval between the geometric axes or the theoretical axes of rotation of at least two displacing elements, with a certain defined axial extension of the gearing and with a certain tip circle diameter of the individual displacing elements, each of said basic gear motor units having a housing wherein said at least two displacing elements are located therein, said basic gear motor units differing from each other at least as regards the size of the tip circle diameter of at least one of said at least two displacing elements; and

a motor with a lesser output volume reducing the gearing height by removing material from the basic gear motor unit thereby forming a gear.

G 05630WO

Fig. a2

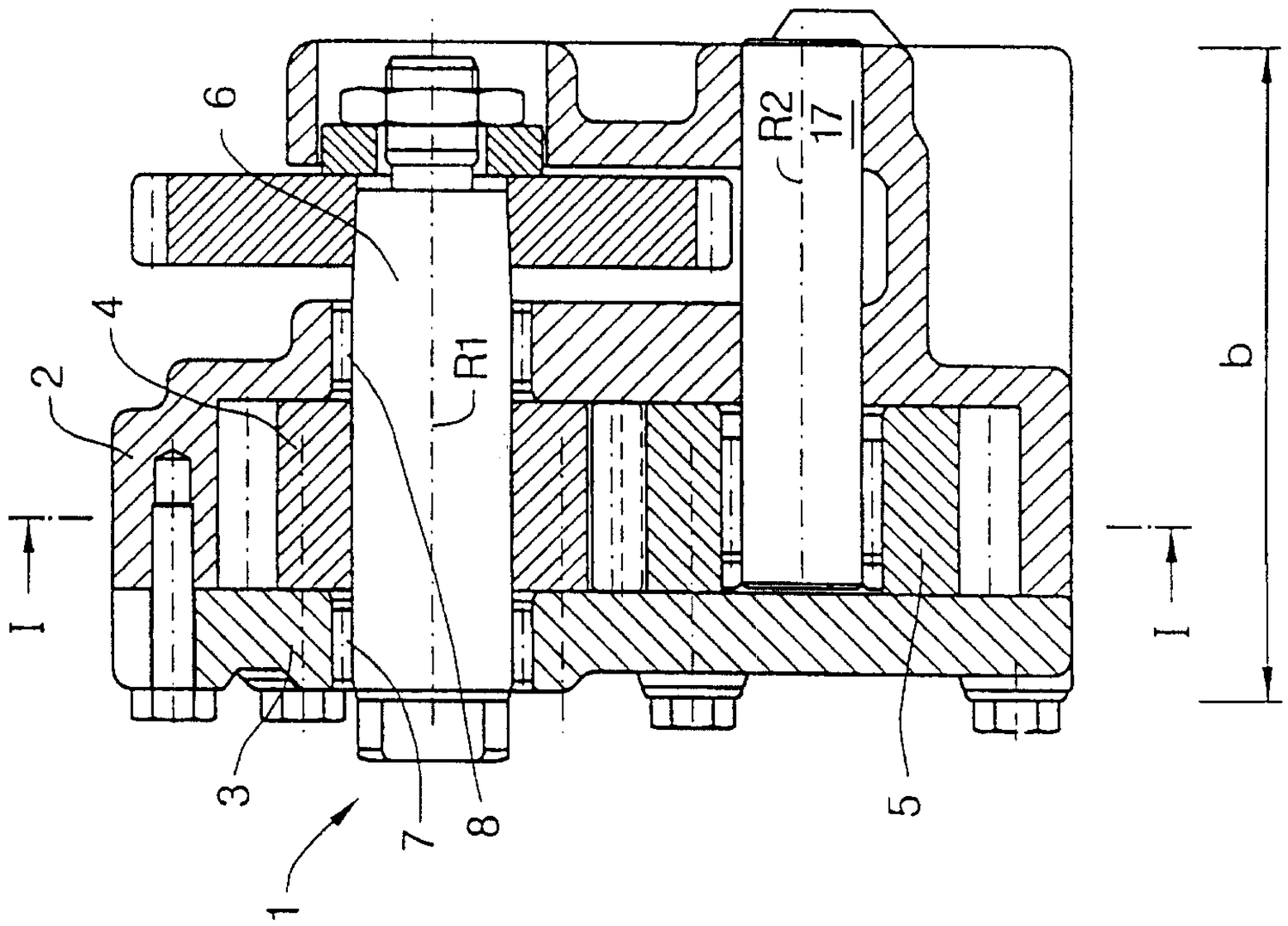


Fig.1a

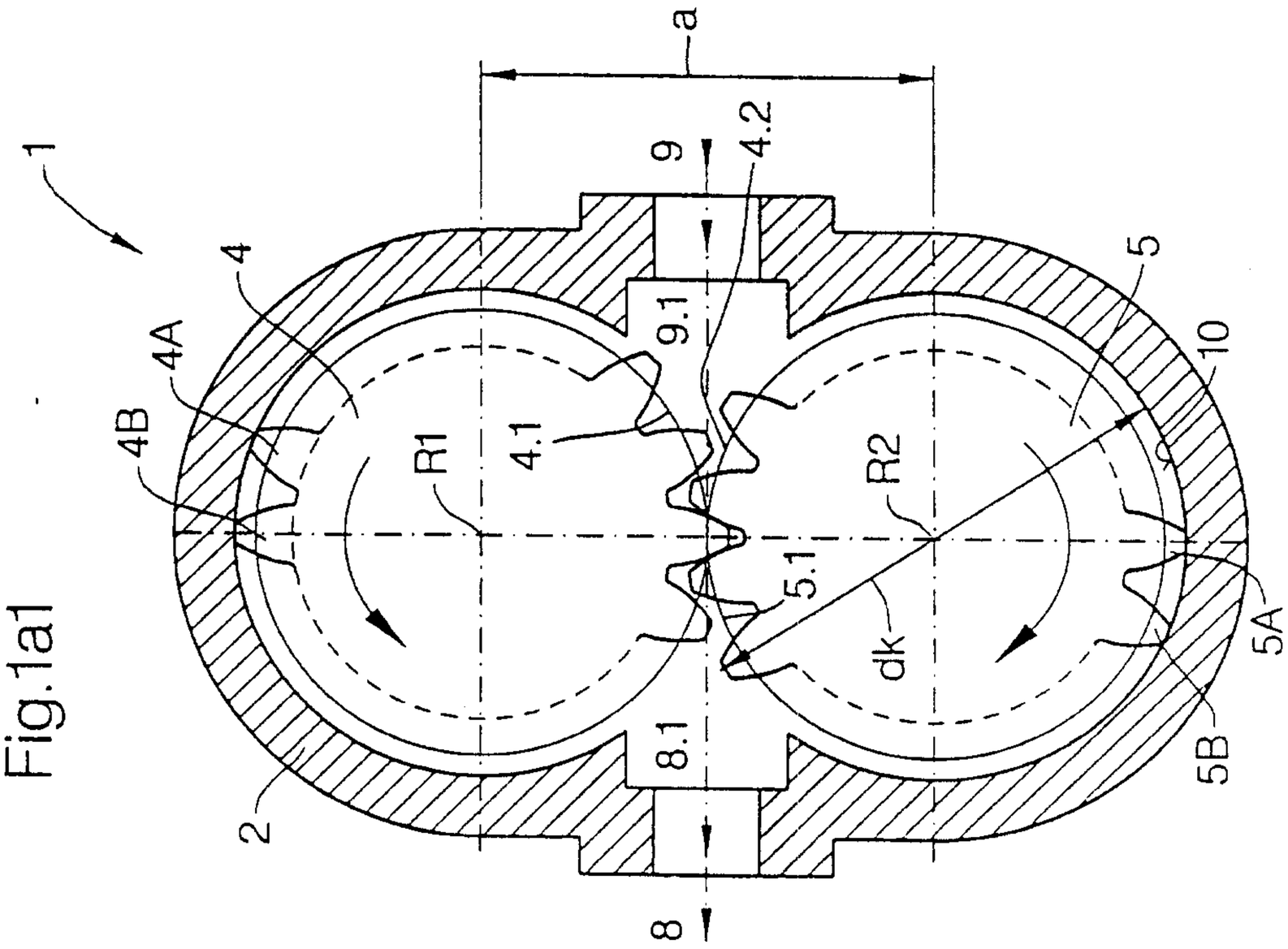


Fig.1a1

G 05630WO

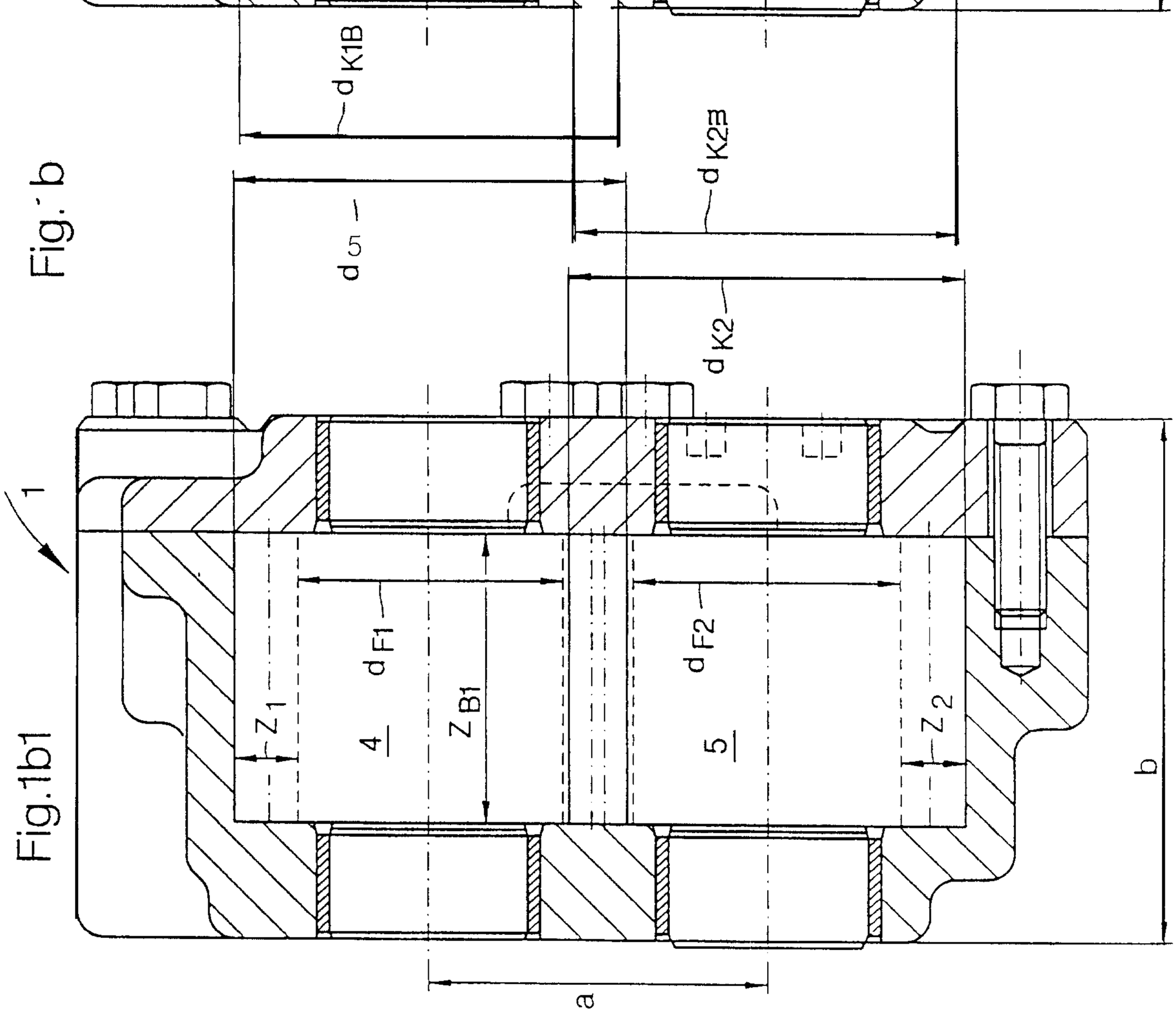


Fig.1b2

Fig.1b

Fig.1b1

Fig.2a

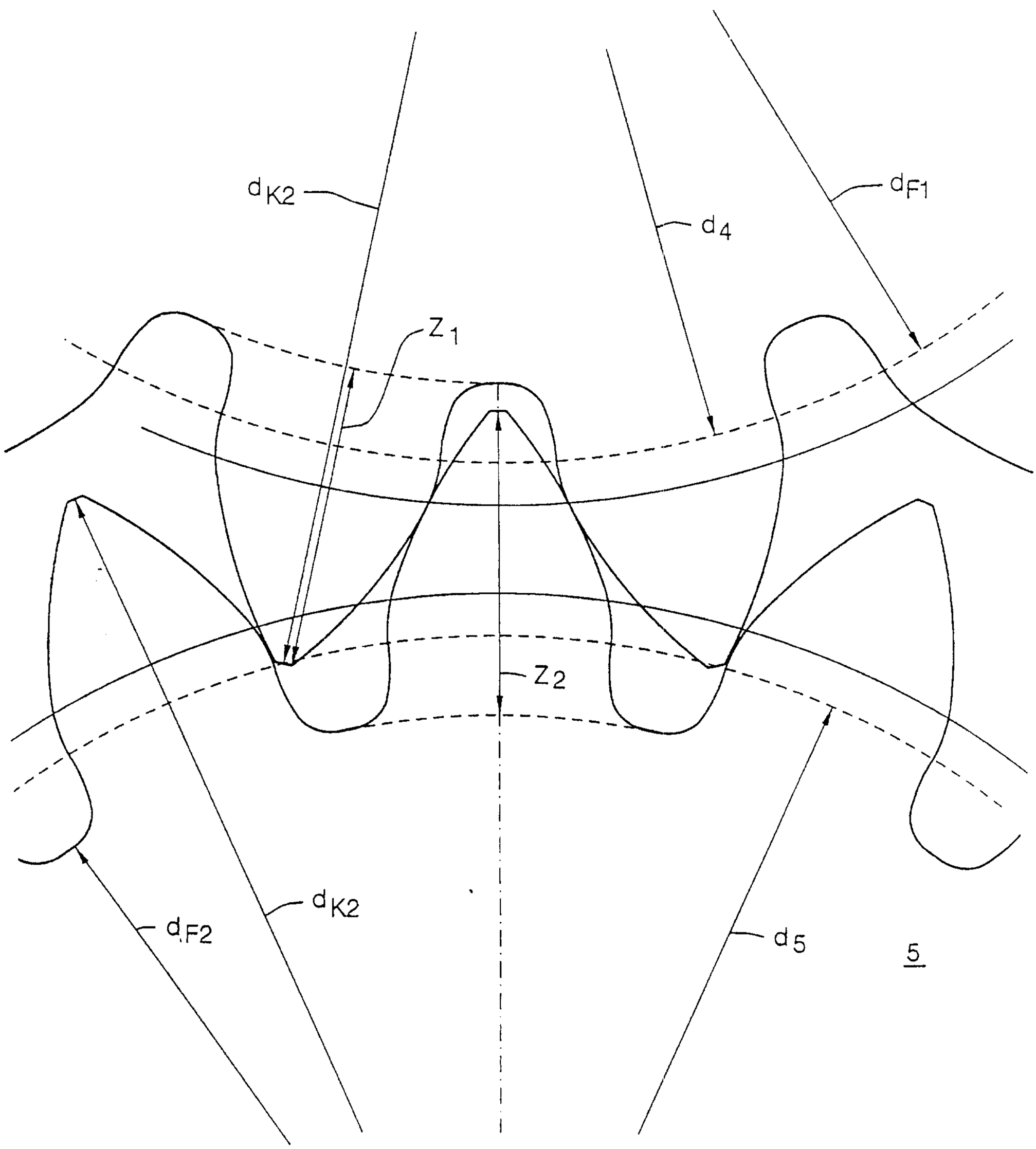
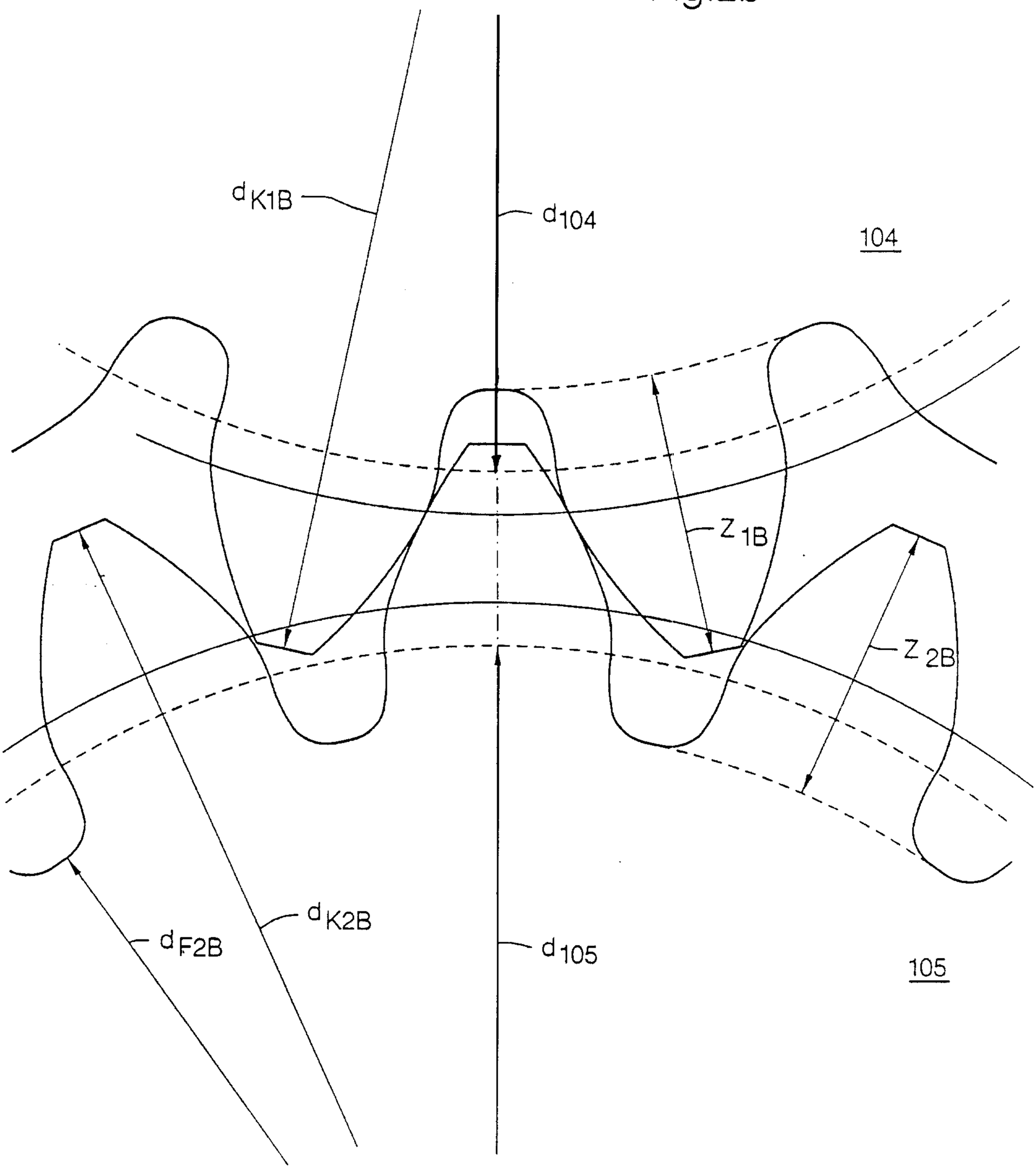
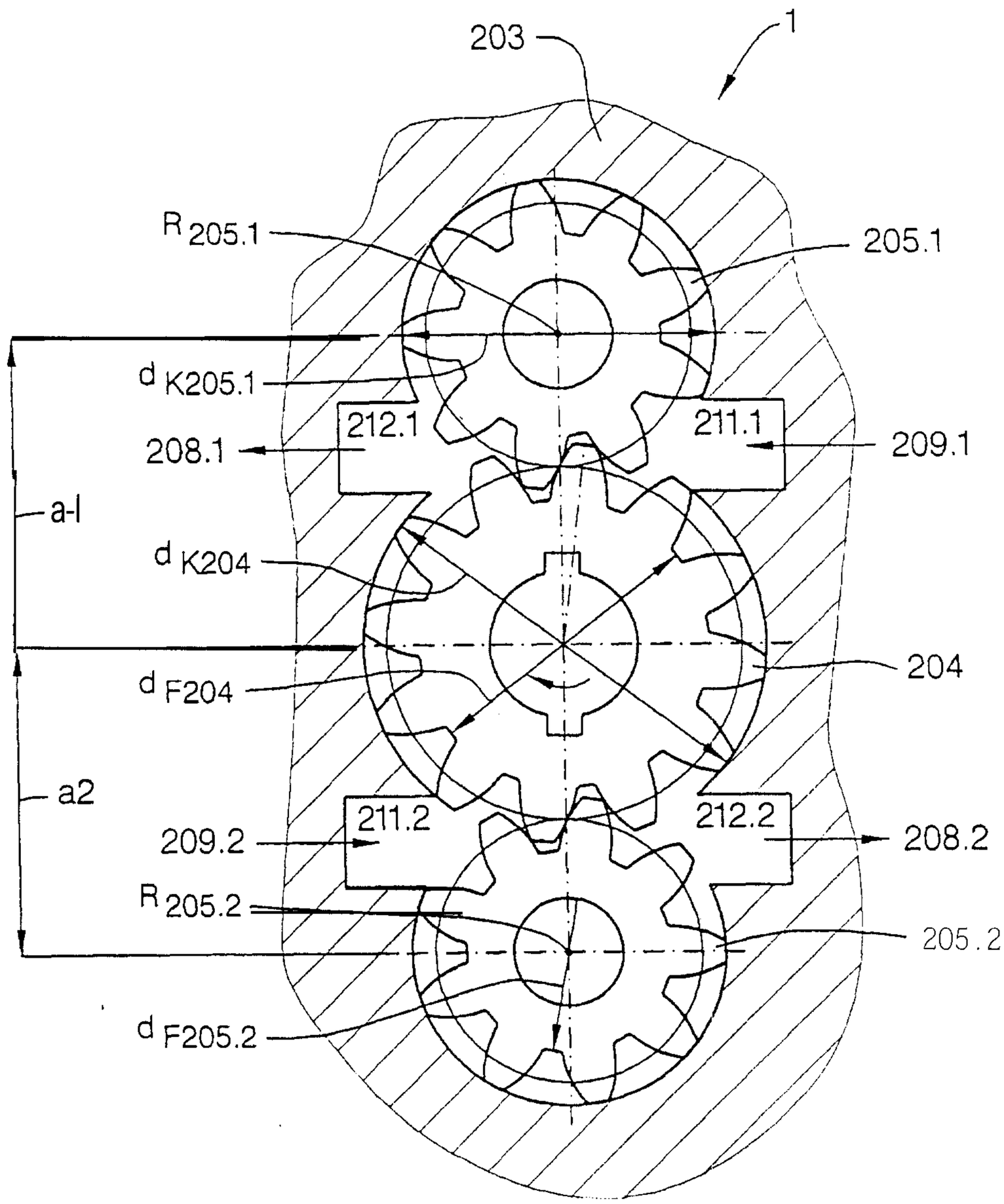


Fig.2b



G 05630WO

Fig.3



b1

1

z_1

4

d_{F1}

z_{B1}

a

d_{K1}

d_{F2}

5

d_{K2}

z_2

b

b2

100

z_{1B}

d_{K1B}

104

d_{F1B}

z_{B2}

d_{F2B}

d_{K2B}

105

z_{2B}

b