(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
3 December 2009 (03.12.2009)

PCT

(10) International Publication Number
WO 2009/144519 Al

(51) International Patent Classification:
BOlF 7/30 (2006.01)

(21) International Application Number:
PCT/HU2009/000046

(22) International Filing Date:
26 May 2009 (26.05.2009)

(25) Filing Language: Hungarian

(26) Publication Language: English

(30) Priority Data:
P0800352 30 May 2008 (30.05.2008) HU

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available):* AE, AG, AL, AM, **AO,** AT, **AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC,** EE, **EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY,** MA, **MD,** ME, **MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ,** TM, **TN, TR,** TT, **TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.**

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available):* ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, **FI,** FR, GB, GR, HR, HU, IE, IS, **IT, LT,** LU, LV, MC, MK, MT, NL, NO, PL, **PT,** RO, SE, SI, SK, TR), OAPI (BF, **BJ,** CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.1 7(U))*

Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(54) Title: SELF-REGULATING PLANETARY MIXER HAVING TWO DEGREES OF FREEDOM

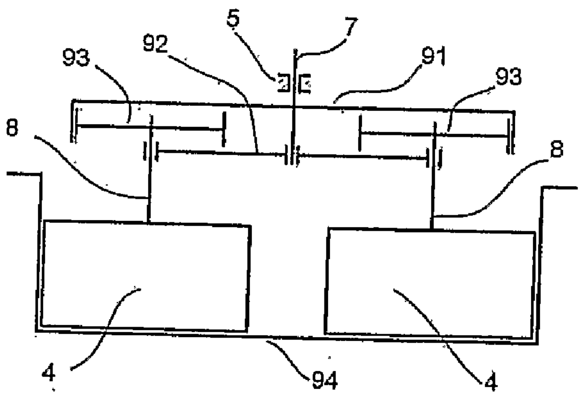

Fig. 10

(57) Abstract: The object of the invention is a self-regulating planetary mixer having two degrees of freedom, comprising a support casing (5), a central gear (91) supported in bearings in the support casing (5) to allow rotation about a central shaft (7), the central gear (9) being connected to a driving motor, in specific cases through a transmission or through a clutch and a gearbox, in a manner that provides torque transfer, at least one planet gear (93) attached to a planet gear shaft (8) in a manner providing torque transfer, which planet gear (93) is connected to the central gear (91).at least one mixer means (4) attached to the planet gear shaft (8) in a manner that provides torque transfer, a planet carrier (92), in which planet carrier (92) at least one planet gear shaft (8) and the central shaft (7) are supported in bearings to allow the rotation of the mixer means (4) such that the mixer means (4) may undergo two-degree-of- freedom motion.

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Self-regulating planetary mixer having two degrees of freedom

The invention relates to a self-regulating planetary mixer having two degrees of freedom. The mixer may be utilized for mixing liquids or grainy materials and for mixing liquids and (solid) grainy materials. The mixer according to the invention is particularly suited for mixing high-viscosity or highly adhesive materials, and for mixing, kneading, and homogenizing materials of different viscosity.

A number of mixer types are conventionally applied for mixing difficult-to-mix materials. One of these types is the multiple agitation mixer that has multiple different mixing elements, adapted for being operated simultaneously or independently. Such a mixer is described in Hungarian patent HU 222 902. The object of the invention is a mixer, particularly concrete mixer, having a funnel-shaped mixing tank. Along the centre axis of the mixing tank an inner mixing tool and and an outer mixing tool are arranged coaxially. The inner mixing tool is implemented as a screw driven in a continuously adjustable manner. The outer mixing tool consists of blades attached to mixing arms driven in a continuously adjustable manner, the blades glidingly moving along the inner surface of the mixing tank. Mixing tools are rotated alternately in the same and opposite direction. The mixer can be applied for the intensive, speedy mixing of liquid and grainy materials, taking advantage of mix streams running in transverse and opposite directions. A disadvantage of the invention is that it cannot adapt to changes in torque demand caused by the changing viscosity of the mixed material. Increasing mechanical resistance resulting from the raised viscosity of the mix may damage the apparatus. A further drawback of the invention is that it needs two drive units for the thorough mixing of the material.

In another type of mixers planetary gear drives are applied. Such a solution is disclosed in US patent No. 4,697,929. The mixer employs a dual concentric drive for driving at least two shafts that may rotate independently, with different speeds. One of the shafts has the central gear of the epicyclic drive attached to it, while the planet gears are attached to the other shaft. Mixing blades are disposed on the shafts of both the central gear and planet gears. The mixer according to the patent US

4,697,929 is implemented applying a single degree-of-freedom epicyclic drive. In such a single degree-of-freedom mixer the mixing blades can only rotate with a constant speed, and are therefore unable to adapt to load changes caused by the changing viscosity of the mixed material. Further drawbacks of the invention are structural complexity, high production costs, and relatively high failure rate.

The object of the present invention is to provide a planetary mixer having a simple structural arrangement where the state of motion of the mixing element is determined by the load torque conditions of the mixed material. In other words, changes of certain material characteristics (viscosity etc.) of the mixed material will result in changes in the state of motion of the mixing head.

The objective of the invention is achieved by applying a self-regulating two degree-of-freedom planetary gear drive. The two degree-of-freedom planetary gear drive may have an arbitrary state of motion. This is advantageous because it allows for a self-regulating adjustment of rotary and translatory motion components of the mixing elements corresponding to the changing characteristics of the mixed material, even when the rotational speed of the input remains the same. Arbitrariness of state of motion implies that the mixing elements may undergo exclusively rotary or exclusively translatory motion. This provides that continuous operation may be maintained in case of certain malfunctions (a stuck bearing, a broken tooth stuck between gears), or in case the motion of the mixing elements is blocked by foreign particles or by agglomeration (coalescence) of the mixed material. If, for whatever reason, the drive train is interrupted, it assumes a state of motion incapable of transferring energy (it "switches to" idle motion) and thereby protects the apparatus from breaking or any other consequent damage. The presence of foreign particles or the agglomeration (coalescence) of the mixed material may be detected utilizing dynamic sensors.

The invention is therefore a self-regulating planetary mixer having two degrees of freedom, comprising

- a support casing,
- a central gear (1, 11, 21, 31, 41, 51, 71, 81, 91, 101, 111, 121) supported in bearings in the support casing (5) to allow rotation about a central shaft (7, 17), the central gear being connected to a driving motor, in specific cases through a transmission or through a clutch and a gearbox, in a manner that provides torque transfer,

- at least one planet gear attached to a planet gear shaft in a manner providing torque transfer, which planet gear is connected to the central gear,
- at least one mixer means attached to the planet gear shaft in a manner that provides torque transfer,
- a planet carrier, in which planet carrier at least one planet gear shaft and the central shaft are supported in bearings to allow the rotation of the mixer means such that the mixer means may undergo two-degree-of-freedom motion.

The mixer according to the invention may be arranged (particularly for mixing viscous or coarse materials at low speeds) having only one planet gear meshing with a single central gear. In the majority of cases, however, it is preferable to apply two or more planet gears, with the planet gears being arranged in a centrally symmetric fashion about the central shaft, and being meshed with the central gear. In a preferred embodiment there are two planet gears directly meshing with the central gear. According to a further preferred embodiment there are three planet gears directly meshing with the central gear.

The planet gears may be connected to the central gear directly or through auxiliary planet gears. According to a preferred embodiment of the invention at least one auxiliary planet gear is disposed meshing with the planet gear and with the central gear. In a further preferred embodiment of the invention, two planet gears, arranged in a centrally symmetric fashion, are meshed with one central gear, to which central gear two auxiliary planet gears - arranged in a centrally symmetric fashion and being meshed with two further planet gears - are connected. The application of such a drive train may provide an extremely thorough mixing of the mixed material.

In a simple preferred embodiment of the invention one central gear is attached to the central shaft in a manner that provides torque transfer. For mixing difficult-to-mix materials two central gears may be attached to the central shaft, in such a way that at least one planet gear meshes with each central gear. Central gears may be implemented with either internal gearing or external gearing.

A mixing means is mounted on the planet gear shafts and/or the auxiliary planet gear shafts in a manner providing torque transfer. According to a preferred embodiment of the invention there are mixing means disposed on every planet gear shaft and on every auxiliary planet gear shaft. By the careful selection of the mixing means arrangement and by utilizing the right number of mixing means the apparatus may be applied for the highly efficient mixing of a wide range of materials. The size and shape of mixing means applied in the inventive planetary mixer may be chosen freely. Different mixer means conventionally applied in the art, such as blade and screw mixers, may be applied as mixer means. According to a preferred embodiment of the invention the mixer means attached to the planet gear shafts have identical shape and size. According to another preferred embodiment the mixer has two planet gears, where mixer means of different shape and/or different size are attached to the planet gear shafts.

In another preferred embodiment a mixer means is attached in a manner providing torque transfer to the central shaft of the central gear. The mixer means attached to the central shaft does not undergo two degree-of-freedom motion. Instead, this particular mixer means is applied for thoroughly mixing the central region of the mixing tank.

The mixer according to the invention comprises a mixing tank known per se. The mixer means extend into the mixing tank. According to a preferred embodiment of the invention the mixing tank and the mixer means are arranged such that the mixer means travel along the inner surface of the mixing tank while they undergo rotary and translatory motion. Such an arrangement provides for more thorough mixing resulting in a homogeneous mix.

To prevent the mixed material from sticking to the wall of the mixing tank the apparatus may comprise a separator blade known per se. The separator blade glidingly moves along the inner surface of the mixing tank, separating the mixed material from the tank wall. According to a preferred embodiment of the invention the separator blade is attached to the planet carrier. In a further preferred embodiment the separator blade is adjustable about its own axis.

According to a still further preferred embodiment of the invention the planet carrier may be implemented as a casing enclosing the central gear and the planet gears, with the central shaft and the planet gear shafts being arranged such that they extend from said casing.

Details of the invention will be described referring to the attached drawings, where

Figs 1a, 1b show, in side and front view, the kinematic scheme of a possible embodiment of the invention,

Figs 2a, 2b show, in side and front view, the kinematic scheme of another embodiment of the invention,

Figs. 3a, 3b show, in side and front view the kinematic scheme of an embodiment of the inventive mixer, comprising auxiliary planet gears,

Figs. 4a, 4b show, in side and front view the kinematic scheme of another conceivable embodiment of the invention, also comprising auxiliary planet gears,

Figs. 5a, 3b show, in side and front view the kinematic scheme of a further embodiment of the invention implemented utilizing auxiliary planet gears,

Figs. 6a, 6b show, in side and front view the kinematic scheme of an embodiment of the invention implemented utilizing the combination of planet gears and auxiliary planet gears,

Fig. 7 shows an embodiment of the inventive mixer comprising one central and two planet gears arranged in an asymmetric fashion,

Fig. 8 shows the top plan view of the mixer shown in Fig. 7,

Fig. 9 shows a further embodiment of the inventive mixer, implemented applying two central gears,

Fig. 10 shows a further embodiment of the inventive mixer, comprising a central gear having internal gearing,

Fig. 11 shows a further embodiment of the inventive mixer, comprising a planet carrier implemented as a casing,

Fig. 12 shows a further embodiment of the mixer according to the invention, and

Fig. 13 is the top plan view of the mixer shown in Fig 12.

Figs. 1a-6b show the kinematics schemes of various different embodiments of the inventive planetary gear mixer having two degrees of freedom. The arrangements shown in Figs. 1a-5b include three mixing heads arranged in a centrally symmetric manner. For the sake of easier comprehension, of the three mixing heads only one is shown in the drawings. In the context of the present application the term "mixing head" refers to a planet gear equipped with mixer means, or to an assembly consisting of a planet gear equipped with at least one mixer means and an auxiliary planet gear. Figs 6a-6b show a mixer arrangement comprising four mixing heads arranged in a centrally symmetrical fashion about a central shaft.

According to the invention the mixer means are driven by an epicyclic gear train consisting in the simplest case (as shown in Figs 1a, 1b) of a central gear 1, planet gears 3, and a planet carrier 2. The central gear 1 is attached to a central shaft 7 in a manner that provides torque transfer. The central shaft 7 is supported in bearings in a support casing 5. The central shaft 7 is connected to a driving motor through a clutch (not shown in the drawing). The central gear 1 is driven by the driving motor through a transmission or gearbox (not shown in the drawing) in case such intermediary elements are necessary. The central gear 1 meshes with planet gears 3. In this embodiment three planet gears 3 (of which only one is shown in the drawing) are meshed with the central gear 1. The planet gears 3 are attached to planet gear shafts 8 in a manner that provides torque transfer. The planet gear shafts 8 are connected with the central shaft 7 by a planet carrier 2 such that the shafts are supported in bearings in the planet carrier 2. Mixer means 4 are attached to the planet gear shafts 8 in a manner providing torque transfer, and a central mixer means 6 is attached, also in a manner providing torque transfer, to the central shaft 7. The planetary mixer arranged in such a way has two degrees of freedom. The mixer means 4 rotate about the planet gear shafts 8, while their axes, carried by the planet carrier 2, undergo translatory motion. According to this structural arrangement the central mixer means 6, mounted on the central shaft 7 of the central gear 1, can undergo only rotary motion. The mixer means 4 may have a wide range of states of motion. Apart from rotating about its own axis it also undergoes translatory motion, resulting in a planetary-type motion. The actual state of motion is determined by dynamic conditions, meaning that the resulting state of motion corresponds to the equilibrium state between driving and loading force systems.

Assuming a lossless drive, in case of a driving torque M_1 - determined by the gear ratios - a load torque M_3, is effected on the planet gear shafts 8, and a load torque M2 is effected on the planet carrier 2 by circumferential forces transferred through the meshing of the central gear 1 and the planet gear 3. In stationary operation these torques maintain an equilibrium with the external load torque acting on the mixer means 4, bringing about a stationary state of motion where the resulting force system is in equilibrium. Since the mixing head 4 may have an arbitrary (planetary-type) state of motion, any intermediary element may be brought to a halt, ensuring that in case there is a malfunctioning element (a stuck bearing, broken gear tooth, or gear damage caused by ingested particles) no consequent failure of the mixer will result and therefore continuous operation may be maintained. If, however, malfunction results in the drive train being interrupted, the drive train assumes a state of motion incapable of transferring energy (it "switches to" idle motion) and protects the apparatus from consequent failure.

The mixer according to the invention may be implemented in various structural arrangements having different geometric and kinematics parameters. Examples of different structural arrangements are shown in Figs. 2a-6b.

The embodiment shown in Figs. 2a and 2b comprises a central gear 11 having internal gearing meshing with planet gears 13. The central shaft 7 of the central gear 11 is supported in bearings in a support casing 5 in a manner allowing rotation. The central shaft 7 and planet gear shafts 8 are supported in bearings in a planet carrier 12. According to this embodiment no mixer means is attached to the central shaft 7. Instead, mixer means 4 are attached to the planet gear shafts 8 in a manner providing torque transfer.

Figs. 3a, 3b illustrate an embodiment comprising auxiliary planet gears, where the central gear 21 has external gearing and meshes with auxiliary planet gears 26 that are meshed with planet gears 23. The central shaft 7, the planet gear shafts 8, and the auxiliary planet gear shafts 9 are supported in bearings in a planet carrier 22. A mixer means 4 is attached to the planet gear shaft 8.

In Figs 4a and 4b an arrangement comprising auxiliary planet gears and a central gear with internal gearing is shown. A central gear 31 having internal gearing is attached to the central shaft 7. The central gear 31 meshes with auxiliary planet gears 36 that are meshed with planet gears 33. The central shaft 7, the auxiliary planet gear shafts 9, and the planet gear shaft 8, are supported in bearings in a planet carrier 32. Although for the sake of simplicity the drawings show only the mixer means 4 that is attached to the planet gear shaft 8, the auxiliary planet gear shafts 9 may also carry mixer means 4, and a central mixer means 6 may also be mounted on the central shaft 7.

Figs. 5a, 5b show a special auxiliary planet gear arrangement. The central gear 46 has external gearing and meshes with auxiliary planet gears 46, which auxiliary planet gears 46 are meshed with planet gears 43. The central shaft 7, the auxiliary planet gear shafts 9, and the planet gear shafts 8 are supported in bearings in a planet carrier 42. The mixer means 4 are attached to the planet gear shafts 8.

The embodiments shown in Figs 1a-5b may be implemented utilizing only one mixing head. In these cases, however, dynamical balancing must be provided for. Such arrangements may be required for mixing dense or viscous materials at low speeds.

Figs. 6a, 6b illustrate an embodiment that is essentially the combination of the embodiments shown in Figs 1a, 1b and Figs 3a, 3b. This mixer arrangement has four mixing heads arranged in a centrally symmetric fashion. The central gear 51 has external gearing and is attached to the central shaft 7 supported in bearings in a support casing 5. According to this embodiment, a central mixer means 6 is also mounted on the central shaft 7. Two planet gears 113 and two auxiliary planet gears 56 are meshθd with the central gear 51. Auxiliary planet gears 56 are meshed with two further planet gears 53. The central shaft 7, the auxiliary planet gear shafts 9, and the planet gear shafts 8 are supported in bearings in a planet carrier 52 in a manner allowing rotation, and mixer means 4 are attached to the planet gear shafts 8. According to this arrangement, if the number of teeth of auxiliary planet gears 56 and planet gears 113 are chosen to be identical, in case of an identical input angular velocity such a state of motion is produced where load torques (resistance torques of the mixing heads) occurring in the different drive trains maintain an equilibrium with the driving torque. Driving torque is distributed between the two auxiliary planet gear drive trains on the one hand and the two planet gear drive trains on the other corresponding to the ratio of load torques occurring in the particular drive trains, the individual members of the two pairs of identical drive trains having an equal share (if a given pair is equipped with identical mixing heads). As it is shown in the kinematic scheme, the planet gears 53, 113 on the one hand and the mixer means 4 attached to the planet gear shaft 8 on the other hand have opposite rotational states of motion, which brings about a state of motion (flowing motion) of the mixed material that may be beneficial for the effectiveness of mixing.

Torque relations of the mixer according to the invention will now be explained referring to Fig. 1a. The internal gear ratio of the drive (the ratio of angular velocities of the central gear 1 and the planet gear 3 in a reference frame tied to the planet carrier 2) is

$$u_{13} = - z_3/z_1, \qquad (1)$$

where

U_{13} is the internal gear ratio of the drive,

z_1 is the number of central gear teeth, and

Z_3 is the number of planet gear teeth.

If - assuming stationary operation and lossless driving action (neglecting bearing and gear friction losses) - a driving torque of M_1 = 1 Nm is effected on the central shaft 7 of the central gear 1, rotating with a constant angular velocity, for maintaining static torque equilibrium a load torque

$$M_3 = - M_1 U_{13} = - 1 U_{13} = - U_{13} \quad [Nm] \quad (2)$$

is required to act on the planet gear 3, and a load torque

$$M_2 = M_1(U_{13} -1) = 1 (U_{13} -1) = U_{13} - 1 \; [Nm] \quad (3)$$

is required to act on the planet carrier 2.

With N (N=2, 3, 4, ...) planet gears 3 arranged in a centrally symmetrical manner and loaded equally, a load torque of M_3/N acts on each planet gear 3, and each planet gear 3 effects a load torque M_2/N on the planet carrier 2. Since the system has two degrees of freedom, unbalanced load distribution cannot occur due to static indeterminacy.

In case of the embodiment comprising auxiliary planet gears (illustrated in Figs. 3a, 3b), the internal gear ratio may be calculated as the ratio of the number of central gear 21 teeth and the number of planet gear 23 teeth:

$$U_{21,23} = z_{23}/z_{21}, \quad (4)$$

where

$U_{21,23}$ is the internal gear ratio of the drive,

Z_{21} number of central gear teeth, and

Z_{23} number of planet gear teeth.

The internal gear ratio is positive in this case, which means that - in a reference frame tied to the planet carrier 22 - the central gear 21 and the planet gear 23 have the same rotation direction. Torques M_{21}, M22, M23 may be calculated similarly to the above described case, with

M_{21} being the driving torque,

M_{22} being the load torque, and

M23 also designating load torque.

An important parameter of the mixer is the torque ratio k:

$$k = M_{21} / M23 = u_{21,23} - 1 / u_{21,23} \qquad (5)$$

Equations (1)-(5) are valid for any system involving planet gears or auxiliary planet gears where the central shaft of the central gear acts as the input and either the planet gear shaft or the auxiliary planet gear shaft acts as the output. In case an angularly adjustable separator blade is attached to the planet carrier, or mixing means are disposed on the planet gear shaft and the auxiliary planet gear shaft, torques and torque relations will naturally change.

The mixer may be implemented applying several structural arrangements. Since lots of independent factors influence load forces and torques occurring in the apparatus - for instance, the configuration and motion of mixing means, characteristics of the mixed material, technical parameters of the mixer - it is very difficult to establish exact drive parameters (structural arrangement, internal gear ratio, and mixer means characteristics) that are optimally suited for a given mixing task solely by theoretical calculations. It is therefore necessary to establish optimal drive parameters by experiments.

Figures 7-13 illustrate different structural arrangements of the mixer according to the invention without limiting the invention to the embodiments described in detail below. A number of other structural arrangements and combinations may be possible within the scope of protection of Claim 1.

The mixer shown in front view in Fig. 7 and in top plan view in Fig. 8 has a simple configuration and is particularly suited for thoroughly "kneading" the mixed substances to produce a homogeneous material. A central shaft 7, acting as input, is supported in bearings in the support casing 5, and a central gear 71, having external gearing, is attached to the central shaft 7 in a manner providing torque transfer. Two differently sized planet gears 73, 123 are meshed with the central gear 71. The planet gears 73, 123 are attached to the planet gear shafts 8 in a manner providing torque transfer. The central shaft 7 and the planet gear shafts 8 are supported in bearings in the planet carrier 72 to allow the rotation of said shafts. Mixer means 4, 41 are attached to the planet gear shafts 8 of the planet gears 73, 123. The mixer means 4, 41 are implemented in this embodiment as curved blade mixers of different size, with the larger mixer means 4 being mounted on the shaft 8 of the larger planet gear 73. The material to be mixed is held in the mixing tank 74 into which the mixing blades 4, 41 extend. The asymmetric arrangement of the mixing blades, more particularly the mixer means 4 being arranged such that it extends through the centre of the mixing tank 74, ensures highly efficient mixing by preventing the formation of an unmixed region near the centre of the mixing tank 74.

Fig. 9 illustrates a mixer having a centrally symmetrical mixing head. Two differently sized central gears 81, 111 are attached in a manner providing torque transfer to a central shaft 7 supported in bearings in a support casing 5. Planet gear 83 is meshed with central gear 81, while planet gear 133 meshes with central gear 111. Mixer means 4 extending into the mixing tank 84 are attached to the planet gear shafts 8. The central shaft 7 and the planet gear shafts 8 are supported in bearings in a planet carrier 82 having a symmetrical configuration.

Fig. 10 shows a symmetrical structural arrangement comprising four mixing heads. A central gear 91 having internal gearing is attached to the central shaft 7 supported in bearings in a support casing 5, with four identical planet gears 93 being meshed with the central gear 91. The central shaft 7 and the planet gear shafts 8 are mounted for rotation about bearings on a planet carrier 92. Mixing means 4 extending into the mixing tank 94 are attached to the planet gear shafts 8.

Fig. 11 shows a further preferred embodiment of the invention. This embodiment is arranged also in a symmetrical fashion, with the planet carrier 102 being implemented as a closed casing. A central gear 101 having external gearing is fixedly attached to the central shaft 7 supported in bearings in a support casing 5. The central gear 101 meshes with two identically sized planet gears 103. A central mixer means 6 is also attached to the central shaft 7 in a manner that provides torque transfer. Similarly to the previously discussed embodiments, the central shaft 8 and the planet gear shafts 8 are supported in bearings in the planet carrier 102. The planet carrier 102 is configured as a closed casing that encloses the central gear 101 and the planet gears 103. Such a planet carrier 102 arrangement provides high mechanical strength while preventing the planet gears attached to the planet carrier from getting soiled by splashes of the mixed material. Separator blades 105 are also attached to the planet carrier 102. The separator blades 105 are arranged along the inner surface of the mixing tank 104 and are attached to the planet carrier 102 such that they are adjustable about their own axis.

Figs 12 and 13 illustrate an embodiment comprising three mixing heads. In this case it is not the central shaft 17 that acts as an input for driving the central gear 121, which central gear 121 has internal gearing. Instead, a driving gear 20 is attached to the central gear 121 . This driving gear 20 is meshed with driving gear 10 for driving the mixing heads. The mixer means 4 extending into the mixing tank 114 are attached to the planet gear shafts 18 of the planet gears 143. The planet gear shafts 18 and the central shaft 17 are supported in bearings in a planet carrier 112.

The mixer according to the invention is suited for mixing various materials of different viscosity and adhesion characteristics in an efficient and energy saving way. An important advantage of the mixer is that it can well adapt to load torque changes caused by the changing viscosity of the mixed material. A further advantage of the apparatus is that a given state of motion of the mixer always corresponds to a given set of material characteristics (e.g. viscosity) of the mixed material, and thus by measuring the rotational speed of the planet carrier it is possible to establish the characteristics of the material that is being mixed. Therefore it is not necessary test the material after mixing. Also, mixing may be stopped automatically if the planet carrier has reached the speed corresponding to the desired material characteristics. A further advantage of the mixer is that it has extremely high operational efficiency.

List of reference numerals

1, 11, 21, 31, 41, 51, 71, 81, 91, 101, 111, 121	central gear
2, 12, 22, 32, 42, 52, 72, 82, 92 102, 112	planet carrier
3, 13, 23, 33, 43, 53, 73, 83, 93, 103,113, 123,	

133, 143	planet gear
4, 41	mixer means
5	support casing
6	central mixer means
7, 17	central shaft
8, 18	planet gear shaft
9	auxiliary planet gear shaft
10	driving gear
20	driving gear
26, 36, 46, 56	auxiliary planet gear
74, 84, 94, 104, 114	mixing tank
105	separator blade
M_1, M_{21}	driving torque
M_2, M_{22}	load torque
M_3, M_{23}	load torque
z_1, z_{21}	number of central gear teeth
z_3, z_{23}	number of planet gear teeth
u_{13}	internal gear ratio of the drive

Claims

1. Self-regulating planetary mixer having two degrees of freedom, comprising
- a support casing (5),
- a central gear (1, 11, 21, 31, 41, 51, 71, 81, 91, 101, 111, 121) supported in bearings in the support casing (5) to allow rotation about a central shaft (7, 17), the central gear (1, 11, 21, 31, 41, 51, 71, 81, 91, 101, 111, 121) being connected to a driving motor, in specific cases through a transmission or through a clutch and a gearbox, in a manner that provides torque transfer,
- at least one planet gear (3, 13, 23, 33, 43, 53, 73, 83, 93, 103, 113, 123, 133, 143) attached to a planet gear shaft (8, 18) in a manner providing torque transfer, which planet gear (3, 13, 23, 33, 43, 53, 73, 83, 93, 103,1 13, 123, 133, 143) is connected to the central gear (1, 11, 21, 31, 41, 51, 71, 81, 91, 101, 111, 121),
- at least one mixer means (4, 41) attached to the planet gear shaft (8, 18) in a manner that provides torque transfer,
- a planet carrier (2, 12, 22, 32, 42, 52, 72, 82, 92 102, 112), in which planet carrier (2, 12, 22, 32, 42, 52, 72, 82, 92 102, 112) at least one planet gear shaft (8, 18) and the central shaft (7) are supported in bearings to allow the rotation of the mixer means (4, 41) such that the mixer means (4, 41) may undergo two-degree-of-freedom motion.

2. The mixer according to Claim 1, characterised by that in case the mixer has at least two planet gears the planet gears (3, 13, 23, 33, 43, 53, 93, 103,1 13, 143) are arranged in a centrally symmetrical manner with respect to the central shaft (7), and the planet gears (3, 13, 23, 33, 43, 53, 93, 103,1 13, 143) are connected to the central gear (1, 11, 21, 31, 41, 51, 91, 101, 121).

3. The mixer according to Claim 1, characterised by that at least one auxiliary planet gear (26, 36, 46, 56) is disposed between the central gear (21, 31, 41, 51) and the planet gear (26, 36, 46, 56).

4. The mixer according to Claim 3, characterised by that it comprises planet gears

(53, 113) and auxiliary planet gears (56) arranged in a centrally symmetrical manner with respect to the central shaft (7), the auxiliary planet gears (56) being connected to the planet gears (53, 113) and to the central gear (51).

5. The mixer according to Claim 1, characterised by having a single central gear (1, 11, 21, 31, 41, 51, 71, 91, 101, 121), with two auxiliary planet gears and two planet gears being attached to the central gear (1, 11, 21, 31, 41, 51, 71, 91, 101, 121), and with the auxiliary planet gears and planet gears being arranged in a centrally symmetrical manner.

6. The mixer according to Claim 1, characterised by that it has two central gears (81, 111), where at least two planet gears (83, 133) are connected to each central gear (81, 111).

7. The mixer according to Claim 1, characterised by that the central gear (11, 31, 91, 121) has internal gearing.

8. The mixer according to Claim 1, characterised by that the central gear (1, 21, 41, 51, 71, 81, 91, 101, 111) has external gearing.

9. The mixer according to Claim 1, characterised by that the mixer means (4, 41) attached to the planet gear shafts (8, 18) are of identical dimensions and shape.

10. The mixer according to Claim 1, characterised by that the mixer means (4, 41) attached to the planet gear shafts (8, 18) have different dimensions and/or shape.

11. The mixer according to Claim 1, characterised by that a central mixer means (6) is attached to the central shaft (7) of the central gear in a manner that provides torque transfer.

12. The mixer according to Claim 1, characterised by that it has a mixing tank (74, 84, 94, 104, 114), where the mixer means (4, 41, 6) are arranged such that they extend into the mixing tank (74, 84, 94, 104, 114).

13. The mixer according to Claim 12, characterised by that it has at least one separator blade (105) attached to the planet carrier (102) such that the separator blade (105) is adjustable about its own axis.

14. The mixer according to Claim 1, characterised by that the planet carrier (102) is implemented as a casing enclosing the central gear (101) and the planet gears (103), with the central shaft (7) and the planet gear shafts (8) being arranged such that they extend from said casing.

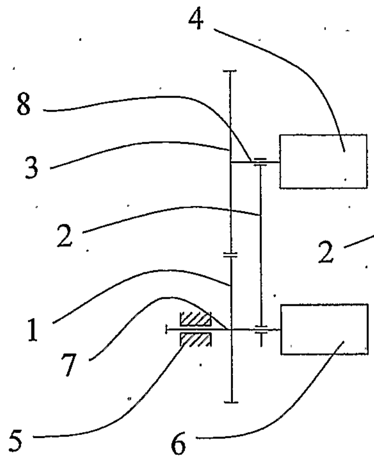

Fig 1.a.

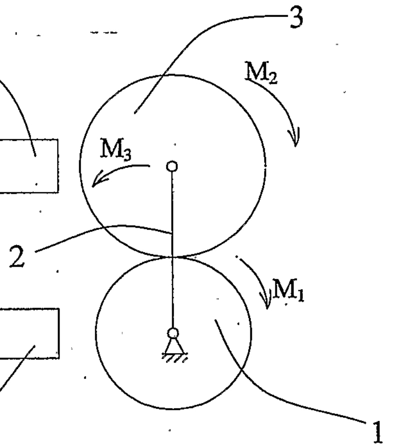

Fig 1.b.

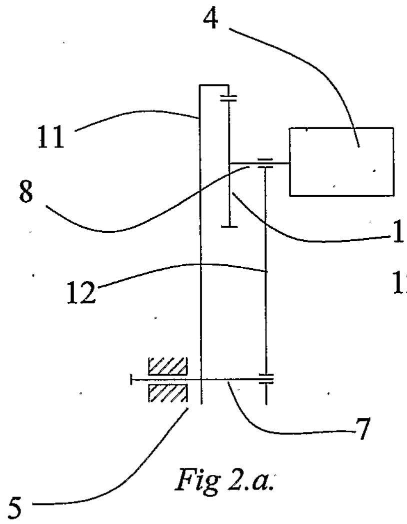

Fig 2.a.

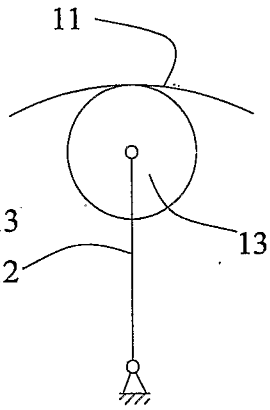

Fig 2.b.

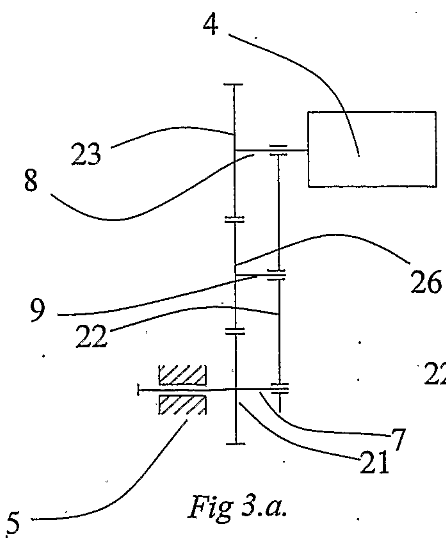

Fig 3.a.

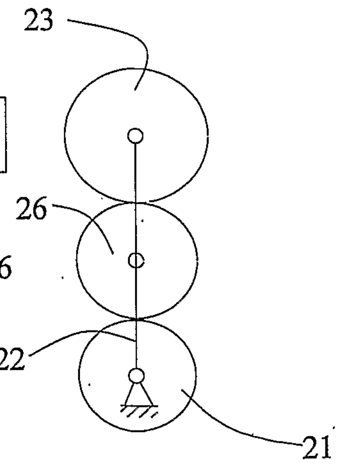

Fig 3.b

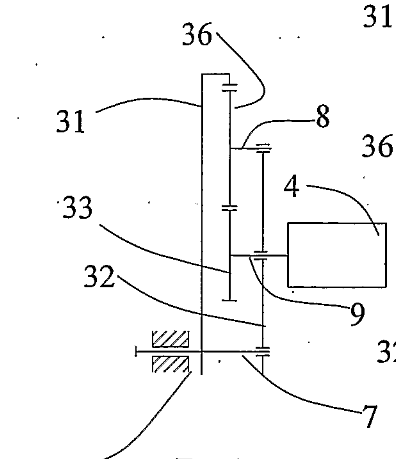

Fig 4.a.

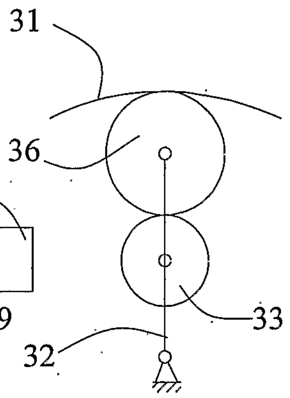

Fig 4.b

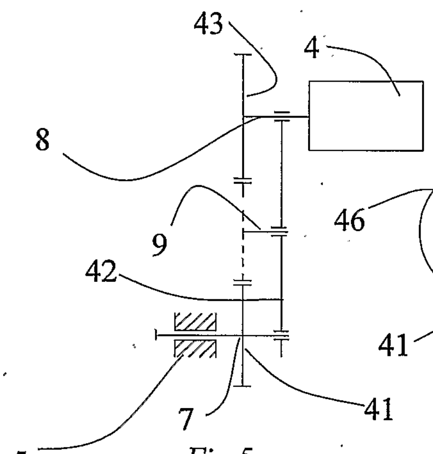

Fig 5.a.

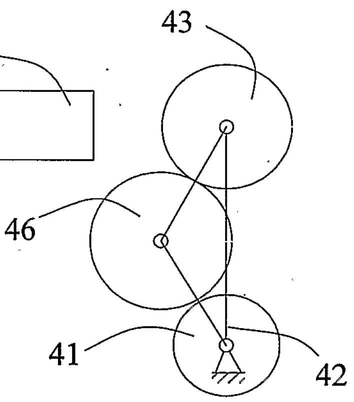

Fig 5.b.

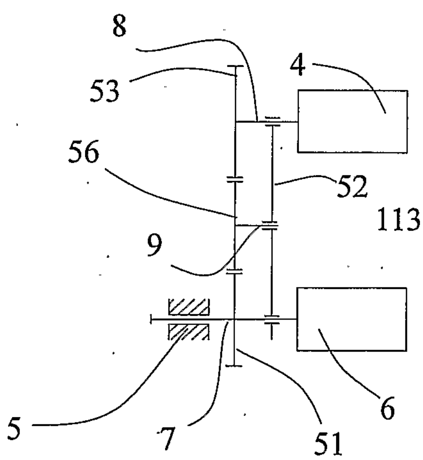

Fig 6.a.

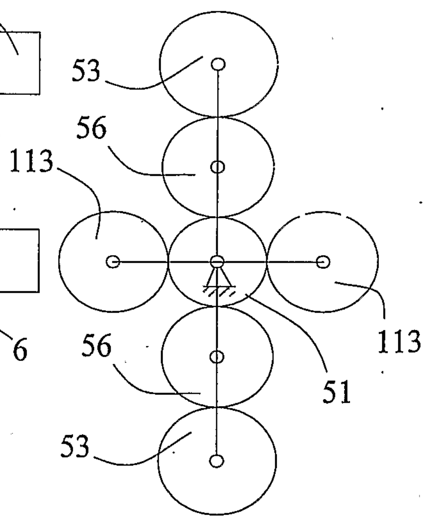

Fig 6.b.

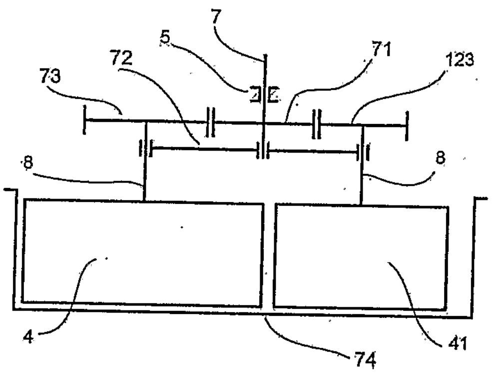

Fig. 7

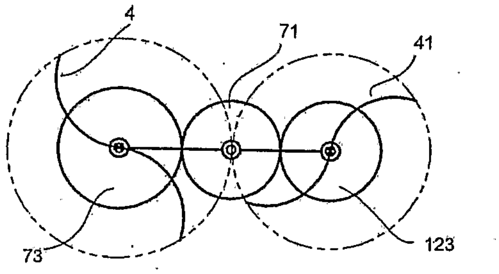

Fig. 8

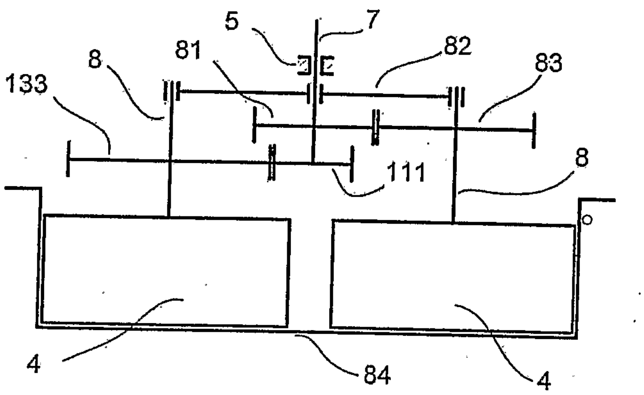

Fig. 9

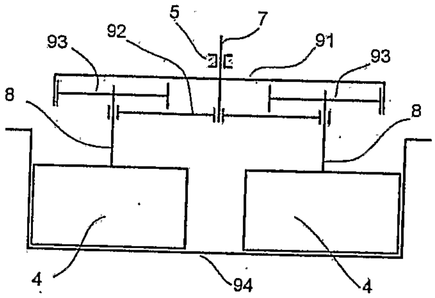

Fig. 10

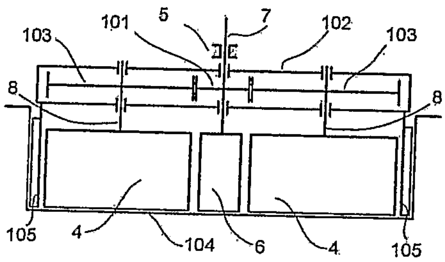

Fig. 11

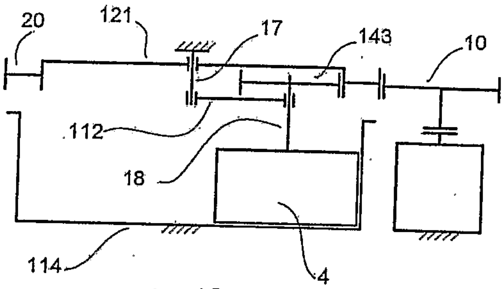

Fig. 12

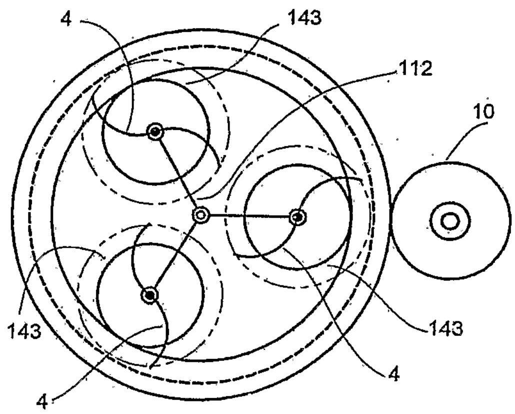

Fig. 13

INTERNATIONAL SEARCH REPORT

International application No
PCT/HU2009/000046

A. CLASSIFICATION OF SUBJECT MATTER
INV. B01F7/30

According to International Patent Classification (IPC) orto both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
BOlF

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical search terms used)

EPO-Internal

C DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	DE 37 01 802 Al (INST MEKH AKADEMII NAUK SSSR [SU]; MO I KHIM MASINOSTROENIJA [SU]) 4 August 1988 (1988-08-04) abstract; figure 1	2
X	EP 0 214 704 Al (STORK FRIESLAND BV [NL]) 18 March 1987 (1987-03-18) abstract; figure 1	1
A	JP 62 204835 A (TSUKISHIMA KIKAI CO) 9 September 1987 (1987-09-09) abstract	1-14

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[X] Further documents are listed in the continuation of Box C

[X] See pateni family annex

* Special categories of cited documents

"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on prionty claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the International filing date but later than the priority date claimed

"T" later document published after the international filing date or pnority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such docu¬ments such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
2 October 2009	26/10/2009

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P B 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel (+31-70) 340-2040, Fax (+31-70) 340-3016	Muller, Gerard

INTERNATIONAL SEARCH REPORT

International application No
PCT/HU2009/000046

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	FR 1 269 453 A (EIRICH WILHELM) 11 August 1961 (1961-08-11) figures 1,2 -----	1-14

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Information on patent family members

International application No
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