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(54) **APPARATUS AND METHOD FOR ROTARY MOTION CONVERSION**

VERFAHREN UND VORRICHTUNG ZUR UMWANDLUNG EINER DREHBEWEGUNG

APPAREIL ET PROCEDE DE CONVERSION D'UN MOUVEMENT ROTATIF

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Description

FIELD OF THE INVENTION

[0001] The invention relates to an apparatus and a method for converting rotary motion at a given input frequency about a primary rotational centerline, to rotary motion of the same frequency about said primary rotational centerline compounded with eccentric rotary motion at an eccentric motion frequency about at least one secondary rotational centerline.

[0002] Document US 3 857 206 A discloses an apparatus comprising non-rotating gear means affixed via a fixed gear housing and housing fixing means to a non-rotating component of a rotary motion machine; drive shaft means connected to an input rotary motion component of said rotary motion machine, passing through said fixed gear housing from an input region of said fixed gear housing to an output region of said fixed gear housing, and by virtue of said connection to said input rotary motion component, rotating at an input frequency about a primary rotational centerline.

[0003] Document US 3 857 206 A discloses a method comprising the steps of : affixing non-rotating gear means via a fixed gear housing and housing fixing means to a non-rotating component of a rotary motion machine; connecting drive shaft means to an input rotary motion component of said rotary motion machine, passing said drive shaft means through said fixed gear housing from an input region of said fixed gear housing to an output region of said fixed gear housing, and by virtue of said connection to said input rotary motion component, rotating said drive shaft means an input frequency about a primary rotational centerline.

BACKGROUND OF THE INVENTION

[0004] Conventional generic orbital sanders, buffers, polishers and carpet cleaners typically drive a sand plate, polishing brush, sand screen pad, carpet brush / sponge at a low speed - typically 175 RPM though sometimes as high as 1000 RPM -- in a circular path. This action produces circular scratches on the sanded surface or carpet. Other random orbital sanders or carpet cleaners in existence rely on a high-speed motor to drive an eccentric random action. The action of the high-speed motor is reduced to the desired speed (e.g., 175 RPM) through various mechanical interactions among the gears, shafts, cams, etc. that comprise the sander / cleaner.

[0005] Illustrative of the prior art is U.S. Patent 3,857,206 for a compound-motion machine in which an eccentric shaft (19) rotates about a motor shaft (14) to produce an eccentric rotation, and a secondary motion is produced by a secondary rotation about the axis of the eccentric shaft, using interacting gear wheels (31 and 32). (Column 2, lines 45-57) The eccentric shaft is fixed to, and rotates at the same speed as, the drive shaft. (Column 2, lines 16-20) The motor needed to drive this device must be a high speed motor on the order of 4000 to 6000 RPM (column 2, line 33), which establishes an eccentric rotation at the motor speed (4000 to 6000 rpm), while the secondary rotation about the eccentric shaft is reduced in speed by virtue of the gear wheel interaction, to perhaps 300 or 600 rpm depending on the gear ratio and the motor speed. The net motion is rotation at the lower speed, with eccentric motion at the higher speed, requiring and being driven by a high speed motor. There is nothing disclosing or suggesting how this might be achieved with a low-speed motor, nor is there anything suggesting or disclosing how to convert the ordinary circular motion of an existing machine to such a compound motion, without having to simply replace the machine entirely. U. S. Patents 4,322,921, 4,467,565 and 4,845,898 all have similar limitations.

[0006] In all of this prior art, an eccentric plate sander is driven by a high-speed (RPM) motor. The eccentric movement is produced directly by the high-speed motor. This high-rotation speed produced by the motor is gear reduced by the gear system into a lower speed rotation. The main drive shaft drives an eccentric drive shaft which in turn drives the gear reduction. This does produce a slow reciprocating action, but requires a high-speed input motor and does not lend itself to adaptation to a low-speed input motor. Nor does it enable a pre-existing low-speed machine to be easily adapted to provide high-speed eccentric action.

[0007] Additionally, sanding is typically a very messy job, with dust particles permeating the area being sanded. An inordinate amount of cleanup is required following a sanding job, and it is usually advisable to remove as many movable items as possible from the area to be sanded, prior to sanding, so that these will not become permeated with dust. This introduces much extra work which is preferably avoided. For carpet cleaning, water and other cleaning fluids are applied to the carpet being cleaned, and the rotary motion (or rotary and eccentric motion) is used to create the desired cleansing action. Here, it is often necessary to wait for a day or so for the water and cleaning fluids to dry before using the carpet again, which is inconvenient. Additionally, since much of the dirt being cleaned becomes suspended in the water or cleaning fluid, removal of as much of this water or fluid as possible will simultaneously remove as much dirt as possible. Allowing water or fluid with***[deletion(s)]*** dirt in suspension to simply dry on the carpet does nothing to remove that dirt, and results in a cleaning job of much lesser quality.

[0008] It would be desirable to have available a means and method for producing eccentric sanding or cleaning motion using a low-speed (e.g., 125 to 1000 RPM) input motor in which the speed of rotation of the output is precisely the same as the input speed, and in which gear increment -- rather than gear reduction -- is used to convert the low-speed input into a higher-speed eccentric movement.

[0009] Because many lower-speed input (e.g. 125 to 1000 RPM) sanders and cleaners are already in use in the market, it would further be desirable to provide a modular attachment for such sanders and cleaners which converts this lower-speed input into a higher-speed eccentric movement coupled with a rotation identical in speed to the lower-speed input, with minimum use of space and without major modifications to the original sander or cleaner, thereby avoiding the need to purchase a separate high-speed input sander or cleaner in order to achieve this motion and expanding the range of applications that can be performed by a single piece of sanding or cleaning equipment.

[0010] It is further desirable to provide a generic method for converting a lower-speed input of, for example, 175 RPM, into a rotary motion still operating at the example input speed of 175 RPM, but adding eccentric motion at a higher frequency.

[0011] It is further desirable for this method to be applied to other rotating sanding devices in existence such as floor sanding edgers, milling machines, and other low speed grinders, as well as hand drill and other rotary motion devices including carpet cleaners.

[0012] It is further desirable to provide a means and method for removing as much dust as possible during sanding, so that dust cleanup afterward, as well as the removal of movable items beforehand, can be avoided.

[0013] It is further desirable to provide a means and method for removing as much water and cleaning fluid as possible, during carpet cleaning.

SUMMARY OF THE INVENTION

[0014] The features of the invention are set forth in the independent claims 1 and 12.

BRIEF DESCRIPTION OF THE DRAWING

[0015] The invention, however, together with further objects and advantages thereof, may best be understood by reference to the following description taken in conjunction with the accompanying drawing(s) in which:

FIG. 1 shows cross-sectional side and bottom-up plan views of the manner in which a sanding, polishing, buffing, or cleaning disk is ordinarily attached to the drive clutch of a rotary-motion sanding or cleaning machine, in the prior art.

FIG. 2 shows cross-sectional side and bottom-up plan views of the preferred embodiment of the invention, using two moving gears.

FIG. 3 shows the geometric constructions utilized to calculate the geometric trajectory over time of a particular "grit" of the sanding, buffing, polishing or cleaning attachment in the preferred and alternate preferred embodiments of the invention.

FIG. 4 shows a bottom-up plan view of a first alternative preferred embodiment of the invention, using four moving gears.

FIG. 5 shows side and bottom-up plan views of a second alternative preferred embodiment of the invention, using a driving disk.

FIG. 6 shows a side plan view of a third alternative preferred embodiment of the invention which further increases the eccentric motion frequency of the invention.

FIG. 7*a* illustrates a side perspective view of a rotary-motion sanding or cleaning machine, a side plan view of the invention embodiment of FIG. 2, and the manner in which the invention (all embodiments) is connected to the sanding or cleaning machine for use.

FIG. 7*b* is a bottom-up plan view along the lines 7b--7b of FIG. 7a, of the manner in which the invention (all embodiments) is connected to the sanding or cleaning machine for use.

FIG. 8 illustrates a side perspective view of the rotary-motion sanding or cleaning machine of FIG. 7a, and a side plan view of the invention embodiment of FIG. 2, as modified with a vacuum attachment for dust (sanding) and water (cleaning) removal.

DETAILED DESCRIPTION OF THE INVENTION

[0016] FIG. 1 shows how a sanding, polishing, buffing or carpet cleaning disk is ordinarily attached to the rotary motion component **102** such as the drive clutch of a rotary-motion sanding or cleaning machine **7** of FIG. 7, in the prior art. As shown in cross-sectional side view in the upper part of FIG. 1, conventional rotary sanding or cleaning machines are set up for sanding, buffing, polishing or cleaning by attaching (mating) a sanding, buffing, polishing or cleaning disk attachment (henceforth referred to as operating attachment **101**) to input rotary motion component **102** of the sander or cleaner, by inserting input rotary motion component **102** into an attachment receptacle **103** of operating attachment **101** as shown by arrow **105.** Often, the mating proceeds by first inserting input rotary motion component **102** into attachment receptacle **103** and then twisting one relative to the other until they lock together. This manner of mating, and its variations, are well known in the art and so needn't be elaborated herein. Attachment receptacle **103** inserts firmly around input rotary motion component **102** as known in the art so that when the sanding or cleaning machine **7** is activated, input rotary motion component **102** will begin to rotate at the input speed (RPM) of the sanding or cleaning machine motor along the direction indicated by (right-hand rule) arrows **104**. (Of course, left-hand motion is equally encompassed.) Thus, by virtue of this mating, the entire operating attachment **101** will similarly rotate concentrically at this same motor input speed, as shown from bottom-up view by arrow **108** illustrating the primary orbital motion direction. Also illustrated is a primary rotational centerline **106**. and operating attachment center **107**.

[0017] FIG. 2 illustrates the preferred embodiment of the invention. Note that the use of "primes" in the component numbering will be used to denote analogous structure and / or function to the prior art structures and /or functions as illustrated in FIG. 1. Rotary-motion conversion module **2** attaches (mates) to input rotary motion component **102** via a conversion module receptacle **103'** which is substantially identical to attachment receptacle **103**, and which mates to input rotary motion component **102** as shown by arrows **105'** in a manner substantially identical to the mating earlier described in FIG. 1 between input rotary motion component **102** and attachment receptacle **103** according to arrows **105**. Thus, a shaft driving disk **101'** which occupies the same position with respect to input rotary motion component **102** as operating attachment **101** of FIG. 1 will be caused to rotate according to arrows **104** once the sanding or cleaning machine **7** is turned on.

[0018] Operating attachment **101**, on the other hand, attaches (mates) to pass-through rotary motion component means **102'** of conversion module 2, which is substantially identical in structure to input rotary motion component **102**. Similarly, the method of mating attachment receptacle **103** to pass-through rotary motion component **102'** according to arrows **105"** is substantially identical to the method of mating conversion module receptacle **103'** to input rotary motion component **102** according to arrows **105',** and to the prior art method of mating attachment receptacle **103** to input rotary motion component **102** according to arrows **105** as in FIG. 1. Because a variety of such mating methods are known in the prior art, this disclosure and its associated claims are intended to fully encompass this variety of mating methods as used within the scope of this invention, and is not dependent on any one or another of these mating methods. However, while shaft driving disk **101'** rotates concentrically about primary centerline **106** at the input frequency (RPM) of the sanding device motor, operating attachment **101** does not follow this same concentric rotation. Rather. due to the motion-conversion mechanism to be described below, operating attachment **101** no longer exhibits concentric rotation. Instead, its primary rotation is at the same speed at the input motor, but a secondary, higher-speed eccentric motion is also introduced.

[0019] To convert the concentric rotary input motion **104** to an eccentric rotary output motion, shaft driving disk **101'** is integrally affixed to a drive shaft **201** which runs substantially through the center of a fixed gear housing **202** and substantially through the center of a non-rotating center gear **203** immovably affixed to fixed gear housing **202**. The region above fixed gear housing **202** and center gear **203** in FIG. 2 will be generally referred to as the "input region" of the housing; while the region below housing **202** and center gear **203** will be referred to as the "output region" of the housing. Drive shaft **201** at its lower extremity (in the output region) is further integrally affixed to a lateral driving connector **204** as shown. In this illustration, lateral driving connector **204** is a driving bar extending laterally within fixed gear housing **202** as shown, though other embodiments for lateral driving connector **204** are also possible, as will be shown later. Drive shaft **201** rotates within fixed gear housing **202** and non-rotating center gear **203**, with bearings and / or appropriate lubricants provided at the surfaces indicated by thicker drawing lines, to facilitate that rotation.

[0020] Fixed gear housing **202**, importantly, is fixed so that it does not in any way rotate in response to the rotation of input rotary motion component **102**. This is achieved by means of a housing fixing device **205** which in the preferred embodiment is an attachment arm as shown. This arm is fixed to the bell of the sanding or cleaning machine **7** as shown and later described in more detail in FIGS. 7a and 7b, so as to prevent fixed gear housing **202** from rotating, i. e., to render fixed gear housing **202** independent of the rotation of input rotary motion component **102**. For other applications, e.g., to convey the rotary motion of a drill into an eccentric rotary motion, the housing fixing device might affix the housing, e.g., to the drill handle. While implementation may thus vary for different applications and devices, the key point is that fixed gear housing **202** is prevented from rotating by affixing it to a non-rotating component of the machine **7** providing the rotary input motion. Non-rotating center gear **203** similarly does not rotate because it is integrally affixed to fixed gear housing **202.** Thus, the rotation of input rotary motion component **102** at a given RPM causes shaft driving disk **101'**, drive shaft **201** and lateral driving connector **204** to rotate at the same RPM as the input drive, while non-rotating center gear 203 remains fixed with respect to this rotation.

[0021] To add eccentric motion, the teeth of a pair of rotating outer gears **206** engage the teeth of non-rotating inner gear **203** as shown. Secondary drive shaft means **207** are integrally affixed to rotating outer **gears ,206** as shown, so as to rotate with the same frequency as outer gears **206**. Secondary drive shafts **207** also pass through and are free to rotate with respect to lateral driving connector **204**, with bearings and / or appropriate lubrication provided at the region again illustrated by the thicker lines to facilitate free rotation. Eccentric motion driving bar means **208** are integrally affixed to secondary drive shafts **207**, and so also rotate at the same frequency as outer gears **206**. Finally, a pair of eccentric motion drive shafts **209** are integrally affixed to secondary driving bars **208**, again, so as to also rotate with the same frequency as outer gears **206**. The combined means comprising components **206, 207, 208** and **209**, which is responsible for introducing the eccentric motion into the system. shall be generally referred to as "eccentric motion generating means."

[0022] Eccentric motion drive shafts **209**, are in turn tapped into a composite motion pass-through means **210** such as the illustrated disk, allowing free rotational movement of eccentric motion drive shafts **209** within composite motion pass-through means **210**, again, with bearings and / or appropriate lubrication at the region illustrated with thicker lines. Pass-through rotary motion component **102'** is affixed proximate the center of composite motion pass-through means **210**, and so when operating attachment **101** is finally attached to pass-through rotary motion component **102'** via rotary motion receptacle **103** as per arrows **105"**, as described earlier, the motion imparted to operating attachment **101** will be that of composite motion pass-through means **210** and pass-through rotary motion component **102'**, rather that of input rotary motion component **102**.

[0023] The eccentric motion is introduced, in particular, by eccentric motion driving bar means **208**, and generally by the eccentric motion generating means comprising components **206, 207, 208** and **209**. The magnitude of the eccentric motion is directly proportional to the displacements **211** between the center of secondary drive shafts **207** and the center of eccentric motion drive shafts **209**. By virtue of the connections outlined above, the rotation **104** of input rotary motion component **102** is imparted directly to lateral driving connector **204** via drive shaft **201** and shaft driving disk **101'.** The rotation of lateral driving connector **204** causes secondary drive shafts **207** to rotate (orbit) concentrically about primary centerline **106** along arrow **108,** while the interaction between rotating outer gears **206** and non-rotating center gear **203** further causes rotating outer gears **206** to rotate (spin) about secondary rotational centerlines **212** along the path illustrated by (right-hand-rule) arrows **213.** From the bottom-up view, the rotation of outer gears **206** about secondary rotational centerlines **212** is as shown by arrows **214.** This rotation (spin) of outer gears **206** is further imparted to secondary driving bars **208** and, via eccentric motion drive shafts **209,** ultimately to composite motion pass-through means **210,** pass-through rotary motion component **102',** and operating attachment **101.**

[0024] In particular, composite motion pass-through means **210,** pass-through rotary motion component **102',** and operating attachment **101** are imparted a net composite motion that captures both the orbit of rotating outer gears **206** about primary centerline **106** (primary orbital motion **108**), and the spin of outer gears **206** about secondary rotational centerlines **212** in combination with the eccentric displacements **211** introduced by eccentric motion driving bars **208** (secondary eccentric motion **214**). Note that it is the boring of drive shaft **201** directly through the fixed gear housing **202** and center gear **203** and its rotation therein that serves to impart to operating attachment **101** a primary orbital motion **108** that is identical in speed (RPM) to input motion **104**.

[0025] If the input frequency (RPM) **104** of the motor is designated by Ω (e.g. 175 RPM for a typical low-speed sander), then the primary orbital motion will be at precisely this same frequency Ω because of the manner in which drive shaft **201** passes straight through the center of center gear **203** and causes outer gears **206** to orbit about center gear **203**. If the number of teeth upon center gear **203** is designated generally by N (N=61 in FIG. 2), and upon outer gear by n (n=30 in FIG. 2), then the frequency ω of the secondary eccentric motion will be stepped up by the ratio N/n, i.e.,

$$\omega = (N/n) \times \Omega, \tag{1}$$

with both rotations (**214** and **108**) occurring in the *same* direction. Thus, in the illustration of FIG. 2 (by way of example, not limitation), if Ω = 175 RPM clockwise, then ω = 61/30 x 175 RPM $\approx$ 356 RPM clockwise. Circular path **213** is thus illustrated with two arrows, while path **104** is illustrated with but a single arrow, to denote this step up in frequency (i. e., that **213** is a higher-frequency rotation that **104**). For a one gear-interaction system such as that of FIG. 2, the step up in the eccentric frequency over the primary frequency is thus determined generally by the gear ratio N/n, though this step up can be further enhanced through multiple gear interactions, as will be later illustrated in connection with FIG 6.

[0026] To maximize sanding, polishing or buffing variation, it is also desirable to choose the number of teeth on each gear so as to introduce the longest possible time (maximum number of cycles) before a particular "grit" upon operating attachment **101** returns to the same radial and angular location (position). In FIG. 2, starting at a given initial position, it requires n=30 revolutions of outer gears **206** about center gear **203,** and, simultaneously, N=61 rotations of outer gears **206** about secondary rotational centerlines **212,** before a particular grit returns to its original position. Had N been chosen to be 60, rather than 61, then because 60 is evenly divisible by 30, a given grit would return to precisely the same position with every revolution of outer gears **206** about center gear **203,** which is not desirable. Generally, gear ratios should thus be chosen so as to avoid common divisible factors. The use of prime number gear counts is helpful in this regard, as this by definition avoids common (indeed any) divisible factors.

[0027] Also, it is possible, alternatively, to replace center gear **203** (which has teeth facing radially-outward) with a gear having teeth facing radially inward, running to the *outside* of outer gears **206,** and engaging the teeth of outer gears **206** along the dotted gear line indicated by **215.** In this configuration, outer gears **206** would then spin about secondary centerlines **212** in a direction *opposite* their revolution about primary centerline **106.** That is, **214** would run opposite **108.** This naturally introduces a higher gear gain ratio (N/n), because of the larger circumference of gear **215** compared to gear **203.**

[0028] FIG. 3 depicts an arbitrarily-selected position of operating attachment **101** during operation. Point P is a randomly-selected grit on operating attachment **101,** R designates the radial distance of point P from the center **107** of operating attachment **101,** and θ designates the angular orientation of point P with respect to operating attachment center **107.** Recalling that the mechanism of FIG. 2 causes lateral driving connector **204** and hence secondary drive shafts **207** to rotate about the center of drive shaft **201** at the input frequency Ω, it is apparent that the geometric (not physical) point labeled as "constant Ω" in FIG. 3 -- constructed at the denoted distance r and angle ϕ with respect to P, is a point that rotates about the center of motion of drive shaft **201,** at a constant frequency and speed given by input frequency Ω. By geometric construction, this point of constant Ω is oriented at the same angle θ with respect to the center of drive shaft **201** as point P is oriented with respect to operating attachment center **107**. Thus, point P moves about the center **107** of operating attachment **101**, and the point labeled constant Ω also moves about the center of drive shaft **201**, over time t, at the constant input frequency Ω, with an angular orientation over time t given by:

$$\theta(t) = 2\pi\Omega t. \qquad (2)$$

Similarly, if ϕ designates the angular orientation of secondary driving bars **208** as shown, it is to be recalled that this orientation will also move with constant angular frequency ω as given eq. 1, that is:

$$\phi(t) = 2\pi\omega t = 2\pi G\Omega t = 2\pi(N/n)\Omega t, \qquad (3)$$

where G = N/n is the gear gain ratio. Finally, r is used to designate the eccentric displacements **211** (see also FIG. 2) introduced by eccentric motion driving bar means **208**.

[0029] With all of the above, one can readily calculate the (x,y) coordinates of point P with respect to the origin of rotation at the center of drive shaft **201** to be:

$$P(x,y) = P(R\cos\theta + r\cos\phi,\ R\sin\theta + r\sin\phi) \qquad (4)$$

Thus, if R' designates the radial distance, and θ' designates the angular orientation, of point P with respect to the *center of drive shaft* **201,** i.e., primary centerline **104** (rather than operating attachment center point **107**), one can readily calculate that:

$$R' = \mathrm{sqrt}\,[R^2 + r^2 + 2Rr\cos(\theta - \phi)] \qquad (5)$$

and

$$\sin\theta'(t) = \frac{(R\sin\theta + r\sin\phi)}{\mathrm{sqrt}\,[R^2 + r^2 + 2Rr\cos(\theta - \phi)].} \qquad (6)$$

To express these over time rather than in terms of angles, one merely substitutes eqs. (2) and (3) into eqs. (5) and (6) above, to yield:

$$R'(t) = \mathrm{sqrt}\,[R^2 + r^2 + 2Rr\cos(2\pi(G-1)\Omega t)] \qquad (7)$$

and

$$\sin \theta'(t) = \frac{(R \sin 2\pi\Omega t + r \sin 2\pi G\Omega t)}{\mathrm{sqrt}\,[R^2 + r^2 + 2Rr \cos (2\pi(G-1)\Omega t)].} \quad (8)$$

In contrast, for the prior art configuration of FIG. 1 (which is the limiting case in which r=0 in eqs. 7 and 8 above), R'(t) = R (constant radius), and $\theta'(t) = 2\pi\Omega t$ (constant frequency).

[0030] FIG. 4 shows a bottom-up plan view of a first alternative preferred embodiment of the invention. This embodiment is substantially the same as the preferred embodiment shown in FIG. 2, however, lateral driving connector **204** is now a driving "cross" as shown, attaching two additional rotating outer gears **206** with all other pertinent elements (e.g., **207, 208, 209**) as shown, in the same manner as earlier discussed in connection with FIG. 2. Thus. while FIG. 2 illustrates a two-moving gear system, FIG. 4 illustrates a four-moving gear system. The use of four gears, rather than two, may provide a preferred weight balance for some applications. It should be apparent by contrasting FIG. 4 with FIG. 2 that the number of moving gears can readily be varied, and that the invention can be constructed even with but a single moving gear if needed, simply by altering the configuration of lateral driving connector **204.** Thus, e.g., for a three-moving gear system, lateral driving connector **204** could have "triangular" arms each emanating about drive shaft **201** at substantially 120 degrees from one another. For five gears, an angle of substantially 72 degrees could separate the arms and the moving gear, etc. Any such variations in the number of moving gears would fall within the scope of this disclosure and its associated claims. Available physical space is the only limiting factor in choosing the number of moving gears. The motion of the device is still calculated according to eqs. 7 and 8, is unaffected by the number of moving gears, and depends only upon gear gain ratio G, eccentric displacement r, and input frequency Ω.

[0031] FIG. 5 illustrates a second alternative preferred embodiment of the invention which is somewhat similar to FIG. 4, insofar as it is also a four-moving gear system. However, in this embodiment, lateral driving connector **204** is now a driving "disk" as shown, wherein secondary drive shafts **207** of rotating outer gears **206** pass through this driving disk-type lateral driving connector **204** at substantially 90 degrees from one another similarly to FIG. 4. (Again, one can use a different number of outer gears **206** within the scope of this disclosure and its associated claims.) Additionally, shaft driving disk **101'** and drive shaft **201** are combined into a single indistinguishable component, wherein drive shaft **201** is substantially widened in relation to its width in FIG. 2, and affixes to lateral driving connector **204** along a much larger contact region as shown. The bore through the center of a non-rotating center gear **203** thus has a much larger radius to accommodate the wider shaft **201.** Thicker, dashed lines continue to indicate regions where rotational bearings and / or sufficient lubrication is required to facilitate rotation.

[0032] In heavy use, the region where drive shaft **201** affixes to lateral driving connector **204** undergoes perhaps the highest degree of physical torque-related stress. In the configuration of FIG. 5, because drive shaft **201** affixes to lateral driving connector **204** along a much larger region, the chance that drive shaft **201** might break off from lateral driving connector **204** under a high-torque stress is greatly reduced. In addition, given the manner in which this overall rotary-motion conversion module **2** attaches to a sanding machine **7** (see FIGS. 7), it is desirable to minimize the vertical height of module **2** as much as possible. The configuration of FIG. 5 helps to further achieve as "flat" a module **2** as possible.

[0033] It was noted in connection with FIGS. 2 and 3 (see also eqs. 1 and 3) that the eccentric motion frequency ω is stepped up by a factor of gear gain ratio G with respect to the input motor frequency Ω, i.e., that $\omega = G \times \Omega$. In a configuration such as that shown in FIGS. 2, 4 and 5, with a single set of rotating outer gears 206 (regardless of how many gears comprise this set), then if N = N(**203**) is the number of teeth in non-rotating center gear **203**, and n = N (**206**) is the number of teeth in each of the rotating outer gears **206** engaging center gear **203**, then, as noted earlier, gear gain ratio G = N/n = N(**203**)/N(**206**). The motion of a single grit is then parameterized in terms of time t, using ratio G, by eqs. 7 and 8. In many cases, the gain ratio G achieved through the configuration of FIGS. 2, 4 and 5 is perfectly acceptable. However, if it is desired to greatly magnify the input frequency Ω into a very high eccentric motion frequency ω (for example, by a ratio of 10 to 1 or more), then a configuration such as that shown in FIG. 6, or something similar thereto that can be deduced by someone of ordinary skill in the mechanical arts, can be used to achieve this.

[0034] FIG. 6 is illustrated based on the two outer gear, driving bar embodiment of FIG. 2. However, it would be obvious to someone of ordinary skill and is within the scope of this disclosure and its associated claims to apply the disclosure of FIG. 6 to work in connection with the four-gear embodiments of FIGS. 4 and 5 as well, or with obvious variations of the embodiments in FIGS. 2, 4 and 5 (e.g., one, three, five and six gear systems, etc.), subject only to physical space limitations.

[0035] FIG. 6 has all of the same elements and interactions as FIG. 2, and is driven and connected to the sanding machine 7 of FIG. 7 in precisely the same way. However, within the eccentric motion generating means, rotating outer gears **206** are replaced by stacked outer gears **206'** and **206'',** and drive shaft **201** drives a lateral driving connector **204** with two parallel, vertically separated, laterally extending bars. If one started with FIG. 4 or 5 rather than FIG. 2, then lateral driving connector **204** would utilized parallel "crosses" (FIG. 4) or parallel "disks" instead. While FIG. 6 illustrates a two-layer stacking, this can be generalized by someone of ordinary skill to multiple layers as desired, or to other gear-increment configurations known in the art, subject only to space limitations.

[0036] When input rotary motion component **102** rotates drive shaft **201** as earlier described, the upper driving connector of **204** rotates upper outer gears **206'** in precisely the same way that outer gears **206** are rotated in FIGS. 2, 4 and 5, with a stepped-up frequency ω given by eq. 1. However, secondary drive shafts **207**, secondary driving bars **208** (which introduce the eccentric motion radius r (**211**) of eqs. 1-8) and eccentric motion drive shafts **209** are now affixed to lower outer gears **206''**, rather than outer gears **206** as in FIGS. 2, 4 and 5. Newly-introduced are first step-up gears **601**, second step-up gears **602**, and third step-up gears 603 (one for each outer gear pair **206'** and **206''**), which further multiply the rotational frequency imparted to secondary drive shafts **207**, eccentric motion driving bars **208** and, particularly, eccentric motion drive shafts **209**, as follows.

[0037] First step up gears **601** are immovably affixed to upper outer gears **206'** via first step-up gear connectors **604** which run through the upper driving connector of **204** just as secondary drive shafts **207** runs through driving connector **204** in FIGS. 2, 4 and 5. (Thick, dotted lines again indicate rotational regions where bearings and / or sufficient lubrication are required.) Thus, first step up gears **601** will be imparted the same frequency of rotation as upper outer gears **206'**. The direction of rotation (based on primary input rotation **104**) is illustrated by the arrows, and the presence of two arrows on each of **206'** and **601** indicates that these each rotate at the same frequency, but that this frequency is already stepped up from the input frequency θ indicated by the single arrow on **104.** However, first step up gears **601** have a larger radius -- and more importantly, more teeth -- than upper outer gears **206'.** The teeth of first step up gears **601** then engage teeth of second step-up gears **602,** which have a smaller radius -- and more importantly, less teeth -- than first step up gears **601.** Thus, second step-up gears **602** rotate at an even higher frequency (with opposite direction) than first step up gears **601,** as illustrated by three arrows rather than two. Second step-up gears **602** are in turn attached directly to third step-up gears **603** with larger radius and more teeth, which by virtue of this attachment will rotate at the same frequency and in the same direction as second step-up gears **602.** The combined element comprising **602** and **603** is fixed in place by upper step up attachments **605** and lower step up attachments **606,** which respectively bore into and rotate freely within the upper and lower arms (or crosses for FIG. 4 and plates for FIG. 5) of driving connector **204,** as shown.

[0038] Finally, the teeth of third step-up gears **603** directly engage the teeth of lower outer gears **206'',** which have a smaller radius and less teeth than third step-up gears **603.** Thus, lower outer gears **206''** will rotate at an even higher frequency (and reverse direction) than third step-up gears **603,** as now illustrated by four arrows. Lower outer gears **206'',** of course, drive secondary drive shafts **207,** eccentric motion driving bars **208** and eccentric motion drive shafts **209.** and thus, the frequency of eccentric rotation **213** (also now showing four arrows) is the same as that of lower outer gears **206''.** Note that lower outer gears **206''** are connected on top into a bore on the lower portion of first step up gears **601,** via lower outer gear attachments **607** that rotate freely within this bore. On the bottom, lower outer gears **206''** are connected through the lower arms (or crosses for FIG. 4 and plates for FIG. 5) of driving connector **204** with secondary drive shafts **207** just as in FIGS. 2, 4 and 5. The connections achieved by components **604, 605, 606, 607** and **207** ensure that the primary rotational frequency Ω (**104**) is preserved and passed through to operating attachment **101.** The free rotation permitted by these same components, however, further enables the secondary (eccentric) frequency **213** to be vastly stepped up.

[0039] In particular, if N(**203**), N(**206'**), N(**601**), N(**602**), N(**603**) and N(**206''**) denote the number of teeth for the particular gears associated with the parenthetical numbers, then the step up gear ratio G, which was G = N/n = N(**203**)/N(**206**) for FIGS. 2, 4 and 5, is, for FIG. 6, now given by:

$$G = [N(203)/N(206')]x[N(601)/N(602)]x[N(603)/N(206'')] \quad (9)$$

Thus, even with an approximate 2 to 1 ratio for each gear interaction, the eccentric frequency can be stepped up by a factor of $2^3 = 8$, and with a 3 to 1 ratio, this provides a factor of 27 to 1. Generally, with a G' to 1 ratio for each gear interaction, $G = G'^3$, The overall motion of a given "grit", however, is unchanged from that of eqs. 1-8: all that changes is the gear gain ratio G. Thus, the motion of a grit on operating attachment 101 in FIG. 6 is described simply by substituting eq. 9 for G into eqs. 1-8 as appropriate.

[0040] FIGS. 7 illustrates how rotary-motion conversion module **2** from any and all of FIGS. 2, 4, 5 and 6 attaches to sanding, carpet cleaning, or similar machine **7**. For illustration, not limitation, module **2** of FIG. 2 is used in FIG. 7. FIG. 7a depicts a conventional sanding or cleaning machine **7** with a bell **71** and a user control shaft **72**. Illustrated with hidden lines within the sander or cleaner **7** is input rotary motion component **102** which was earlier illustrated at the top of each FIGS. 1, 2, 5 and 6. Rotary motion component **102** rotates in direction **104** at input frequency Ω as has been discussed all along, and is driven by a sander motor (not shown) in a manner well known in the art.

[0041] To modify a preexisting sanding or cleaning machine **7** of input frequency Ω to accept rotary-motion conversion module **2**, one first affixes a housing fixing device receptacle means **73** directly to the bell **71** as shown in both FIGS. 7. Receptacle means **73** can be screwed into the bell, welded thereon, or attached (permanently or removably) in any other way that is known in the attachment arts. What is important, however, is that this attachment be very secure, and that it not come loose when subjected to the shear stresses that are introduced once conversion module **2** is attached to sanding machine **7** and operated.

[0042] Next, one inserts and locks (**105'**) shaft driving disk **101'** into input rotary motion component **102** via attachment receptacle **103',** as first described in connection with FIG. 2, and later in connection with FIGS. 4, 5 and 6. At the same time, one locks housing fixing device **205** into housing fixing device receptacle means **73** as illustrated by arrow **74** in FIG. 7a, and as shown from bottom view in FIG. 7b. While housing fixing device **205** is illustrated herein as an attachment arm and housing fixing device receptacle means **73** is illustrated as a "U" to which housing fixing device **205** mates, any configuration is acceptable so long as these two components mate securely to one another without danger of becoming disconnected during operation, so that the fixed gear housing **202** does not rotate during operation. Finally, one chooses operating attachment **101** and attaches (**105"**) it to pass-through rotary motion component **102'** via rotary motion receptacle **103**, as first discussed in connection with FIG. 2 and also later discussed for FIGS. 4, 5 and 6. At this point, conversion module **2** is fully ready for operation.

[0043] Because housing fixing device **205** is locked into housing fixing device receptacle means **73**, fixed gear housing **202** and non-rotating center gear **203** which are integrally attached thereto are prevented from moving in a rotational direction. This enables the outer gears **206** (or **206'** plus assorted step up gears from FIG. 6) to engage center gear 203 and produce the input frequency rotational motion with higher frequency eccentric oscillation described throughout this disclosure, and quantified by eqs. 7 and 8.

[0044] The various configurations described above can be used generally to convert a rotary motion input of given frequency Ω with no eccentricity, into rotary motion of the similar primary frequency Ω, compounded with eccentric motion at a stepped-up frequency $\omega=G\Omega$, and described in detail by eqs. 7 and 8. This is true whether the subject invention is embodied as a module to be attached to a preexisting rotary motion machine (as presented in detail herein), or is embodied directly, non-removably, within a given machine as a way of generating highfrequency eccentric oscillations from a lower-frequency input rotation motor. Either alternative is encompassed by this disclosure and its associated claims. Of course, stepped-down eccentric motion can also be achieved if desired, by appropriate alteration of gear ratios.

[0045] While this discussion has referred generally to a sanding or cleaning machine **7** as the device to which this invention is applied, it is understood that this invention can be used in connection with any rotary motion machine for which it is desired to introduce a (higher-frequency) eccentric oscillation. In all cases, what is needed are simply two points of contact with that machine. First, the fixed gear housing **202** must be fixed to some fixed (non-rotating) component of the machine via a housing fixing means that serves the function of component **205**. Second, the drive shaft **201** must be affixed to (driven by) that component of the machine which generates the rotary motion, such as input rotary motion component **102**. Thus, for example, a modified version of this device using all of the principles outlined herein can be non-rotatably fixed (**205**), say, to the arm of a standard power drill, with its drive shaft **201** driven by the rotational output of the drill. With, for example, an operating attachment **101** that is a buffer, and with pass-through rotary motion component **102'** designed to accept drill attachments in the same manner that the drill itself normally accepts these, the drill can then be used to provide rotating buffing with eccentric oscillations. This also has application, for example, not limitation, to milling machines and low-speed grinding machines.

[0046] FIG. 8 illustrates how a sanding or cleaning machine **7**, including but not limited to the various embodiments of the invention disclosed thus far, is modified to enable a vacuum attachment that can be used to collect dust and other waste matter created when sanding (and buffing and polishing), and to collect excess water or cleaning fluid (including dirt suspended in the water or fluid) when machine **7** is used for carpet cleaning.

[0047] To introduce a vacuum attachment, rotary-motion conversion module **2** and machine **7** are modified as follows. Machine **7** and fixed gear housing **202** are modified to further comprise a machine vacuum receptacle **85**, a housing vacuum receptacle **80**, and a vacuum aperture **81**, all allowing air passage therethrough. When rotary-motion conversion module **2** is mated with machine **7** as described earlier in connection with FIGS. 7, housing vacuum receptacle **80** and machine vacuum receptacle **85** are aligned and mated along vacuum alignment line 86 so that a vacuum means (not shown) known in the art can be attached to housing vacuum receptacle 80 and machine vacuum receptacle **85**. When the vacuum means is activated, this will suck air through vacuum receptacle **85**. housing vacuum receptacle **80**, and vacuum aperture **81**, thus creating a vacuum within an interior region **87** of rotary-motion conversion module **2**. Additionally, composite motion pass-through means **210** and operating attachment **101** are respectively modified to include a plurality of composite motion pass-through vacuum apertures **82** and operating attachment vacuum apertures **83**, which are aligned with one another to provide and air flow passage therethrough. Thus, the vacuum created in interior region **87** by attachment of a vacuum means to housing vacuum receptacle **80** and machine vacuum receptacle **85** will additionally suck up air through composite motion pass-through vacuum apertures **82** and operating attachment vacuum apertures **83**. Finally, an optional vacuum skirt **84** attached as illustrated about the circumference of fixed gear housing **202** helps to concentrate the vacuum in a way most desirable to substantially remove dust and other waste products created by sanding, polishing, and buffing, and to substantially remove water and cleaning fluid, along with any dirt suspended therein, for carpet cleaning and similar applications. These waste products are sucked into the vacuum means, and then disposed of in any of a variety of manners well known in the art. It is understood that while these waste products are sucked "into" the vacuum means, that these may or not ultimately remain in the vacuum means prior to disposal. Thus, for example, the vacuum means may comprise a dirt bag as is well known in the art, which accumulates dust and dirt for subsequent disposal along with the bag. Or, for example, the vacuum means may simply be a vacuum pump that causes the dirt (or water / fluid) to pass through the pump and be disposed of in a drum or similar waste receptacle, by environmentally safe runoff, or in any other manner known in the art for disposing of waste products gathered by means of a vacuum.

[0048] It is to be observed that while the vacuum attachment of FIG. 8 is illustrated in connection with the use of rotary-motion conversion module **2**, that the type of vacuum attachment illustrated in FIG. 8 can be applied to any preexisting sander, buffer, polisher, carpet cleaner and similar machine substantially as illustrated in FIG. 8, even if rotary-motion conversion module **2** is not used. In this alternative embodiment, machine **7** is still modified to include machine vacuum receptacle **85**, operating attachment **101** is still modified to include a plurality of operating attachment vacuum apertures **83**, and bell **71** serves the role of optional vacuum skirt **84** to concentrate the vacuum. All that is eliminated is rotary-motion conversion module **2**, and the modifications made thereto for vacuum purposes as earlier described. A vacuum means is then attached to machine vacuum receptacle **85** as earlier described. When this vacuum means is activated, a vacuum is created which will again suck up air through operating attachment vacuum apertures **83**. This suction will again substantially remove dust and other waste products created by sanding, polishing, and buffing, and will substantially remove water and cleaning fluid, along with any dirt suspended therein, for carpet cleaning and similar applications.

[0049] While the various embodiments of this invention have been illustrated using "toothed" wheels, it is fully understood that "friction" wheels are an obvious, equivalent substitute for these wheels, and that this substitution is included within the use of the terms "gear" and "wheel" as defined and utilized in this specification and its associated claims.

[0050] Finally, while the operating attachment **101** has been described herein generally as a sander, buffer, polisher, or carpet cleaner, this is illustrative, not limiting. Any type of attachment that one ordinarily attaches to a rotating machine to produce a desired effect on a work product such as wood, stone, marble, metal, glass, ceramic, or any other substance to be finished, the work effect of which can be enhanced by introducing eccentric oscillations over the primary rotary motion, is considered within the scope of the invention as disclosed and claimed. Similarly, any application, whether to wood finishing, stone or marble finishing, metal, glass or ceramic finishing, or any other substance finishing or cleaning, is also considered within the scope of this disclosure.

Claims

1. An apparatus for converting rotary motion at a given input frequency Ω about a primary rotational centerline (106), to rotary motion of the same frequency Ω about said primary rotational centerline (106) compounded with eccentric rotary motion at an eccentric motion frequency ω about at least one secondary rotational centerline (212), comprising:

non-rotating gear means (203) affixed via a fixed gear housing (202) and housing fixing means (205) to a non-rotating component of a rotary motion machine (7);

drive shaft means (201) connected to an input rotary motion component (102) of said rotary motion machine (7), passing through said fixed gear housing (202) from an input region of said fixed gear housing (202) to an output region of said fixed gear housing (202), and by virtue of said connection to said input rotary motion component (102), rotating at said input frequency Ω about said primary rotational centerline (106);***[deletion(s)]***

lateral driving connector means (204) affixed to said drive shaft means (201) proximate said output region of said fixed gear housing (202) and thereby also rotating at said input frequency Ω about said primary rotational centerline (106);

eccentric motion generating means (206, 206', 207, 208, 209) passing through said lateral driving connector means (204) and thereby orbiting at said input frequency Ω about said primary rotational centerline (106), and further engaging said non-rotating gear means (203) and thereby causing said eccentric motion generating means (206, 206', 207, 208, 209) and secondary drive shaft means (207), eccentric motion driving bar means (208) and eccentric motion drive shaft means (209) thereof to also rotate at said eccentric motion frequency ω about said at least one secondary rotational centerline (212); and

pass-through rotary motion component means (102') connected to said eccentric motion drive shaft means (209), imparting both the orbit of said eccentric motion drive shaft means (209) at said input frequency Ω about said primary rotational centerline (106) and the rotation of said eccentric motion drive shaft means (209) at said eccentric motion frequency ω about said at least one secondary rotational centerline (212), to an operating attachment (101) attached to said pass-through rotary motion component means (102').

2. The apparatus of claim 1, wherein:

said apparatus is a rotary motion conversion module (2) separate and distinct from said rotary motion machine (7);
said apparatus further comprises a conversion module receptacle (103') of a form substantially equivalent to an attachment receptacle (103) of said operating attachment (101);
said housing fixing means (205) is so-fixed to said non-rotating component of said rotary motion machine (7);
said drive shaft means (201) is affixed to said conversion module receptacle (103') and is connected to said input rotary motion component (102) of said rotary motion machine (7) by mating said conversion module receptacle (103') with said input rotary motion component (102) in substantially the same manner that said attachment receptacle (103) of said operating attachment (101) is mated with said input rotary motion component (102) when said modular device is not used;
said pass-through rotary motion component means (102') is of a form substantially equivalent to said input rotary motion component (102) of said rotary motion machine (7); and
said attachment receptacle (103) of said operating attachment (101) is mated with said pass-through rotary motion component means (102') in substantially the same manner that said attachment receptacle (103) is mated with said input rotary motion component (102) when said modular device is not used.

3. The apparatus of claim 1, wherein said lateral driving connector means (204) is selected from the group consisting of a driving bar, a driving cross, and a driving disk.

4. The apparatus of claim 1, wherein:

said eccentric motion generating means (206, 206', 206", 207, 208, 209) further comprises at least one outer gear means (206, 206', 206") affixed to said secondary drive shaft means (207) and engaging said non-rotating gear means (203); and
said secondary drive shaft means (207) passes through said lateral driving connector means (204); thereby causing said eccentric motion generating means (206, 206', 206", 207, 208, 209) and said secondary drive shaft means (207), eccentric motion driving bar means (208) and eccentric motion drive shaft means (209) thereof to so-rotate at said eccentric motion frequency ω about said at least one secondary rotational centerline (212).

5. The apparatus of claim 1, wherein said eccentric motion generating means (206, 206', 206", 207, 208, 209) further comprises at least one step up gear (601, 602, 603) to increase said eccentric motion frequency ω above what said frequency ω would be in the absence of said at least one step up gear (601, 602, 603).

6. The apparatus of claim 5, wherein said lateral driving connector means (204) further comprises a plurality of parallel layers driving a plurality of stacked outer gears (206', 206").

7. The apparatus of claim 1, further comprising composite motion pass-through means (210), wherein

said eccentric motion drive shaft means (209) are tapped into said composite motion pass-through means (210) to allow free rotational movement of said eccentric motion drive shaft means (209) within said composite motion pass-through means (210); and

said pass-through rotary motion component means (102') is affixed to said composite motion pass-through means (210); thereby

so-imparting motion comprising both said input frequency Ω about said primary rotational centerline (106) and said eccentric motion frequency ω about said at least one secondary rotational centerline (212), to said operating attachment (101).

8. The apparatus of claim 1, wherein the motion of a selected point P of said operating attachment (101) located at a radial distance R from a center of said operating attachment (101), over time t, is substantially given by:

$$R'(t) = \text{sqrt}\,[R^2 + r^2 + 2Rr\cos(2\pi(G-1)\Omega t)]$$

and

$$\sin \theta'(t) = \frac{(R \sin 2\pi\Omega t + r \sin 2\pi G\Omega t)}{\mathrm{sqrt}\,[R^2 + r^2 + 2Rr \cos (2\pi(G\text{-}1)\Omega t)],}$$

where R'(t) designates a radial distance and θ'(t) designates an angolat orientation of said point P with respect to said primary rotational centerline (106), where G designates a gear gain ratio of said eccentric motion generating means (206, 206', 206", 207, 208, 209), and where r designates eccentric displacements introduced by said eccentric motion driving bar means (208).

9. The apparatus of claim 1, further comprising:

a machine vacuum receptacle (85) attached to said rotary motion machine (7) and allowing passage of air and waste products therethrough; and
operating attachment vacuum apertures (83) passing through said operating attachment (101) and allowing passage of air and waste products therethrough; wherein:

attaching a vacuum means to said machine vacuum receptacle (85) and activating said vacuum means causes waste products produced by said rotary motion machine (7) to be collected and sucked up proximate said operating attachment (101), through said openting attachment vacuum apertures (83), through said machine vacuum receptacle (85), and into said vacuum means.

10. The apparatus of claim 2, further comprising:

a machine vacuum receptacle (85) attached to said rotary motion machine (7) and allowing passage of air and waste products therethrough;
operating attachment vacuum apertutes (83) passing through said operating attachment (101) and allowing passage of air and waste products therethrough; and
a housing vacuum receptacle (80) and vacuum aperture (81) passing through said rotary motion conversion module (2) and allowing passage of air and waste products therethrough, said housing vacuum receptade (80) further substantially aligning and mating (86) with said machine vacuum receptacle (85); wherein:

attaching a vacuum means to said machine vacuum receptacle (85) and activating said vacuum means causes waste products produced by said rotary motion machine (7) to be collected and sucked up proximate said operating attachment (101), through said operating attachment vacuum apertures (83), through said vacuum aperture (81) and said housing vacuum receptacle (80), through said machine vacuum receptacle (85), and into said vacuum means.

11. The apparatus of claim 7, further comprising:

a machine vacuum receptacle (85) attached to said rotary motion machine (7) and allowing passage of air and waste products therethrough;
operating attachment vacuum apertures (83) passing through said operating attachment (101) and allowing passage of air and waste products therethrough;
a housing vacuum receptacle (80) and vacuum aperture (81) passing through said rotary motion conversion module (2) and allowing passage of air and waste products therethrough, said housing vacuum receptacle (80) further substantially aligning and mating (86) with said machine vacuum receptacle (85); and
composite motion pass-through vacuum apertures (82) passing through said composite motion pass-through means (210) and allowing passage of air and waste products therethrough, said composite motion pass-through vacuum apertures (82) further substantially aligning (87) with said operating attachment vacuum apertures (83); wherein:

attaching a vacuum means to said machine vacuum receptacle (85) and activating said vaccom means causes waste products produced by said rotary motion machine (7) to be collected and sucked up proximate said operating attachment (101), through said operating attachment vacuum apertures (83), through said composite motion pass-through vacuum apertures (82), through said vacuum aperture (81) and said housing vacuum receptacle (80), through said machine vacuum receptacle (85), and into said vacuum means.

12. A method for converting rotary motion at a given input frequency Ω about a primary rotational centerline (106), to rotary motion of the same frequency Ω about said primary rotational centerline (106) compounded with eccentric rotary motion at an eccentric motion frequency ω about at least one secondary rotational centerline (212), comprising the steps of:

affixing non-rotating gear means (203) via a fixed gear housing (202) and housing fixing means (205) to a non-rotating component of a rotary motion machine (7);
connecting drive shaft means (201) to an input rotary motion component (102) of said rotary motion machine (7), passing said drive shaft means (201) through said fixed gear housing (202) from an input region of said fixed gear housing (202) to an output region of said fixed gear housing (202), and by virtue of said connection to said input rotary motion connponent (102), rotating said drive shaft means (201) at said input frequency Ω about said primary rotational centerline (106);
affixing lateral driving connector means (204) to said drive shaft means (201) proximate said output region of said fixed gear housing (202) and thereby also rotating said lateral driving connector means (204) at said input frequency Ω about said primary rotational centerline (106);***[deletion(s)]***
passing eccentric motion generating means (206, 206', 206'', 207, 208, 209) through said lateral driving connector means (204) and thereby orbiting said eccentric motion generating means (206, 206', 206", 207, 208, 209) at said input frequency Ω about said primary rotational centerline (106);
further engaging said eccentric motion generating means (206, 206', 206", 207, 208. 209) with said non-rotating gear means (203) and thereby causing said eccentric motion generating means (206, 206', 206", 207, 208, 209) and secondary drive shaft means (207), eccentric motion driving bar means (208) and eccentric motion drive shaft means (209) thereof to also rotate at said eccentric motion frequency ω about said at least one secondary rotational centerline (212);
connecting pass-through rotary motion component means (102') to said eccentric motion drive shaft means (209), thereby imparting both the orbit of said eccentric motion drive shaft means (209) at said input frequency Ω about said primary rotational centerline (106) and the rotation of said eccentric motion drive shaft means (209) at said eccentric motion frequency ω about said at least one secondary rotational centerline (212), to said pass-through rotary motion component means (102'); and
attaching an operating attachment (101) to said pass-through rotary motion component means (102').

13. The method of claim 12, wherein a rotary motion conversion module separate and distinct from said rotary motion machine (7) comprises said non-rotating gear means (203), fixed gear housing (202), housing fixing means (205), connecting drive shaft means (201), lateral driving connector means (204), eccentric motion generating means (206, 206', 206'', 207, 208, 209) and pass-through rotary motion component means (102'), comprising the further steps of:

so-fixing said housing fixing means (205) to said non-rotating component of said rotary motion machine (7);
affixing said drive shaft means (201) to a conversion module receptacle (103') of a form substantially equivalent to an attachment receptacle (103) of said operating attachment (101);
connecting said drive shaft means (201) to said input rotary motion component (102) of said rotary motion machine (7) by mating said conversion module receptacle (103') with said input rotary motion component (102) in substantially the same manner that said attachment receptacle (103) of said operating attachment (101) is mated with said input rotary motion component (102) when said modular device is not used;
mating said attachment receptacle (103) of said operating attachment (101) with said pass-through rotary motion component means (102') in substantially the same manner that said attachment receptacle (103) is mated with said input rotary motion component (102) when said modular device is not used, wherein said pass-through rotary motion component means (102') is of a form substantially equivalent to said input rotary motion component (102) of said rotary motion machine (7).

14. The method of claim 12, wherein said lateral driving connector means (204) is selected from the group consisting of a driving bar, a driving cross, and a driving disk.

15. The method of claim 12, said eccentric motion generating means (206, 206', 206", 207, 208, 209) further comprising at least one outer gear means (206, 206', 206'') affixed to said secondary drive shaft means (207), comprising the further steps of:

engaging said outer gear means (206, 206', 206'') with said non-rotating gear means (203);
passing said secondary drive shaft means (207) through said lateral driving connector means (204); and
thereby causing said eccentric motion generating means (206, 206', 206'', 207, 208, 209) and said secondary drive shaft means (207), eccentric motion driving bar means (208) and eccentric motion drive shaft means (209) thereof to so-rotate at said eccentric motion frequency ω about said at least one secondary rotational centerline (212).

16. The method of claim 12, said eccentric motion generating means (206, 206', 206'', 207, 208, 209) further comprising at least one step up gear (601, 602, 603), comprising the further step of increasing said eccentric motion frequency ω using said at least one step up gear (601, 602, 603), to above what said frequency ω would be in the absence of said at least one step up gear (601, 602, 603).

17. The method of claim 16, said lateral driving connector means (204) further comprising a plurality of parallel layers, comprising the further step of driving a plurality of stacked outer gears (206', 206'') using said lateral driving connector means (204).

18. The method of claim 12, further comprising the steps of:

tapping said eccentric motion drive shaft means (209) into composite motion pass-through means (210) thereby allowing free rotational movement of said eccentric motion drive shaft means (209) within said composite motion pass-through means (210); and
affixing said pass-through rotary motion component means (102') to said composite motion pass-through means (210); thereby
so-imparting motion comprising both said input frequency Ω about said primary rotational centerline (106) and said eccentric motion frequency ω about said at least one secondary rotational centerline (212), to said operating attachment (101).

19. The method of claim 12, said method resulting in the motion of a selected point P of said operating attachment (101) located at a radial distance R from a center of said operating attachment (101), over time t, being substantially given by:

$$R'(t) = \mathrm{sqrt}\,[R^2 + r^2 + 2Rr\cos(2\pi(G-1)\Omega t)]$$

and

$$\sin\theta'(t) = \frac{(R\sin 2\pi\Omega t + r\sin 2\pi G\Omega t)}{\mathrm{sqrt}\,[R^2 + r^2 + 2Rr\cos(2\pi(G-1)\Omega t)],}$$

where R'(t) designates a radial distance and θ'(t) designates an angular orientation of said point P with respect to said primary rotational centerline (106), where G designates a gear gain ratio of said eccentric motion generating means (206, 206', 206''. 207, 208, 209), and where r designates eccentric displacements introduced by said eccentric motion driving bar means (208).

20. The method of claim 12, further comprising the steps of:

attaching a vacuum means to a machine vacuum receptacle (85) of, and allowing passage of air and waste products through, said rotary motion machine (7); and
activating said vacuum means, thereby causing waste products produced by said rotary motion machine (7) to be collected and sucked up proximate said operating attachment (101), through operating attachment vacuum apertures (83) passing through said operating attachment (101), through said machine vacuum receptacle (85), and into said vacuum means.

21. The method of claim 13, further comprising the steps of:

attaching a vacuum means to a machine vacuum receptacle (85) of, and allowing passage of air and waste products through, said rotary motion machine (7); and

activating said vacuum means, thereby causing waste products produced by said rotary motion machine (7) to be collected and sucked up proximate said operating attachment (101), through operating attachment vacuum apertures (83) passing through said operating attachment (101), through a vacuum aperture (81) and a housing vacuum receptacle (80) passing through said rotary motion conversion module (2), through said machine vacuum receptacle (85), and into said vacuum means;
said housing vacuum receptacle (80) substantially aligning and mating (86) with said machine vacuum receptacle (85).

22. The method of claim 18, further comprising:

a machine vacuum receptacle (85) attached to said rotary motion machine (7) and allowing passage of air and waste products therethrough;
operating attachment vacuum apertures (83) passing through said operating attachment (101) and allowing passage of air and waste products therethrough;
a housing vacuum receptacle (80) and vacuum aperture (81) passing through said rotary motion conversion module (2) and allowing passage of air and waste products therethrough, said housing vacuum receptacle (80) further substantially aligning and mating (86) with said machine vacuum receptacle (85); and
composite motion pass-through vacuum apertures (82) passing through said composite motion pass-through means (210) and allowing passage of air and waste products therethrough, said composite motion pass-through vacuum apertures (82) further substantially aligning (87) with said operating attachment vacuum apertures (83); wherein:

attaching a vacuum means to said machine vacuum receptacle (85) of, and allowing passage of air and waste products through, said rotary motion machine (7); and
activating said vacuum means, thereby causing waste products produced by said rotary motion machine (7) to be collected and sucked up proximate said operating attachment (101), through operating attachment vacuum apertures (83) passing through said operating attachment (101), through composite motion pass-through vacuum apertures (82) passing through said composite motion pass-through means (210), through a vacuum aperture (81) and a housing vacuum receptacle (80) passing through said rotary motion conversion module (2), through said machine vacuum receptacle (85), and into said vacuum means;
said housing vacuum receptacle (80) substantially aligning and mating (86) with said machine vacuum receptacle (85); and
said composite motion pass-through vacuum apertures (82) further substantially aligning (87) with said operating attachment vacuum apertures (83).

Patentansprüche

1. Eine Vorrichtung zur Umwandlung von Drehbewegung bei einer gegebenen Eingangs frequenz Ω um eine primäre Hauptdrehachse (106) in Drehbewegung der selben Frequenz Ω um die primäre Hauptdrehachse (106), die aus außermittiger Drehbewegung bei einer außermittigen Bewegungsfrequenz ω um mindestens eine sekundäre Hauptdrehachse (212) zusammengesetzt ist, wobei sie umfasst:

nicht drehendes Getriebemittel (203), das über ein festes Getriebegehäuse (202) und Gehäusebefestigungsmittel (205) an eine nicht drehende Komponente einer Drehbewegungsmaschine (7) angebracht ist;

Antriebswellenmittel (201), das mit einer Eingangsdrehbewegungskomponente (102) der Drehbewegungsmaschine (7) verbunden ist, das durch das feste Getriebegehäuse(202) eines Eingangsbereiches des festen Getriebegehäuses(202) zu einem Ausgangsbereich des festen Getriebegehäuses(202) läuft, und aufgrund der Verbindung zu der Eingangsdrehbewegungskomponente (102), die sich mit der Eingangsfrequenz Ω um die primäre Hauptdrehachse (106) dreht;***[Streichung(en)]***

ein seitliches Antriebskopplungsmittel (204), das an dem Antriebswellenmittel (201) befestigt ist, das nahe dem Ausgangsbereich des festen Getriebegehäuses (202) liegt, und sich dabei auch mit der Eingangsfrequenz Ω um die primäre Hauptdrehachse (106) dreht;

außermittige Bewegungserzeugungsmittel (206, 206', 207, 208, 209), die **durch** das seitliche Antriebskopplungsmittel (204) verlaufen und dabei mit der Eingangsfrequenz Ω um die primäre Hauptdrehachse(106) kreisen, wobei außerdem das nicht-drehende Getriebemittel (203) in Eingriff gebracht wird und **dadurch** bewirken, dass die außermittigen Bewegungserzeugungsmittel (206, 206', 207, 208, 209) und das sekundäre Antriebswellenmittel (207), das außermittige Bewegungsantriebsstangenmittel (208) und das außermittige Bewegungsantriebswellenmittel (209) sich auch mit der außermittigen Bewegungsfrequenz ω um mindestens eine sekundäre Hauptdrehachse (212) drehen; und

Durchlauf-Drehbewegungskomponentenmittel (102'), das mit dem außermittigen Bewegungsantriebswellenmittel (209) verbunden ist, das sowohl die Umkreisung des außermittigen Bewegungsantriebswellenmittels (209) mit der Eingangsfrequenz Ω um die primäre Hauptdrehachse (106) übermittelt, als auch die Drehung des außermittigen Bewegungsantriebswellenmittel (209) mit der außermittigen Bewegungsfrequenz ω um mindestens eine sekundäre Hauptdrehachse (212) zu einem arbeitenden Zusatzgerät (101), das an das Durchlauf-Drehbewegungskomponentenmittel (102') angefügt ist.

2. Die Vorrichtung von Anspruch 1, wobei:

die Vorrichtung ein Drehbewegungs-Umwandlungsmodul (2) ist, das getrennt und eigenständig von der Drehbewegungsmaschine (7) ist;

die Vorrichtung umfasst zudem einen Umwandlungsmodulaufnahme (103') von einer Form, die im wesentlichen einer Zusatzgeräteaufnahme (103) des arbeitenden Zusatzgeräts (101) entspricht;

das Gehäusebefestigungsmittel (205) an die nicht-drehende Komponente der Drehbewegungsmaschine (7) befestigt ist;

das Antriebswellenmittel (201) ist an die Umwandlungsmodulaufnahme (103') befestigt und mit der Eingangsdrehbewegungskomponente (102) der Drehbewegungsmaschine (7) dadurch verbunden, dass der Umwandlungsmodulanschluss (103') mit der Eingangsdrehbewegungskomponente (102) auf die im wesentlichen selbe Art ineinander greift, wie der Zusatzgeräteanschluss (103) des arbeitenden Zusatzgeräts (101) mit der Eingangsdrehbewegungskomponente (102) ineinander greift, wenn das modulare Gerät nicht verwendet wird;

das Durchlauf-Drehbewegungskomponentenmittel (102') ist von einer Form, die im wesentlichen der Eingangsdrehbewegungskomponente (102) der Drehbewegungsmaschine (7) entspricht; und

Zusatzgeräteanschluss (103) des arbeitenden Zusatzgeräts (101) mit dem Durchlauf-Drehbewegungskomponentenmittel (102') auf die im wesentlichen selbe Art ineinander greift, wie Zusatzgeräteanschluss (103) mit der Eingangsdrehbewegungskomponente (102) verbunden ist, wenn das modulare Gerät nicht verwendet wird.

3. Die Vorrichtung von Anspruch 1, wobei das seitliche Antriebskopplungsmittel (204) aus der Gruppe ausgewählt wird, die aus einer Antriebsstange, einer Antriebskreuzschiene und einer Antriebsscheibe besteht.

4. Die Vorrichtung von Anspruch 1, wobei:

die außermittigen Bewegungserzeugungsmittel (206, 206', 206'', 207, 208, 209) außerdem mindestens ein äußeres Getriebemittel (206, 206', 206'') umfasst, das an dem sekundären Antriebswellenmittel (207) befestigt ist und das nicht-drehende Getriebemittel (203) in Betrieb hält; und

das sekundäre Antriebswellenmittel (207) durch das seitliche Antriebskopplungsmittel (204) läuft;

wobei dadurch die außermittigen Bewegungserzeugungsmittel (206, 206', 206'', 207, 208, 209) das sekundäre Antriebswellenmittel (207), außermittiges Bewegungsantriebsstangenmittel (208) und außermittige Bewegungsantriebswellenmittel (209) dazu gebracht werden, sich so mit der außermittigen Bewegungsfrequenz ω um mindestens eine sekundäre Hauptdrehachse (212) zu drehen.

5. Die Vorrichtung von Anspruch 1, wobei die außermittigen Bewegungserzeugungsmittel (206, 206', 206'', 207, 208, 209) außerdem mindestens ein Übersetzungsgetriebe (601, 602, 603) umfassen, um die außermittige Bewegungsfrequenz ω über diejenige Frequenz ω zu erhöhen, die ohne das mindestens eine Übersetzungsgetriebe (601, 602, 603) vorliegen würde;

6. Die Vorrichtung von Anspruch 5, wobei das seitliche Antriebskopplungsmittel (204) außerdem mehrere Parallelschichten umfasst, die mehrere übereinander angeordnete äußere Getriebe (206', 206'') antreiben.

7. Die Vorrichtung von Anspruch 1, die außerdem zusammengesetztes Bewegungsdurchlaufmittel (210) umfasst, wobei
die außermittigen Bewegungsantriebswellenmittel (209) an das zusammengesetzte Bewegungsdurchlaufmittel (210) angeschlossen werden, um freie Drehbewegung des außermittigen Bewegungsantriebswellenmittel (209) innerhalb des zusammengesetzten Bewegungsdurchlaufmittels (210) zu gestatten; und
das Durchlauf-Drehbewegungskomponentenmittel (102') an dem zusammengesetzten Bewegungsdurchlaufmittel (210) festgemacht ist;
wobei die so übertragende Bewegung sowohl die Eingangsfrequenz Ω um die primäre Hauptdrehachse (106) als auch die außermittige Bewegungsfrequenz ω um mindestens eine sekundäre Hauptdrehachse (212) zum arbeitenden Zusatzgerät (101) umfasst.

8. Die Vorrichtung von Anspruch 1, wobei die Bewegung eines ausgewählten Punktes P des arbeitenden Zusatzgeräts (101), das in einem Radialabstand R von einer Mitte des arbeitenden Zusatzgeräts (101) liegt, über Zeit t, im wesentlichen gegeben ist durch:

$$R'(t) = sqrt\,[R^2 + r^3 + 2Rr\cos(2\pi(G\text{-}1)\Omega t)]$$

und

$$\sin\theta'(t) = \frac{(R\sin 2\pi\Omega t + r\sin 2\pi G\Omega t)}{sqrt\,[R^2 + r^2 + 2Rr\cos(2\pi(G\text{-}1)\Omega t)]}$$

wobei R (t) einen Radialabstand bestimmt und θ'(t) eine Drehausrichtung des Punktes P mit Bezug auf die primäre Hauptdrehachse (106) bestimmt, wo G ein Übersetzungssteigerungsverhältnis der außermittigen Bewegungserzeugungsmittel (206, 206', 206'', 207, 208, 209) bestimmt, und wo r außermittige Verschiebungen bestimmt, die durch das außermittige Bewegungsantriebsstangenmittel (208) eingebracht werden.

9. Die Vorrichtung von Anspruch 1 umfasst außerdem:

einen Maschinenvakuumanschluss (85), der an der Drehbewegungsmaschine (7) befestigt ist und Durchlass von Luft und Abfallstoffen da hindurch erlaubt; und

Betriebs-Zusatzgerät-Vakuumöffnungen (83), die durch das arbeitende Zusatzgerät (101) hindurchlaufen und Durchlass von Luft und Abfallstoffe da hindurch erlauben; wobei:

das Befestigen eines Vakuummittels an den Maschinenvakuumanschluss (85) und das Aktivieren dieses Vakuummittels Abfallstoffe verursacht, die von der Drehbewegungsmaschine (7) erzeugt werden, welche in der Nähe des arbeitenden Zusatzgeräts (101) durch die Betriebs-Zusatzgerät-Vakuumöffnungen (83) und durch den Maschinenvakuumanschluss (85) in das Vakuummittel gesammelt und aufgesaugt werden.

10. Die Vorrichtung von Anspruch 2 umfasst außerdem:

einen Maschinenvakuumanschluss (85), der an der Drehbewegungsmaschine (7) befestigt ist und Durchlass von Luft und Abfallstoffen dort hindurch erlaubt;

Betriebs-Zusatzgerät-Vakuumöffnungen (83), die durch das Betriebs-Zusatzgerät (101) hindurch laufen und Durchlass von Luft und Abfallstoffen dort hindurch erlauben; und

ein Gehäusevakuumanschluss (80) und Vakuumöffnung (81), die durch das Drehbewegung-Umwandlungsmodul (2) laufen und so Durchlass von Luft und Abfallstoffen erlauben, wobei der Gehäusevakuumanschluss (80) sich außerdem im wesentlichen nach dem Maschinenvakuumanschluss (85) ausrichtet und mit ihm ineinander greift (86); wobei:

das Befestigen eines Vakuummittels an den Maschinenvakuumanschluss (85) und das Aktivieren des Vakuummittels Abfallstoffe verursacht, die durch die Drehbewegungsmaschine (7) verursacht werden und in der Nähe des Betriebs-Zusatzgeräts (101) durch die arbeitenden Zusatzgerät-Vakuumöffnungen (83), durch die Vakuumöffnung (81) und den Gehäusevakuumanschluss (80), durch den Maschinenvakuumanschluss (85) gesammelt und in das Vakuummittel aufgesaugt werden.

11. Die Vorrichtung von Anspruch 7 umfasst außerdem:

einen Maschinenvakuumanschluss (85), der an der Drehbewegungsmaschine (7) festgemacht ist und Durchlass von Luft und Abfallstoffen dort hindurch erlaubt;

Betriebs-Zusatzgerät-Vakuumöffnungen (83), die durch das Betriebs-Zusatzgerät (101) hindurch laufen und Durchlass von Luft und Abfallstoffen dort hindurch erlauben; und

einen Gehäusevakuumanschluss (80) und Vakuumöffnung (81), die durch das Drehbewegungs-Umwandlungsmodul (2) läuft und Durchlass von Luft und Abfallstoffen dort hindurch erlaubt, wobei der Gehäusevakuumanschluss (80) sich außerdem im wesentlichen nach dem Maschinenvakuumanschluss (85) ausrichtet und mit ihm ineinander greift (86); und

zusammengesetzte Bewegungsdurchlauf-Vakuumöffnungen (82), die durch das zusammengesetzte Bewegungsdurchlaufmittel (210) führen und Durchlass von Luft und Abfallstoffen dort hindurch erlauben, wobei die zusammengesetzten Bewegungsdurchlauf-Vakuumöffnungen (82) sich außerdem im wesentlichen nach den Betriebs-Zusatzgerät-Vakuumöffnungen (83) ausrichten (87); wobei:

das Befestigen eines Vakuummittels an den Maschinenvakuumanschluss (85) und das Aktivieren des Vakuummittels Abfallstoffe verursacht, die durch die Drehbewegungsmaschine (7) verursacht werden, und in der Nähe des arbeitenden Zusatzgeräts (101) durch die Betriebs-Zusatzgerät-Vakuumöffnungen (83), durch die zusammengesetzten Bewegungsdurchlauf-Vakuumöffnungen (82), durch die Vakuumöffnungen (81) und durch den Gehäusevakuumanschluss (80) durch den Maschinenvakuumanschluss (85) in das Vakuummittel zu sammeln und aufzusaugen sind.

12. Ein Verfahren zur Umwandlung einer Drehbewegung mit einer gegebenen Eingangsfrequenz Ω um eine primäre Hauptdrehachse (106) zu Drehbewegung derselben Frequenz Ω um die primäre Hauptdrehachse (106), sich zusammensetzend aus außermittiger Drehbewegung bei einer außermittigen Bewegungsfrequenz ω um mindestens eine sekundäre Hauptdrehachse (212), wobei diese Schritte umfasst werden:

Anbringen von nicht-drehendem Getriebemitteln (203) über ein festes Getriebegehäuse (202) und ein Gehäusebefestigungsmittel (205) zu einer nicht-drehenden Komponente einer Drehbewegungsmaschine (7);

Verbinden von Antriebswellenmittel (201) mit einer Eingangsdrehbewegungskomponente (102) der Drehbewegungsmaschine (7), die das Antriebswellenmittel (201) durch das feste Getriebegehäuse (202) von einem Eingangsbereich des festen Getriebegehäuses (202) zu einem Ausgangsbereich des festen Getriebegehäuses (202) hindurch führt, und aufgrund dieser Verbindung zu der Eingabedrehbewegungskomponente (102), drehen der Antriebswellenmittel (201) mit der Eingangsfrequenz Ω um die primäre Hauptdrehachse (106);

Anbringen von seitlichem Antriebskopplungsmittel (204) an das Antriebswellenmittel (201) in der Nähe des Ausgangsbereichs des festen Getriebegehäuses (202) und dadurch auch Drehen des seitlichem Antriebskopplungsmittels (204) bei einer Eingangsfrequenz Ω um die primäre Hauptdrehachse (106);***[Streichung(en)]***

Durchführen von außermittigen Bewegungserzeugungsmitteln (206, 206', 206'', 207, 208, 209) **durch** das seitliche Antriebskopplungsmittel (204) und **dadurch** Umkreisen der außermittigen Bewegungserzeugungsmittel (206, 206', 206'', 207, 208, 209) mit der Eingangsfrequenz Ω um die primäre Hauptdrehachse (106);

außerdem Ineinandergreifen lassen der außermittigen Bewegungserzeugungsmittel (206, 206', 206'', 207, 208, 209) mit dem nicht-drehenden Getriebemittel (203) und **dadurch** verursachen, dass die außermittigen Bewegungserzeugungsmittel (206, 206', 206'', 207, 208, 209) und das sekundäre Antriebswellenmittel (207), außermittiges Bewegungsantriebsstangenmittel (208) und außermittiges Bewegungsantriebswellenmittel (209) sich auch bei der außermittigen Bewegungsfrequenz ω um mindestens eine sekundäre Hauptdrehachse

(212) drehen;

Verbinden von Durchlauf-Drehbewegungskomponentenmittel (102') mit dem außermittigen Bewegungsantriebswellenmittel (209), wobei **dadurch** sowohl die Kreisbahn des außermittigen Bewegungsantriebswellenmittels (209) mit der Eingangsfrequenz Ω um die primäre Hauptdrehachse (106) als auch die Drehung des außermittigen Bewegungsantriebswellenmittels (209) mit der außermittigen Bewegungsfrequenz ω um mindestens eine sekundäre Hauptdrehachse (212) zu dem Durchlauf-Drehbewegungskomponentenmittel (102') übermittelt wird; und

Befestigen eines Betriebs-Zusatzgeräts (101) an das Durchlauf-Drehbewegungskomponentenmittel (102').

13. Das Verfahren von Anspruch 12, wobei ein Drehbewegung-Umwandlungsmodul, getrennt und verschieden von der Drehbewegungsmaschine (7), das nicht-drehende Zahnradgetriebe (203), das feste Getriebegehäuse (202), das Gehäusebefestigungsmittel (205), das verbindende Antriebswellenmittel (201), das seitliche Antriebskopplungsmittel (204), außermittige Bewegungserzeugungsmittel (206, 206', 206'', 207, 208, 209) und das Durchlauf-Drehbewegungskomponentenmittel (102') umfasst, die diese weiteren Schritte umfassen:

Festmachen des Gehäusebefestigungsmittels (205) an die nicht-drehende Komponente der Drehbewegungsmaschine (7);

Befestigen von Antriebswellenmittel (201) an einen Umwandlungsmodulanschlusses (103') von einer Form, die im wesentlichen einem Zusatzgeräteanschluss (103) des arbeitenden Zusatzgeräts (101) entspricht;

Verbinden des Antriebswellenmittels (201) mit der Eingangsdrehbewegungskomponente (102) der Drehbewegungsmaschine (7) durch Ineinandergreifen des Umwandlungsmodulanschlusses (103') mit der Eingabedrehbewegungskomponente (102) auf die im wesentlichen selbe Art, wie der Zusatzgeräteanschluss (103) des Betriebs-Zusatzgeräts (101) mit der Eingabedrehbewegungskomponente (102) verbunden ist, wenn verbunden ist, wenn das modulare Gerät nicht verwendet wird;

Verbinden des Zusatzgeräteanschlusses (103) des arbeitenden Zusatzgeräts (101) mit dem Durchlauf-Drehbewegungskomponentenmittel (102') auf die im wesentlichen selbe Art, wie der Zusatzgeräteanschluss (103) mit der Eingabedrehbewegungskomponente (102) ineinander greift, wenn das modulare Gerät nicht verwendet wird, wobei das Durchlauf-Drehbewegungskomponentenmittel (102') über eine Form verfügt, die im wesentlichen der Eingabedrehbewegungskomponente (102) der Drehbewegungsmaschine (7) entspricht.

14. Das Verfahren von Anspruch 12, wobei das seitliche Antriebskopplungsmittel (204) von der Gruppe ausgewählt wird, die aus einer Antriebsstange, einer Antriebskreuzschiene und einer Antriebsscheibe besteht.

15. Das Verfahren von Anspruch 12, wobei die außermittigen Bewegungserzeugungsmittel (206, 206', 206'', 207, 208, 209) außerdem mindestens ein äußeres Getriebemittel (206, 206', 206'') umfassen, das an dem sekundären Antriebswellenmittel (207) festgemacht ist, was die weiteren Schritte umfasst:

Ineinandergreifen lassen von dem äußeren Getriebemittel (206, 206', 206'') mit dem nicht-drehenden Getriebemittel (203);

Schieben des sekundären Antriebswellenmittels (207) durch das seitliche Antriebskopplungsmittel (204); und dadurch bewirken, dass die außermittigen Bewegungserzeugungsmittel (206, 206', 206'', 207, 208, 209) und das sekundäre Antriebswellenmittel (207), außermittiges Bewegungsantriebsstangenmittel (208) und außermittiges Bewegungsantriebswellenmittel (209) sich so mit der außermittigen Bewegungsfrequenz ω um mindestens eine sekundäre Hauptdrehachse (212) drehen.

16. Das Verfahren von Anspruch 12, wobei die außermittigen Bewegungserzeugungsmittel (206, 206', 206'', 207, 208, 209) außerdem mindestens ein Übersetzungsgetriebe (601, 602, 603) umfassen, was den weiteren Schritt umfasst, die außermittige Bewegungsfrequenz ω zu erhöhen, indem mindestens ein Übersetzungsgetriebe (601, 602, 603) verwendet wird, über diejenige Frequenz ω, die in Abwesenheit von mindestens einem Übersetzungsgetriebe (601, 602, 603) vorliegen würde.

17. Das Verfahren von Anspruch 16, wobei das seitliche Antriebskopplungsmittel (204) außerdem mehrere parallele

Schichten umfasst, was den weiteren Schritt umfasst, mehrere übereinander gelagerte Außengetriebe (206', 206'') anzutreiben, wobei das seitliche Antriebskopplungsmittel (204) verwendet wird.

18. Das Verfahren von Anspruch 12, das außerdem diese Schritte umfasst:

Hineinschlagen des außermittigen Bewegungsantriebswellenmittels (209) in das zusammengesetzte Bewegungsdurchlaufmittel (210), wobei dadurch freie Drehbewegung des außermittigen Bewegungsantriebswellenmittels (209) innerhalb des zusammengesetzten Bewegungsdurchlaufmittels (210) erlaubt wird; und

Befestigen des Durchlauf-Drehbewegungskomponentenmittels (102') an dem zusammengesetzten Bewegungsdurchlaufmittel (210); dadurch

Übermitteln von Bewegung, die sowohl die Eingangsfrequenz Ω um die primäre Hauptdrehachse (106) als auch die außermittige Bewegungsfrequenz ω um mindestens eine sekundäre Hauptdrehachse (212) zu dem Betriebs-Zusatzgerät (101) umfasst.

19. Das Verfahren nach Anspruch 12, wobei das Verfahren zu der Bewegung von einem gewählten Punkt P des arbeitenden Zusatzgeräts (101) führt, der in einem Radialabstand R von einer Mitte des arbeitenden Zusatzgeräts (101) gelegen ist, über Zeit t, die im wesentlichen gegeben ist durch:

$$R'(t) = sqrt\,[R^2 + r^2 + 2Rr\cos(2\pi(G\text{-}1)\Omega t)]$$

und

$$\sin\theta'(t) = \frac{(R\sin 2\pi\Omega t + r\sin 2\pi G\Omega t)}{sqrt\,[R^2 + r^2 + 2Rr\cos(2\pi(G\text{-}1)\Omega t)]}$$

wo R'(t) einen Radialabstand bestimmt und θ'(t) eine Drehausrichtung des Punktes P mit Bezug auf die primäre Hauptdrehachse (106), wo G ein Übersetzungsverhältnis der außermittigen Bewegungserzeugungsmittel (206, 206', 206'', 207, 208, 209) bestimmt und wo r außermittige Verschiebungen bestimmt, eingebracht durch das außermittige Bewegungsantriebsstangenmittel (208).

20. Das Verfahren von Anspruch 12, das außerdem diese Schritte umfasst:

Befestigen eines Vakuummittels an einen Maschinenvakuumanschluss (85) der Drehbewegungsmaschine (7) und Durchlassen von Luft und Abfallstoffen durch diese; und

Aktivieren des Vakuummittels, wobei dadurch Abfallstoffe erzeugt werden, die durch die Drehbewegungsmaschine (7) erzeugt werden, und die in der Nähe von dem Betriebs-Zusatzgeräts (101) durch Betriebs-Zusatzgerät-Vakuumöffnungen (83), die durch das arbeitende Zusatzgerät (101) laufen, durch den Maschinenvakuumanschluss (85) und in das Vakuummittel aufgesammelt und aufgesaugt werden.

21. Das Verfahren von Anspruch 13, das außerdem diese Schritte umfasst:

Befestigen eines Vakuummittels an einen Maschinenvakuumanschluss (85) der Drehbewegungsmaschine (7) und Durchlassen von Luft und Abfallstoffen durch diese; und

Aktivieren des Vakuummittels, wobei dadurch durch die Drehbewegungsmaschine (7) Abfallstoffe erzeugt werden, die in der Nähe des arbeitenden Zusatzgeräts (101) durch arbeitende Zusatzgerät-Vakuumöffnungen (83), die durch das arbeitende Zusatzgerät (101) laufen, durch eine Vakuumöffnung (81) und einen Gehäusevakuumanschluss (80), der durch das Drehbewegungs-Umwandlungsmodul (2) läuft, durch den Maschinenvakuumanschluss (85) in das Vakuummittel aufgesammelt und aufgesaugt werden;

den Gehäusevakuumanschluss (80), der sich im wesentlichen nach dem Maschinenvakuumanschluss (85) ausrichtet und mit ihm ineinander greift (86) .

22. Das Verfahren von Anspruch 18, das außerdem umfasst:

einen Maschinenvakuumanschluss (85), der an der Drehbewegungsmaschine (7) befestigt ist und Durchlass von Luft und Abfallstoffen dort hindurch erlaubt;

Betriebs-Zusatzgerät-Vakuumöffnungen (83), die durch das arbeitende Zusatzgerät (101) laufen und Durchlass von Luft und Abfallstoffen dort hindurch erlauben;

einen Gehäusevakuumanschluss (80) und Vakuumöffnung (81), die durch das Drehbewegungs-Umwandlungsmodul (2) verlaufen und Durchlass von Luft und Abfallstoffen dort hindurch erlaubt, wobei der Gehäusevakuumanschluss (80) sich außerdem im wesentlichen nach dem Maschinenvakuumanschluss (85) ausrichtet und mit ihm ineinander greift (86); und

zusammengesetzte Bewegungsdurchlauf-Vakuumöffnungen (82), die durch das zusammengesetzte Bewegungsdurchlaufmittel (210) laufen und Durchlass von Luft und Abfallstoffen dort hindurch erlauben, wobei die zusammengesetzten Bewegungsdurchlauf-Vakuumöffnungen (82) sich außerdem im wesentlichen nach den arbeitenden Zusatzgerät-Vakuumöffnungen (83) ausrichten (87); wobei

ein Vakuummittel an dem Maschinenvakuumanschluss (85) der Drehbewegungsmaschine (7) befestigt wird und Durchlass von Luft und Abfallstoffen durch diese erlaubt wird; und

das Vakuummittel aktiviert wird, wobei dadurch Abfallstoffe erzeugt werden, die durch die Drehbewegungsmaschine (7) erzeugt werden, die in der Nähe von dem arbeitenden Zusatzgerät (101) durch arbeitende Zusatzgerät-Vakuumöffnungen (83), die durch das arbeitende Zusatzgerät (101) laufen, durch zusammengesetzte Bewegungsdurchlauf-Vakuumöffnungen (82), die durch das zusammengesetzte Bewegungsdurchlaufmittel (210) laufen, durch eine Vakuumöffnung (81) und einen Gehäusevakuumanschluss (80), der durch das Drehbewegungs-Umwandlungsmodul (2) läuft, durch den Maschinenvakuumanschluss (85) in das Vakuummittel aufgesammelt und aufgesaugt werden;

der Gehäusevakuumanschluss (80) sich im wesentlichen nach dem Maschinenvakuumanschluss (85) ausrichtet und mit ihm ineinander greift (86); und

die zusammengesetzten Bewegungsdurchlauf-Vakuumöffnungen (82) sich außerdem im wesentlichen nach den arbeitenden Zusatzgerät-Vakuumöffnungen (83) ausrichten (87).

Revendications

1. Appareil pour convertir un mouvement rotatif à une fréquence d'entrée donnée Ω autour d'une ligne centrale de rotation principale (106) en un mouvement rotatif à la même fréquence Ω autour de ladite ligne centrale de rotation principale (106) combiné à un mouvement rotatif excentrique à une fréquence ω d'un mouvement d'excentrique autour d'au moins une ligne centrale de rotation secondaire (212), comprenant :

un moyen d'engrenage sans rotation (203) fixé par l'intermédiaire d'un carter d'engrenage fixe (202) et un moyen de fixation du carter (205) sur un composant sans rotation d'une machine à mouvement rotatif (7) ;
un moyen d'arbre d'entraînement (201) connecté à un composant de mouvement rotatif d'entrée (102) de ladite machine à mouvement rotatif (7), traversant ledit carter d'engrenage fixe (202) d'une région d'entrée dudit carter d'engrenage fixe (202) à une région de sortie dudit carter d'engrenage fixe (202), et, en vertu de ladite connexion audit composant de mouvement rotatif d'entrée (102), tournant à ladite fréquence d'entrée Ω autour de ladite ligne centrale de rotation principale (106) ;***[suppression(s)]***
un moyen de connecteur d'entraînement latéral (204) fixé audit moyen d'arbre d'entraînement (201) est placé à proximité de ladite région de sortie dudit carter d'engrenage fixe (202) et de ce fait tournant également à ladite fréquence d'entrée Ω autour de ladite ligne centrale de rotation principale (106) ;
un moyen de génération de mouvement excentrique (206, 206', 207, 208, 209) traversant ledit moyen de connecteur d'entraînement latéral (204) et orbitant de ce fait à ladite fréquence d'entrée Ω autour de ladite ligne centrale de rotation principale (106) et engrenant de plus avec ledit moyen d'engrenage sans rotation (203) et causant ainsi la rotation dudit moyen de génération de mouvement excentrique (205, 206', 207, 208, 209) et du moyen d'arbre d'entraînement secondaire (207), du moyen de barre d'entraînement du mouvement

excentrique (208) et des moyens d'arbre d'entraînement du mouvement excentrique (209) de celui-ci à ladite fréquence du mouvement excentrique ω autour de ladite au moins une ligne centrale de rotation secondaire (212) ; et

un moyen de composant de mouvement rotatif traversant (102') connecté auxdits moyens arbre d'entraînement de mouvement excentrique (209), transmettant à la fois l'orbite dudit moyen d'arbre d'entraînement de mouvement excentrique (209) à ladite fréquence d'entrée Ω autour de ladite ligne centrale de rotation principale (106) et la rotation dudit moyen d'arbre d'entraînement de mouvement excentrique (209) à ladite fréquence de mouvement excentrique ω autour de ladite au moins une ligne centrale de rotation secondaire (212), à une attache de manoeuvre (101) attachée audit moyen de composant de mouvement rotatif traversant (102').

2. Appareil selon la revendication 1, dans lequel :

ledit appareil est un module conversion du mouvement rotatif (2). séparé et distinct de ladite machine à mouvement rotatif (7) ;

ledit appareil comporte de plus un réceptacle (103') du module de conversion de forme quasiment équivalente à un réceptacle d'attache (103) de ladite attache de manoeuvre (101) ;

ledit moyen de fixation du carter (205) est fixé ainsi audit composant sans rotation de ladite machine à mouvement rotatif (7) ;

ledit moyen d'arbre d'entraînement (201) est fixé audit réceptacle (103') du module de conversion et est connecté audit composant de mouvement rotatif d'entrée (102) de ladite machine à mouvement rotatif (7) en faisant correspondre ledit réceptacle (103') du module de conversion et ledit composant de mouvement rotatif d'entrée (102) de manière quasiment identique à la manière dont ledit réceptacle d'attache (103) de ladite attache de manoeuvre (101) correspond audit composant de mouvement rotatif d'entrée (102) quand ledit dispositif modulaire n'est pas utilisé ;

ledit moyen de composant de mouvement rotatif traversant (102') est de forme quasiment équivalente audit composant de mouvement rotatif d'entrée (102) de ladite machine à mouvement rotatif (7) ; et

ledit réceptacle d'attache (103) de ladite attache de manoeuvre (101) correspond audit moyen de composant de mouvement rotatif traversant (102') de manière quasiment identique à la manière dont ledit réceptacle d'attache (103) correspond audit composant du mouvement rotatif d'entrée (102) quand ledit dispositif modulaire n'est pas utilisé.

3. Appareil selon la revendication 1, dans lequel ledit moyen de connecteur d'entraînement latéral (204) est sélectionné dans le groupe constitué d'une barre d'entraînement, d'une croix d'entraînement et d'un disque d'entraînement.

4. Appareil selon la revendication 1, dans lequel :

ledit moyen de génération de mouvement excentrique (206, 206', 206", 207, 208, 209) comporte de plus au moins un moyen d'engrenage externe (206, 206', 206") fixé audit moyen d'arbre d'entraînement secondaire (207) et engrenant avec ledit d'engrenage sans rotation (203) ; et

et ledit moyen d'arbre d'entraînement secondaire (207) traverse ledit moyen de connecteur d'entraînement latéral (204) ; ainsi

causant une telle rotation dudit moyen de génération de mouvement excentrique (205, 206', 206", 207, 208, 209) et dudit moyen d'arbre d'entraînement secondaire (207), du moyen de barre d'entraînement du mouvement excentrique (208) et des moyens d'arbre d'entraînement du mouvement excentrique (209) de celui-ci, à ladite fréquence du mouvement excentrique ω autour de ladite au moins une ligne centrale de rotation secondaire (212).

5. Appareil selon la revendication 1, dans lequel ledit moyen de génération de mouvement excentrique (206, 206', 206", 207, 208, 209) comporte de plus au moins un engrenage multiplicateur (601, 602, 603) pour rendre ladite fréquence de mouvement excentrique ω supérieure à ce que ladite fréquence ω serait en l'absence dudit au moins un engrenage multiplicateur (601, 602, 603).

6. Appareil selon la revendication 5, dans lequel ledit moyen de connecteur d'entraînement latéral (204) comporte de plus une pluralité de couches parallèles entraînant une pluralité d'engrenages externes empilés (206', 206").

7. Appareil selon la revendication 1, comportant en outre un moyen de mouvement composite traversant (210), dans lequel lesdits moyens d'arbre d'entraînement de mouvement excentrique (209) sont branchés dans ledit moyen de mouvement composite traversant (210) pour permettre un mouvement rotatif libre dudit moyen d'arbre d'entraînement de mouvement excentrique (209) à l'intérieur dudit moyen de mouvement composite traversant (210) ; et

ledit moyen de composant de mouvement rotatif traversant (102') est fixé audit moyen de mouvement composite traversant (210) ; ainsi

transmettant de la sorte le mouvement comportant à la fois ladite fréquence d'entrée Ω autour de ladite ligne centrale de rotation principale (106) et ladite fréquence de mouvement excentrique ω autour de ladite au moins une ligne centrale de rotation secondaire (212) à ladite attache de manoeuvre (101).

8. Appareil selon la revendication 1, dans lequel le mouvement d'un point P sélectionné de ladite attache de manoeuvre (101) situé à une distance radiale R d'un centre de ladite attache de manoeuvre (101), pendant un temps t, est quasiment donnée par :

$$R'(t) = \text{sqrt}\,[R2 * r2 + 2Rr \cos(2\pi(G-1)\Omega t)]$$

et

$$\sin\theta'(t) = \frac{(R \sin 2\pi\Omega t + r \sin 2\pi G\Omega t)}{\text{sqrt}\,[R^2 + r^2 + 2Rr\cos(2\pi(G-1)\Omega t)]}$$

où R'(t) représente une distance radiale et θ'(t) représente une orientation angulaire dudit point P par rapport à ladite ligne centrale de rotation principale (106), dans laquelle G représente un rapport de gain d'engrenage dudit moyen de génération de mouvement excentrique (205, 206', 206", 207, 208, 209) et dans laquelle r représente des déplacements excentriques introduits par ledit moyen de barre d'entraînement de mouvement excentrique (208).

9. Appareil selon la revendication 1, comprenant de plus :

un réceptacle d'aspiration (85) de la machine attaché à ladite machine à mouvement rotatif (7) et permettant le passage de l'air et des déchets à travers celui-ci ; et

des ouvertures d'aspiration (83) de l'attache de manoeuvre traversant ladite attache de manoeuvre (101) et permettant le passage de l'air et des déchets à travers celles-ci ; dans lequel :

le fait d'attacher un moyen d'aspiration audit réceptacle d'aspiration (85) de la machine et le fait d'activer ledit moyen d'aspiration cause la collecte des déchets produits par ladite machine à mouvement rotatif (7) et leur aspiration à proximité de ladite attache de manoeuvre (101), à travers lesdites ouvertures d'aspiration (83) de l'attache de manoeuvre, à travers ledit réceptacle d'aspiration (85) de la machine et dans le moyen d'aspiration.

10. Appareil selon la revendication 2, comprenant de plus :

un réceptacle d'aspiration (85) de la machine attaché à ladite machine à mouvement rotatif (7) et permettant le passage de l'air et des déchets à travers celui-ci ;

des ouvertures d'aspiration (83) de l'attache de manoeuvre traversant ladite attache de manoeuvre (101) et permettant le passage de l'air et des déchets à travers celles-ci ; et

un réceptacle d'aspiration (80) du carter et une ouverture d'aspiration (81) traversant ledit module de conversion du mouvement rotatif (2) et permettant le passage de l'air et des déchets à travers celui-ci, ledit réceptacle d'aspiration (80) du carter étant de plus quasiment aligné avec et correspondant (86) audit réceptacle d'aspiration (85) de la machine ; dans lequel :

le fait d'attacher un moyen d'aspiration audit réceptacle d'aspiration (35) de la machine et le fait d'activer ledit moyen d'aspiration cause la collecte des déchets produits par ladite machine à mouvement rotatif (7) et leur aspiration à proximité de ladite attache de manoeuvre (101), à travers lesdites ouvertures d'aspiration (83) de l'attache de manoeuvre, à travers ladite ouverture d'aspiration (81) et ledit réceptacle d'aspiration (80) du carter, à travers ledit réceptacle d'aspiration (85) de la machine, et dans le moyen d'aspiration.

11. Appareil selon la revendication 7, comprenant de plus :

un réceptacle d'aspiration (85) de la machine attaché à ladite machine à mouvement rotatif (7) et permettant le passage de l'air et des déchets à travers celui-ci ;
des ouvertures d'aspiration (83) de l'attache de manoeuvre traversant ladite attache de manoeuvre (101) et permettant le passage de l'air et des déchets à travers celles-ci ;
un réceptacle d'aspiration (80) du carter et une ouverture d'aspiration (81) traversant ledit module de conversion du mouvement rotatif (2) et permettant le passage de l'air et des déchets à travers celui-ci, ledit réceptacle d'aspiration (80) du carter étant de plus quasiment aligné avec et correspondant (86) audit réceptacle d'aspiration (85) de la machine ; et
des ouvertures d'aspiration (82) du mouvement composite traversant qui traversent ledit moyen de mouvement composite traversant (210) et qui permettent le passage de l'air et des déchets à travers celles-ci, lesdites ouvertures d'aspiration (82) du mouvement composite traversant étant de plus quasiment alignées (87) avec lesdites ouvertures d'aspiration (83) de l'attache de manoeuvre ; dans lequel
le fait d'attacher un moyen d'aspiration audit réceptacle d'aspiration (85) de la machine et le fait d'activer ledit moyen d'aspiration cause la collecte des déchets produits par ladite machine à mouvement rotatif (7) et leur aspiration à proximité de ladite attache de manoeuvre (101), à travers lesdites ouvertures d'aspiration (83) de l'attache de manoeuvre. à travers lesdites ouvertures d'aspiration (82) du mouvement composite traversant, à travers ladite ouverture d'aspiration (81) et ledit réceptacle d'aspiration (80) du carter, à travers ledit réceptacle d'aspiration (85) de la machine, et dans le moyen d'aspiration.

12. Procédé pour convertir un mouvement rotatif à une fréquence d'entrée Ω autour d'une ligne centrale de rotation principale (106), en un mouvement rotatif à la même fréquence Ω autour de ladite ligne centrale de rotation principale (106) combiné à un mouvement rotatif excentrique à une fréquence de mouvement excentrique ω autour d'au moins une ligne centrale de rotation secondaire (212), comprenant les étapes consistant à :

fixer un moyen d'engrenage sans rotation (203) par l'intermédiaire d'un carter d'engrenage fixe (202) et un moyen de fixation du carter (205) sur un composant sans rotation d'une machine à mouvement rotatif (7) ;
connecter un moyen d'arbre d'entraînement (201) à un composant de mouvement rotatif d'entrée (102) de ladite machine à mouvement rotatif (7), faire passer ledit moyen d'arbre d'entraînement (201) à travers ledit carter d'engrenage fixe (202) d'une région d'entrée dudit carter d'engrenage fixe (202) à une région de sortie dudit carter d'engrenage. fixe (202), et, en vertu de ladite connexion audit composant de mouvement rotatif d'entrée (102), faire tourner ledit moyen d'arbre d'entraînement (201) à ladite fréquence d'entrée Ω autour de ladite ligne centrale de rotation principale (106) ;
fixer un moyen de connecteur d'entraînement latéral (204) audit moyen d'arbre d'entraînement (201) est placé à proximité de ladite région de sortie dudit carter d'engrenage fixe (202) et de ce fait faire également tourner ledit moyen de connecteur d'entraînement latéral (204) à ladite fréquence d'entrée Ω autour de ladite ligne centrale de rotation principale (106) ;***[suppression(s)]***
faire passer un moyen de génération de mouvement excentrique (206, 206', 206", 207, 208, 209) à travers ledit moyen de connecteur d'entraînement latéral (204) et orbiter de ce fait ledit moyen de génération de mouvement excentrique (206, 206', 206", 207, 208, 209) à ladite fréquence d'entrée Ω autour de ladite ligne centrale de rotation principale (106) ;
engrener de plus ledit moyen de génération de mouvement excentrique (206, 206', 206", 207, 208, 209) avec ledit d'engrenage sans rotation (203) et causant ainsi une rotation dudit moyen de génération de mouvement excentrique (205, 206', 206", 207, 208, 209) et dudit moyen d'arbre d'entraînement secondaire (207), du moyen de barre d'entraînement du mouvement excentrique (208) et des moyens d'arbre d'entraînement du mouvement excentrique (209) de celui-ci à ladite fréquence du mouvement excentrique ω autour de ladite au moins une ligne centrale de rotation secondaire (212) ;
connecter un moyen de composant de mouvement rotatif traversant (102') auxdits moyens arbre d'entraînement de mouvement excentrique (209), transmettant ainsi à la fois l'orbite dudit moyen d'arbre d'entraînement de mouvement excentrique (209) à ladite fréquence d'entrée Ω autour de ladite ligne centrale de rotation principale (106) et la rotation dudit moyen d'arbre d'entraînement de mouvement excentrique (209) à ladite fréquence de mouvement excentrique ω autour de ladite au moins une ligne centrale de rotation secondaire (212), audit moyen de composant de mouvement rotatif traversant (102') ;
attacher une attache de manoeuvre (101) audit moyen de composant de mouvement rotatif traversant (102').

13. Procédé selon la revendication 12, dans lequel un module conversion du mouvement rotatif séparé et distinct de ladite machine à mouvement rotatif (7) comprend ledit moyen d'engrenage sans rotation (203), un carter d'engrenage fixe (202), un moyen de fixation du carter (205), un moyen d'arbre d'engrenage de connexion (201), un moyen de connecteur d'entraînement latéral (204), un moyen de génération de mouvement excentrique (205, 206' , 206", 207, 208, 209) et un moyen de composant de mouvement rotatif traversant (102'), comprenant les autres étapes consistant à :

fixer ainsi ledit moyen de fixation du carter (205) ainsi audit composant sans rotation de ladite machine à mouvement rotatif (7) ;
fixer ledit moyen d'arbre d'entraînement (201) à un réceptacle (103') du module de conversion de forme quasiment équivalente à un réceptacle d'attache (103) de ladite attache de manoeuvre (101) ;
connecter ledit moyen d'arbre d'entraînement (201) audit composant de mouvement rotatif d'entrée (102) de ladite machine à mouvement rotatif (7) en faisant correspondre ledit réceptacle (103') du module de conversion et ledit composant de mouvement rotatif d'entrée (102) de manière quasiment identique à la manière dont ledit réceptacle d'attache (103) de ladite attache de manoeuvre (101) correspond audit composant de mouvement rotatif d'entrée (102) quand ledit dispositif modulaire n'est pas utilisé ;
faire correspond ledit réceptacle d'attache (103) de ladite attache de manoeuvre (101) audit moyen de composant de mouvement rotatif traversant (102') de manière quasiment identique à la manière dont ledit réceptacle d'attache (103) correspond audit composant du mouvement rotatif d'entrée (102) quand ledit dispositif modulaire n'est pas utilisé, dans lequel ledit moyen de composant de mouvement rotatif traversant (102') est de forme quasiment équivalente audit composant de mouvement rotatif d'entrée (102) de ladite machine à mouvement rotatif (7).

14. Procédé selon la revendication 12, dans lequel ledit moyen de connecteur d'entraînement latéral (204) est sélectionné dans le groupe constitué d'une barre d'entraînement, d'une croix d'entraînement et d'un disque d'entraînement.

15. Procédé selon la revendication 12, ledit moyen de génération de mouvement excentrique (206, 206', 206", 207, 208, 209) comportant de plus au moins un moyen d'engrenage externe (206, 206', 206") fixé audit moyen d'arbre d'entraînement secondaire (207), comprenant les autres étapes consistant à :

engager ledit moyen d'engrenage externe (206, 206', 206") avec ledit moyen d'engrenage sans rotation (203) ;
passer ledit moyen d'arbre d'entraînement secondaire (207) à travers ledit moyen de connecteur d'entraînement latéral (204) ; et causant ainsi une telle rotation dudit moyen de génération de mouvement excentrique (205, 206', 206", 207, 208, 209) et dudit moyen d'arbre d'entraînement secondaire (207), du moyen de barre d'entraînement du mouvement excentrique (208) et des moyens d'arbre d'entraînement du mouvement excentrique (209) de celui-ci, à ladite fréquence du mouvement excentrique ω autour de ladite au moins une ligne centrale de rotation secondaire (212).

16. Procédé selon la revendication 12, ledit moyen de génération de mouvement excentrique (206, 206', 206", 207, 208, 209) comportant de plus au moins un engrenage multiplicateur (601, 602, 603), comprenant l'autre étape consistant à augmenter ladite fréquence de mouvement excentrique ω en utilisant ledit au moins un engrange multiplicateur (601, 602, 603), pour la rendre supérieure à ce que ladite fréquence ω serait en l'absence dudit au moins un engrenage multiplicateur (601, 602, 603).

17. Procédé selon la revendication 16, ledit connecteur d'entraînement latéral (204) comportant en outre une pluralité de couches parallèles, comprenant l'autre étape consistant à entraîner une pluralité de couches externes empilées (206', 206") en utilisant ledit moyen de connecteur d'entraînement latéral (204).

18. Procédé selon la revendication 12, comprenant en outre les étapes consistant à :

brancher lesdits moyens d'arbre d'entraînement de mouvement excentrique (209) dans ledit moyen de mouvement composite traversant (210) pour permettre ainsi un mouvement de rotation libre dudit moyen d'arbre d'entraînement de mouvement excentrique (209) à l'intérieur dudit moyen de mouvement composite traversant (210) ; et
fixer ledit moyen de composant de mouvement rotatif traversant (102') audit moyen de mouvement composite traversant (210) ; ainsi
transmettre de la sorte le mouvement comportant à la fois ladite fréquence d'entrée Ω autour de ladite ligne centrale de rotation principale (106) et ladite fréquence de mouvement excentrique ω autour de ladite au moins une ligne centrale de rotation secondaire (212) à ladite attache de manoeuvre (101) .

19. Procédé selon la revendication 12, ledit procédé ayant pour résultat le mouvement d'un point P sélectionné de ladite attache de manoeuvre (101) situé à une distance radiale R d'un centre de ladite attache de manoeuvre (101), pendant un temps t.

étant quasiment donnée par :

$$R'(t) = \text{sqrt}\,[R2 * r2 + 2Rr \cos(2\pi(G-1)\Omega t)]$$

et

$$\sin\theta'(t) = \frac{(R \sin 2\pi\Omega t + r \sin 2\pi G\Omega t)}{\text{sqrt}\,[R^2 + r^2 + 2Rr \cos(2\pi(G-1)\Omega t)]}$$

où R'(t) représente une distance radiale et θ'(t) représente une orientation angulaire dudit point P par rapport à ladite ligne centrale de rotation principale (106), dans laquelle G représente un rapport de gain d'engrenage dudit moyen de génération de mouvement excentrique (205, 206', 206", 207, 208, 209) et dans laquelle r représente des déplacements excentriques introduits par ledit moyen de barre d'entraînement de mouvement excentrique (208).

20. Procédé selon la revendication 12, comprenant en outre les étapes consistant à :

attacher un moyen d'aspiration à un réceptacle d'aspiration (85), et permettre le passage de l'air et des déchets à travers celui-ci, de ladite machine à mouvement rotatif (7); et

activer ledit moyen d'aspiration, causant ainsi la collecte des déchets produits par ladite machine à mouvement rotatif (7) et leur aspiration à proximité de ladite attache de manoeuvre (101), à travers les ouvertures d'aspiration (83) de l'attache de manoeuvre traversant ladite attache de manoeuvre (101), à travers ledit réceptacle d'aspiration (85) de la machine et dans le moyen d'aspiration.

21. Procédé selon la revendication 13, comprenant en outre les étapes consistant à :

attacher un moyen d'aspiration à un réceptacle d'aspiration (85), et permettre le passage de l'air et des déchets à travers celui-ci, de ladite machine à mouvement rotatif (7); et

activer ledit moyen d'aspiration, causant ainsi la collecte des déchets produits par ladite machine à mouvement rotatif (7) et leur aspiration à proximité de ladite attache de manoeuvre (101), à travers les ouvertures d'aspiration (83) de l'attache de manoeuvre traversant ladite attache de manoeuvre (101), à travers une ouverture d'aspiration (81) et un réceptacle d'aspiration (80) du carter traversant ledit module de conversion du mouvement rotatif (2), à travers ledit réceptacle d'aspiration (85) de la machine et dans le moyen d'aspiration ;

ledit réceptacle d'aspiration (80) du carter étant quasiment aligné avec et correspondant (86) audit réceptacle d'aspiration (85) de la machine.

22. Procédé selon la revendication 18, comprenant de plus :

un réceptacle d'aspiration (85) de la machine attaché à ladite machine à mouvement rotatif (7) et permettant le passage de l'air et des déchets à travers celui-ci ;

des ouvertures d'aspiration (83) de l'attache de manoeuvre traversant ladite attache de manoeuvre (101) et permettant le passage de l'air et des déchets à travers celles-ci ;

un réceptacle d'aspiration (80) du carter et une ouverture d'aspiration (81) traversant ledit module de conversion du mouvement rotatif (2) et permettant le passage de l'air et des déchets à travers celui-ci, ledit réceptacle d'aspiration (80) du carter étant de plus quasiment aligné avec et correspondant (86) audit réceptacle d'aspiration (85) de la machine ; et

des ouvertures d'aspiration (82) du mouvement composite traversant qui traversent ledit moyen de mouvement composite traversant (210) et qui permettent le passage de l'air et des déchets à travers celles-ci, lesdites ouvertures d'aspiration (82) du mouvement composite traversant étant de plus quasiment alignées (87) avec lesdites ouvertures d'aspiration (83) de l'attache de manoeuvre ; dans lequel

attacher un moyen d'aspiration audit réceptacle d'aspiration (85), et permettre le passage de l'air et des déchets à travers celui-ci, de ladite machine à mouvement rotatif (7); et

activer ledit moyen d'aspiration, causant ainsi la collecte des déchets produits par ladite machine à mouvement

rotatif (7) et leur aspiration à proximité de ladite attache de manoeuvre (101), à travers les ouvertures d'aspiration (83) de l'attache de manoeuvre traversant ladite attache de manoeuvre (101), à travers des ouvertures d'aspiration (82) du mouvement composite traversant qui traversent ledit moyen de mouvement composite traversant (210), à travers une ouverture d'aspiration (81) et un réceptacle d'aspiration (80) du carter traversant ledit module de conversion du mouvement rotatif (2), à travers ledit réceptacle d'aspiration (85) de la machine et dans le moyen d'aspiration ;
ledit réceptacle d'aspiration (80) du carter étant quasiment aligné avec et correspondant (86) audit réceptacle d'aspiration (85) de la machine ; et
lesdites ouvertures d'aspiration (82) du mouvement composite traversant étant de plus quasiment alignées (87) avec lesdites ouvertures d'aspiration (83) de l'attache de manoeuvre.

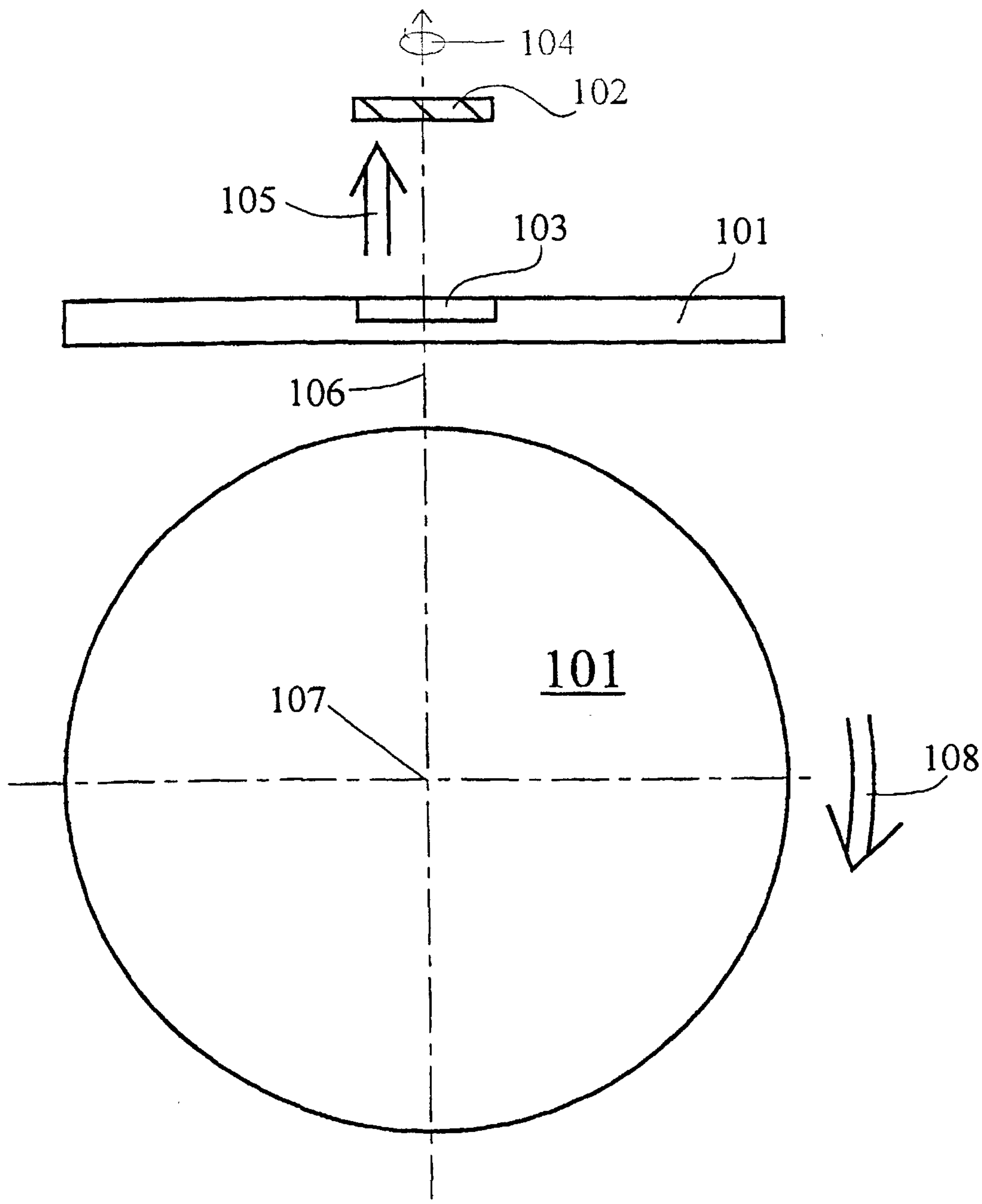
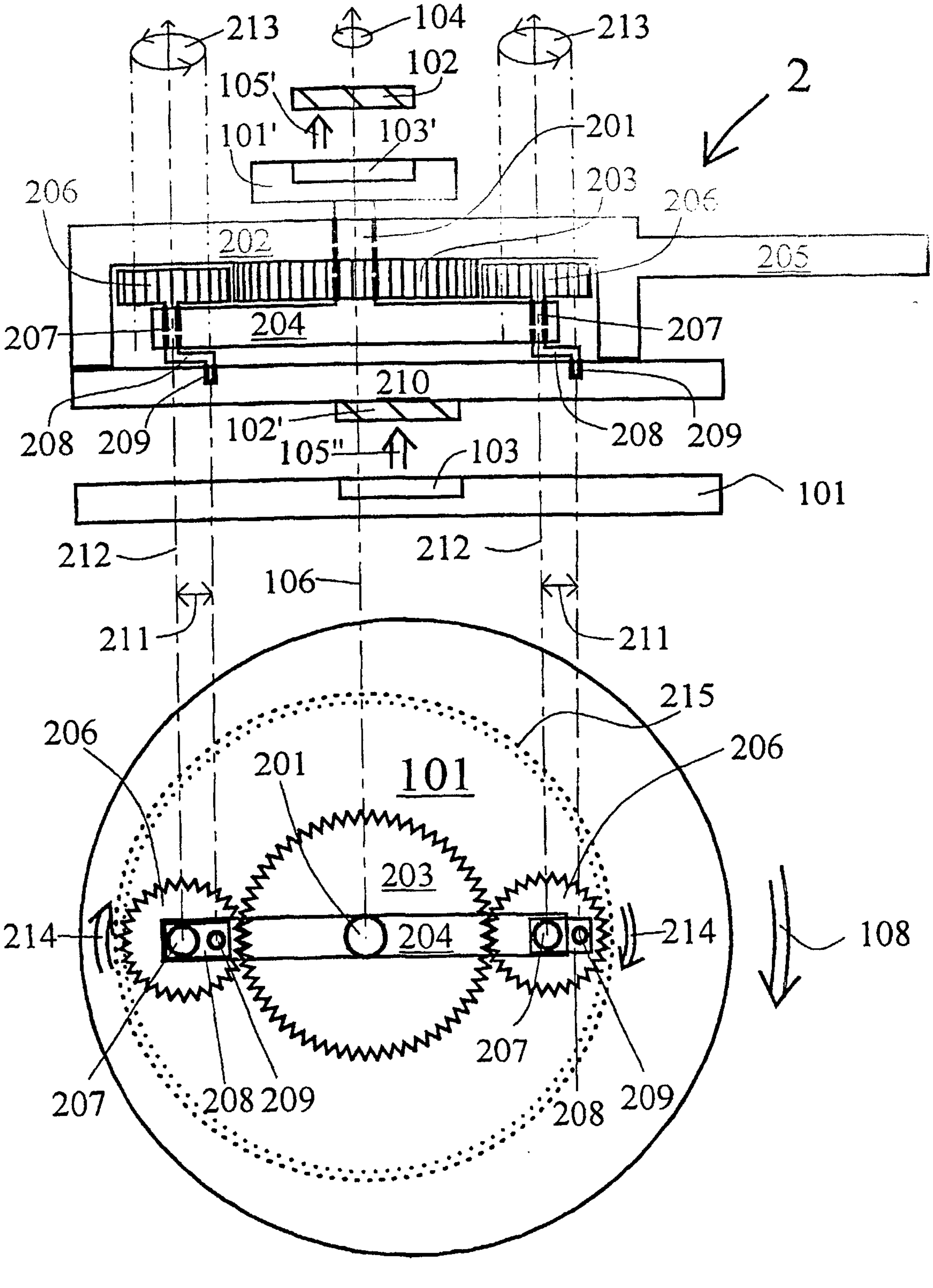


FIG. 1 (Prior Art)


213
104
213
102
2
105'
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201
206
203
206
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102'
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105''
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212
212
106
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215
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206
201
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203
214
204
214
108
207
207
208
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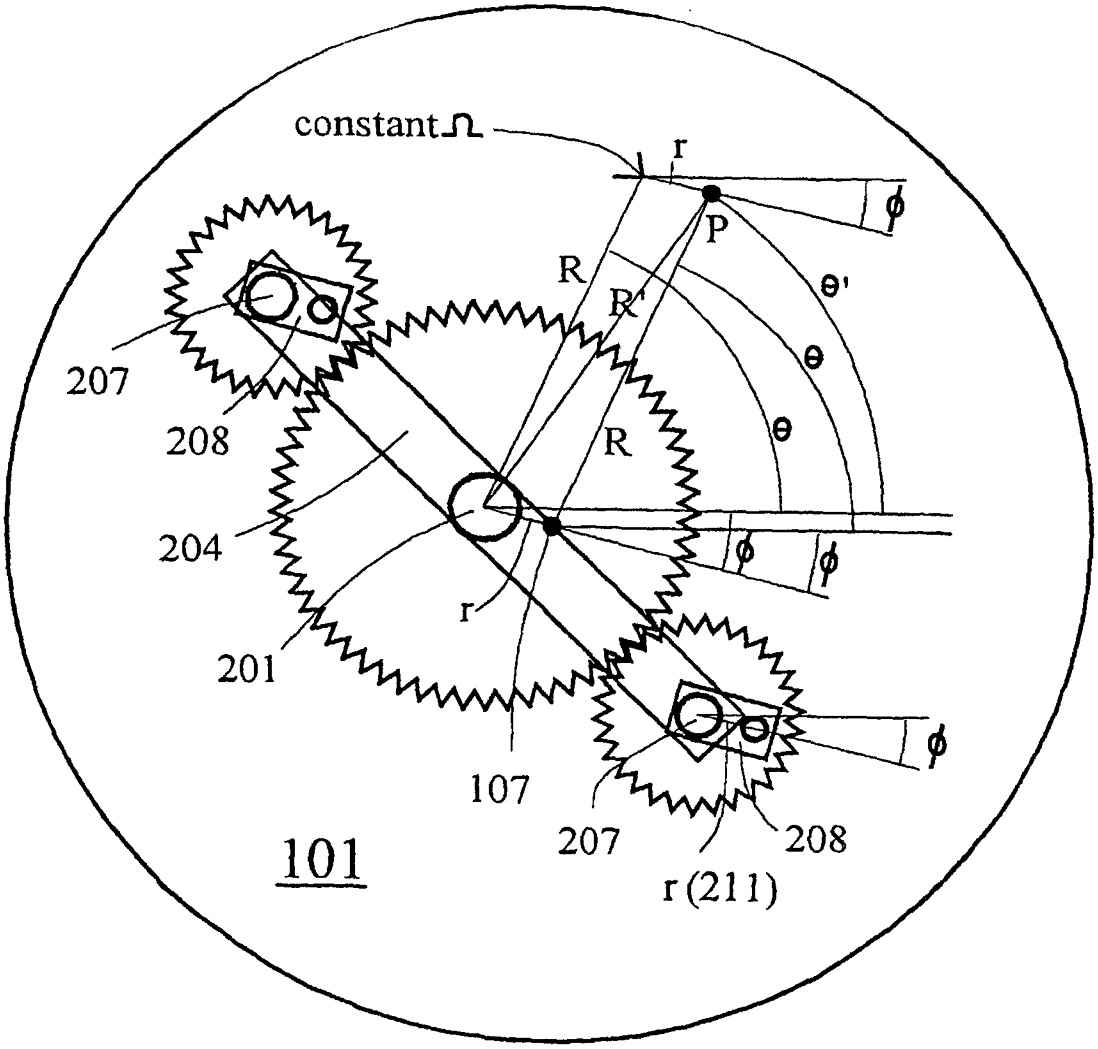
208
209

FIG. 2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r
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ϕ
R
R'
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208
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201
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ϕ
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107
ϕ
207
208
r (211)
101

FIG. 3

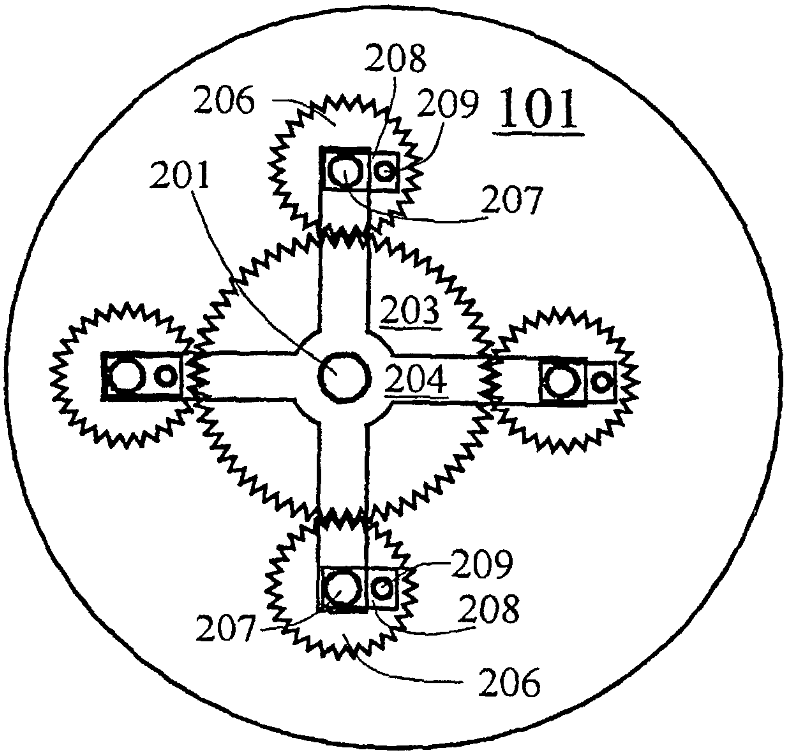
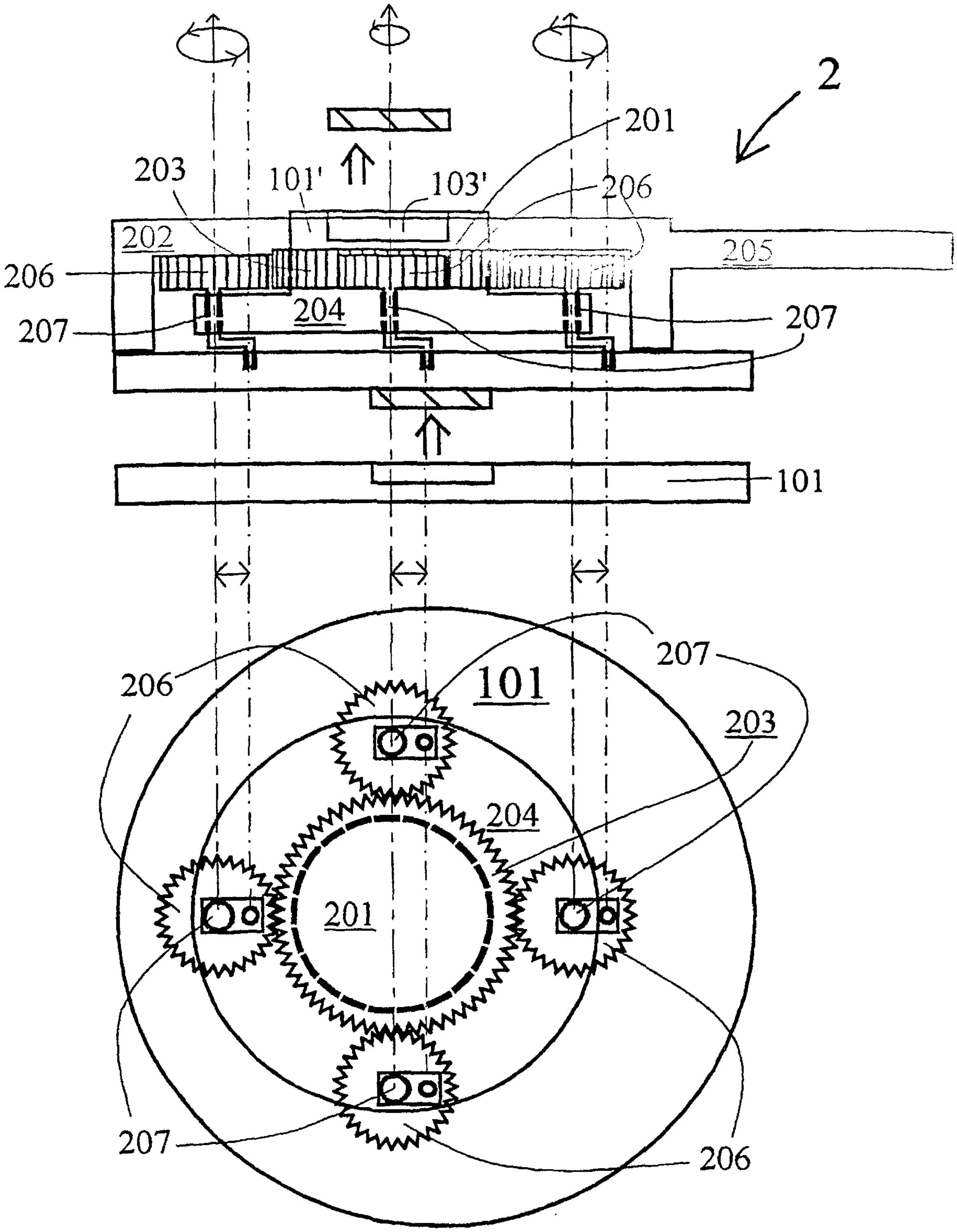


FIG. 4



2
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101'
103'
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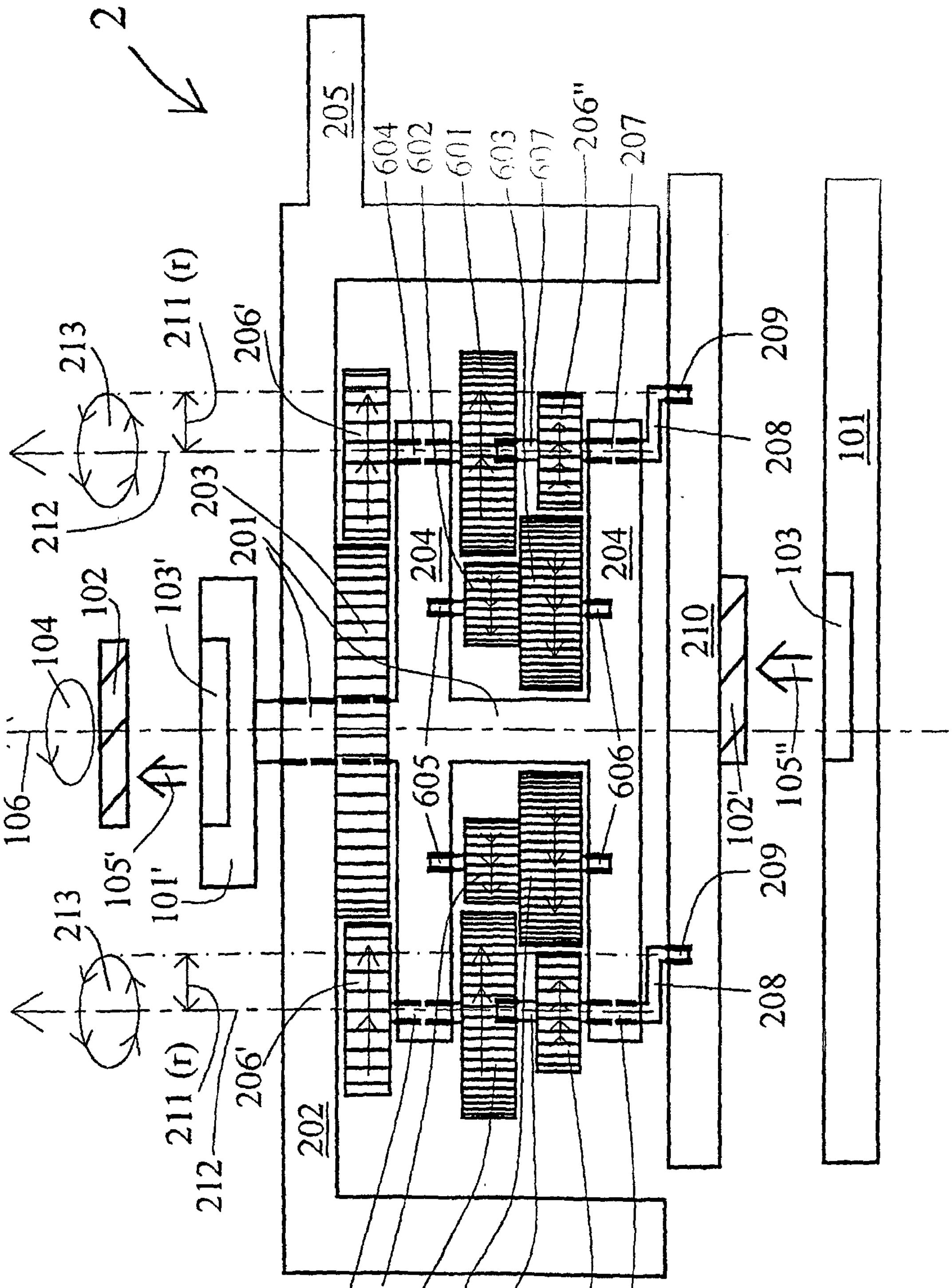
206

FIG. 5


2
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601
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607
206"
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213
211 (r)
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206'
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208
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103
210
104
102
103'
106
105'
101'
605
606
102'
105"
202

FIG. 6

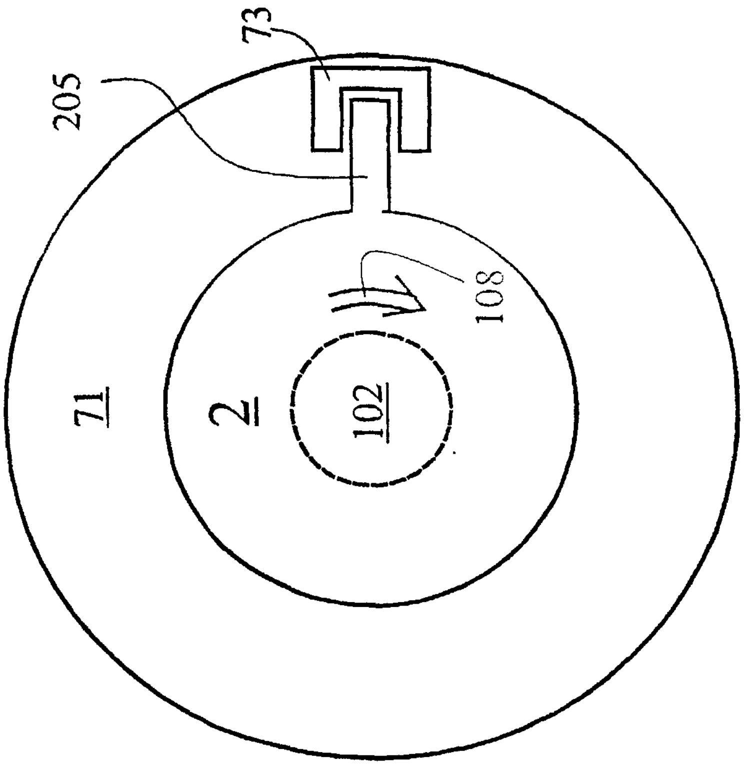
73
205
108
71
2
102

FIG. 7b

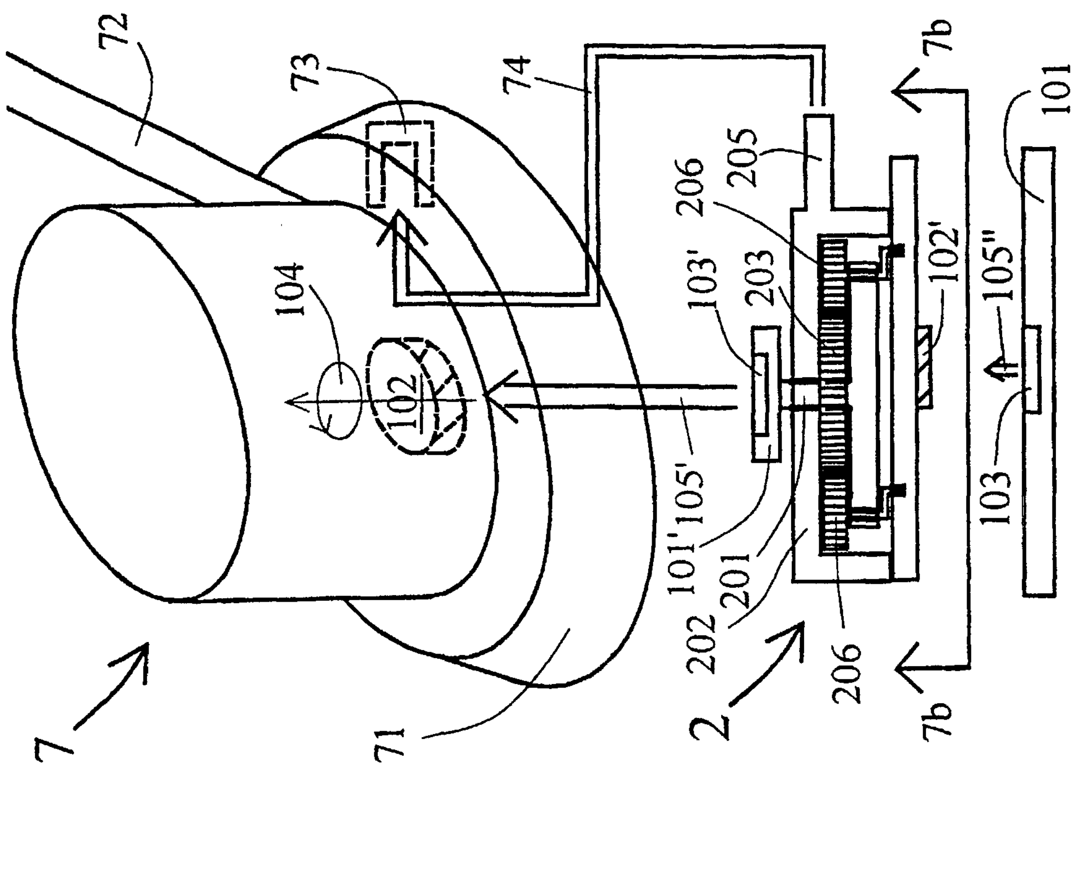
72
73
74
7b
205
206
203
103'
104
102
101
102'
105"
103
105'
101'
201
202
206
2
7
71
7b

FIG. 7a

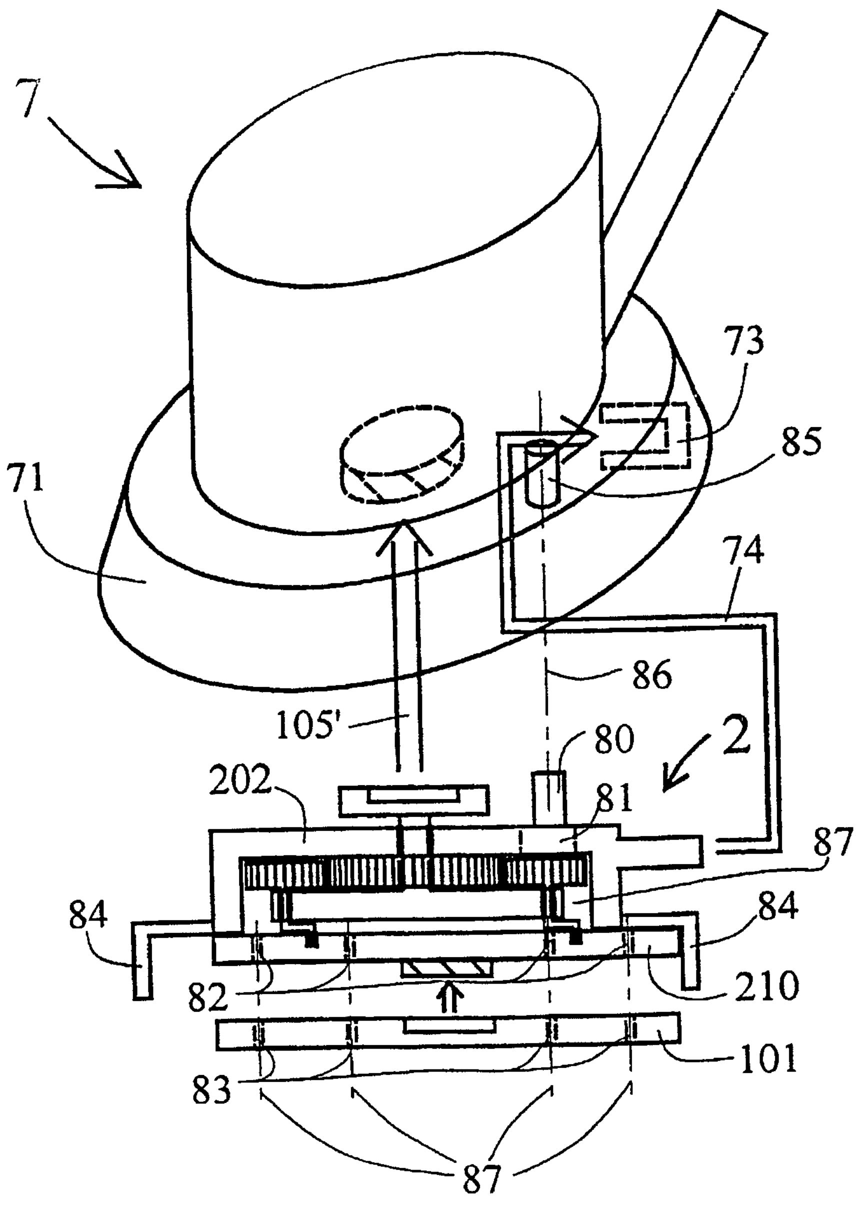

FIG. 8