Description

Title of invention: Retractable blade power transmission device

Technical area

[1] The field of invention is that of land, water or air rolling vehicles, and wheels for such vehicles, which have blades generating pressure allowing the vehicle to be propelled on hard ground as well as on soft ground or even on or in a fluid.

Technical problem

[2] Removing a vehicle from mud, sand or snow and driving on these environments has been the subject of very important research, for public works, agriculture and armaments, but no really effective solution has been proposed apart from tracks or chains which are complex, difficult to set up and maneuver, and fragile.

[3] Rolling on the water to cross rivers is still a dream, and boats still need ports, whereas if they had wheels, they could do without them.

[4] The problem to be solved is therefore to find a rustic and economical way to propel a vehicle by the same transmission device, wheels or tracks, on or in any type of environment, giving it good road or steering depending on the environment, good mechanical efficiency and great comfort.

Prior Technique

[5] The principle of retractable means to ensure the propulsion of wheels on water were invented in 2005, priority of W02007079045A2 of July 12, 2007 by MUNSHAUR TODD [US] and VAN OSDELL STEVEN [US] which describes an amphibious vehicle equipped with floating amphibious propulsion wheels with foldable pockets arranged around the surface of the wheel and oriented in the direction of rotation of the wheel.

[6] Retractable blades appeared in 2009, priority of US20090305585Al of December 10, 2010 of CHIPPAS REILLY LINDA ANN [US] which describes a tracked vehicle with vanes held in the rest position by a spring, but which can, under the effect of the current of the water, deploy to provide the aquatic propulsion of the vehicle.

[7] The automatic retraction of a blade encountering an obstacle appeared in 2011, priority of CN202337178 (U) of July 18, 2012 by MISHI WANG.

[8] The principle of a centralized control of the blade deployment is known from two documents
- CN107160961A of 15 September 2017 from LAI XIAOLI [CNI and ZHU YANHUA [CNI, which allows the vehicle to be configured to adapt it to the terrain of shallow water areas,
- and GAO SHENGYUN [CN] CNI 14619813A dated 14 June 2022 which describes a different mechanism for having a land and a water driving mode,
but neither proposes a way to automatically retract a blade or prevent it from deploying when an obstacle stands in the way of its deployment.

[9] We are also familiar with CNI 10816179A by SUN HANBING et al. of February 21, 2020, anticipated by the above-mentioned documents, which describes a wheel whose blades deploy and retract by a hydraulic mechanism. The contraction length is adjustable but it does not automatically react to the presence of obstacles.
There are also many documents describing studs and studs of tires to cling to ice or ice. These elements are not part of the technical field of the present invention because they cannot interact with a fluid or a soft medium in order to generate a propulsive force, but on the contrary only to improve the grip by their grip on solid ground such as ice or packed snow.

Brief description of the drawings

[10] The invention will be well understood, and other purposes, advantages and features of the invention will become clearer from the following description, which is illustrated in Figures I to 24.

[11] [fig. 1] is a perspective view of the constituents of a wheel according to the invention and of an assembled wheel. On the left, we see vanes 21, 22 and 23 and following in the shape of chevrons. On the right, we can see that only vanes 24 and 25 are visible, the others remaining locked in their dwellings 210, 220 and 230.

[12] [fig.2] is a perspective and cross-sectional view of the wheel in Figure 1, in which the axis of rotation of the secondary shaft 40 which determines the position of the blades is not far from the axis of rotation 10 of the wheel, with the result that the blades are all set back from the element hereinafter referred to as the peripheral casing, the external surface of which may be the tread, and do not limit the elasticity of the wheel to absorb the shocks of small obstacles.

[13] [fig.3] is also a perspective and cross-sectional view of the wheel in Figure 1 and Figure 2, in which the secondary shaft 40 is offset downwards and forwards (to the left of the figure), with the effect that the vanes at the front of the wheel give rise to a propulsive force directed more downwards than on the wheel. device shown in Figure 1 where this force is directed backwards.

[14] [fig.4] is a perspective view of two wheels IA whose blades 21 and 22 are flat and slide through the peripheral envelope 2. These blades may have sets of winter tire studs on the right. Elastic rappels 31, 32 and following push them in the direction from their retracted position to their extended position. On the left, the wheel rolls on hard ground and the lower blades are here in the retracted position, while the upper blades are in the extended position. On the right, the blades are all held in the retracted position by a device not shown. The figure also shows the blade 28 and the elastic recall 38.

[15] [fig.5] is a perspective view of two wheels according to the invention, whose receptacles 210 and following of the blades are attached only to the peripheral casing of the wheel IA. Like the one shown in the previous figure, this device is particularly suitable for airless tyres.

[16] [fig.6] is a perspective view of blades 21 22 and following similar to those shown in Figure L, each with a bearing, respectively 211, 221, 231, 241, 251 and 261 allowing their position to be determined by cooperation with a concave cam visible in Figure 7.

[17] [fig. 7] is a perspective view of a mechanism called a regulator that limits the range of possible positions of the blades according to their position in the rotation cycle of the wheel. Unshown elastic rappels push the blades to their extended positions, but this displacement is limited by the 401 and/or 402 concave cams. On the left, the concave cam 402 places them all equidistant from the primary shaft 10, while on the right, the concave cam has rotated 180 degrees and freed the blades in such a way that it is the oblong cam 401 that allows the blades of the lower part of the wheel to be more extended while those of the upper part are less or not so extended.

[18] [fig.8] is a perspective view of a vehicle equipped with paddle wheels according to figures 1, 2, 3 or 6. It is equipped with 4 wheels according to the invention and in addition to the front a 70 obstacle crossing assistance device according to the patent application FR3048404A3 of Franck Guigan [FR] of September 8, 2017.

[19] [fig.9] is a perspective view of two mechanical sub-assemblies of this vehicle. The left blade is in hard ground mode and all blades are in the retracted position, while the right blade is in water or on-water mode and the bottom blades are in the extended position. This figure also shows control 42 which allows you to change the part of the wheel rotation cycle in which the blades are to be deployed. It acts on an unshown rack that controls gears located on each wheel on the same side of the vehicle.

[20] [fig. 10] is a perspective view of three wheels IA whose blades 21, 22 and following are tire sculptures. These vanes are

- in the retracted position to the left - a position adapted to traffic at a limited speed _, which reduces the surface area of the peripheral envelope actually in contact with the ground when the power transmission device is running on flat and hard ground, thus allowing significant energy savings and a reduction in rolling noise.
- in the middle position in the centre - a position suitable for high-speed traffic - which gives the advantage of good grip, good stability in corners, a short braking distance and a high level of driving comfort, but leads to higher fuel consumption,
- and in the right-hand position, which allows you to drive on snowy or muddy ground.

[21] [fig. 11] is a perspective view of a power transmission device of a nature similar to those in Figure 10, showing the casing, which comprises subassemblies of 5001 coaxial, 5002 radial and 5003 diagonal cables intersecting at a single point 5000, and sets of blades 21 to 24 located on either side of this single point 5000.

[22] [fig. 12] is a perspective view of four sets of blades unfolding simultaneously. On the left, we see through transparency the wheel IA and the six chevron-shaped blades 21 to 26, the position of which is determined by the position of the hub 400 which can be slid along the axis of rotation of the wheel to cause them to retract or deploy. The 21 blade is connected to the 400 hub by a 2100 articulated arm and it is the same goes for the other 5 blades. The three sets on the right represent the positions of the blades for different positions of this hub, and we can see that we can fully retract the blades as illustrated by the rightmost assembly shown.

[23] [fig. 13] is a series of 3 views from the same perspective of the same device according to the

invention, whose herringbone blades have no contact and therefore no friction with the wheel IA, and are each guided by two rollers denoted 2 IA and 21 B for blade 21, 22A and 22B for blade 22, etc. which are themselves mounted on ball bearings.

[24] [fig. 14] is a series of 2 seen from different perspectives illustrating a particular mode of implementation which has a storage slot 1001 which is not the perimeter envelope 2 and receives the power transmission device when it is not in use. The wheel IA which has this peripheral envelope and the blades is stored in this storage slot in the two upper devices, is out of it in the middle ones and the blades are themselves deployed in the two lower devices. Between the two devices shown at the bottom is the separate peripheral envelope 2, from two different perspectives.

[25] [fig. 15] is a perspective view of a device whose set of blades is fixed on one of the sides of a conventional wheel whose peripheral casing constitutes the tread of the device according to the invention. On the right, we see three vehicles equipped with such assemblies, which show from left to right the lowered blades, centred on the axis of rotation of the wheel and on the right raised.

[26] [fig. 16] is a series of perspective views of a variant of the device shown in Figure 15, whose blades are flexible so that they can be folded less when not in use, in order to limit their size. On the left, they are in operation, in a low position, while on the right they are not only raised but also folded.

[27] [fig. 17] is a perspective view and then two views in two different sections of the same impeller, which includes a central part 1000 filled with pressurized air. The blades come in pairs 22A and 22B, 23A and 23B, etc.

[28] [fig. 18] is a perspective and cross-sectional view of two wheels whose moving parts, known as blades, are sculptures 21, 22 and following, which can generate or undergo pressure when moving in a fluid or soft ground. They have the particularity of having an elastically deformable part so that they are compressed so as not to protrude from the tread, when the wheel is driving on hard ground, (left) but deploy automatically when the wheel is driving on soft ground (right). This deformable part is an elastic reminder that moves a blade from its retracted position to its extended position. The sculptures are synchronized. A 60 ring acts as a regulator and rotates freely inside the tyre, and is connected to each of the blades, which are here simple treads, so that each angular position of the ring corresponds to a value of the deployment of all the treads.

[29] [fig. 19] is a perspective view of two autonomous wheels AI according to the invention. Each device has only one wheel. The one on the left is equipped with a 400 chassis which has two supports of 401 and 402 legs, and works like the devices often called gyropods or monowheels. The one on the right has a 300 rod with a handlebar 301 and two controls 302 and 303. As an option, a 304 oarlock attached to a vehicle allows the propulsion force generated by the rotation of the wheel to be transmitted to it, while allowing the handlebars to determine the direction of the thrust exerted by the device according to the invention on this vehicle.

[30] [fig.20] is a perspective and cross-sectional view of a wheel according to the invention. The

blades 21, 22 and following, located in the front part (here to the left of each of the illustrations), generate a downward force, while those located in the rear part do not cause water to rise upwards from the wheel.

They could be flat or herringbone or any other shape, but here they are curved according to the teaching of the engineer Poncelet.

[31] [fig.21] is a perspective and cross-sectional view of a part of a wheel according to the invention, in a particular embodiment, running in the trigonometric direction. At the top, we see the blades deployed, which is their resting position, on the left in full and on the right in section to see the regulator 200, at the bottom left they are retracted in the position corresponding to a hard ground, and at the bottom right they are deployed in the opposite direction during a braking. The regulator 200 ensures the synchronous movement of all blades by its possible rotation around the axis of rotation of the wheel.

[32] [fig.22] is a perspective view of another part of a wheel according to the invention, which allows us to see another form of regulator 200 which is here a circular plate with curved grooves determining the unfolding/retracting movement of blades 21, 22, 23 and following.

[33] [fig.23] is a perspective view of a particular implementation of the invention, in which blades 21 and 22 comprise so-called disc portions, respectively 2101, 2102 and 2103 for blade 21 and 2201, 2202 and 2203 for blade 22.

[34] [fig.24] is a perspective view of a caterpillar according to the invention. Blades 21, 22 and beyond are in the downside extended position, providing propulsion on soft ground or on or in the water, while the top blades are in the retracted position. The blades are shaped like a portion of a cylinder and can rotate around the axis of revolution of that cylinder, with the effect that the force that can be exerted on a blade has no component perpendicular to that axis, and that force cannot contribute to either its expansion or contraction. A weak spring, not shown, pushes each blade to unfold but this deployment is limited by belts 61 and 62. It is therefore enough to have a weak force, that of the elastic return, for the slightest obstacle to push the blade towards its retracted position.

Description of the invention

[35] [35] The invention is a power transmission device such as an IA wheel or an IB track, the cyclic motion of which drives or is driven by the displacement of a vehicle in relation to its solid, fluid or gaseous environment, comprising:

- an element called peripheral envelope 2,
- one or more cyclic pressure generating elements, hereinafter referred to as blades 21, 22 et seq.,
- a means known as deploying/retracting enabling a blade or part of a blade to deploy by moving in a direction from the inside to the outside of said peripheral envelope, and conversely to retract by moving in the opposite direction, the set of possible positions of all the parts of a blade in relation to said peripheral envelope forming a domain known as the original displacement domain of the blade in question,

characterized in that:

- when a blade encounters an obstacle, it is retracted if it is partially or totally extended and prevented from deploying if it is partially or totally retracted,
- and said power transmission device comprises a means called regulator 200 for reducing the said displacement range of a blade in relation to the original range, it being specified that a pressure generating element means an element whose orientation and geometry are designed to interact with a fluid or a loose medium in order to generate a propulsive force, unlike a tire stud whose main function is to improve grip by its grip on solid ground.

Detailed description of the invention

[36] To simplify the description, the following is called

- rotation of the power transmission device, both the rotation of the wheel in the case of a wheel and the rotation of one of its rollers or sprocket in the case of a track,
- in the case where there are more than one blade, the downstream blade of another blade shall be a blade which follows that other blade in the cyclic motion of the power transmission device, and the upstream blade shall be the one preceding it,
- and configuration a set of blade positions.

[37] In a common mode of implementation, the so-called external face of the peripheral envelope 2 is the tread of the power transmission device in such a way that, on hard ground, the vehicle rolls on this tread, while the blades come out of this peripheral envelope to propel it on soft ground or on a fluid or even in a fluid.

[38] The proposed governor 200 can, directly or indirectly, mechanically connect the vehicle with a plurality of blades. Such regulators are shown in Figures 1, 2, 3, 6, 7, 12 and 24.

[39] The essential feature of the innovation is the presence of the regulator 200 which makes it possible to limit the possible deployment/retraction displacements of the blade(s), preventing them from having all the deployment/retraction possibilities that they would have in the absence of the regulator.

[40] What is new is the combination of automatic blade travel range reduction and central control. This combination was made possible by the invention of a regulator whose function was not to determine the position of each blade, but to reduce the range of their displacement.

[41] It is this combination that makes it possible to have the best configuration, to limit the wear of the blades and that of their retractable deployment mechanisms, while optimizing mechanical efficiency and comfort in all circumstances.

[42] Since the invention of retractable blades in 2005, their improvement in 2009, and that of centralized control in 2017, we had not found a way to combine these two inventions, although it is essential to be able to determine the position of the blades while allowing them to retract automatically in the event of an obstacle and to deploy automatically when the environment on which the propulsion device is running allows it, which is also the case where this deployment is useful.

[43] The use of a regulator, which is a dynamic synchronization system for the deployment/retraction movements of the blades, allows the reduction of internal friction and a great improvement in energy efficiency.

[44] It avoids friction, reduces wear and improves the efficiency of power transmission on all types

of terrain, as well as handling and driving comfort.

[45] The innovation brought by this regulator makes it possible to optimize the configuration by dynamically and without delay limiting their range of movement, depending on the type of ground or fluid, and the mechanical stresses detected.

[46] It is a change of logic, moving from a purely reactive method that - since it was invented in 2012 - has not given anyone the idea of equipping the device with a means of dynamic synchronization of the blades, and thus to move to a method that can be predictive.

[47] This is a key innovation, as the prior art only treated the blades either reactively but individually, or collectively but non-reactively.

[48] No previous document addresses the possibility of regulating the movement of blades globally, preventing certain blades from deploying unnecessarily, and ensuring that they retract when they come into contact with an obstacle.

[49] The regulator is advantageously a purely mechanical mechanism, excluding any use of hydraulic or pneumatic technologies, to benefit from the simplicity and reliability of such mechanisms, reduced maintenance and low cost, but it is not mandatory: one or more sensors can be used to perceive part of the environment in 3D and a servo control that automatically retracts one or more blades or allows them to deploy according to the conditions met.

[50] The invention also makes it possible to couple the control of the 200 regulator with artificial intelligence for terrain recognition. Such AI can take into account the angular position of the blades (determine which blades should be retracted first), the nature of the ground or environment (detection of terrain: hard, soft, liquid or gaseous), the speed and direction of the vehicle (influencing the timing to avoid jolts), and the force applied to each blade (real-time analysis of resistance to movement). These parameters are interdependent and require an advanced algorithmic or mechanical approach that would not have been possible in 2012 or 2017 but is possible today.

[51] The simplest solution to achieve automatic retraction is for a blade to deploy under the effect of centrifugal force, and its deployment is limited or becomes impossible when it encounters an obstacle. As with the folding blade propellers of some sailing boats, which are rotated faster to open them, a blade can be deployed when the power transmission device is in or on a fluid or patina on soft ground, by giving it a cyclic movement of sufficient frequency.

[52] In order for the vanes to deploy on soft ground or on liquid or gaseous even at low velocity, it is advantageous that the means by which the blades can retract or not deploy when an obstacle prevents their deployment should be a 3:1 elastic reminder that moves a blade from its retracted position to its extended position. The resting position of a blade, the one in which it automatically places itself under the effect of the elastic recall, is therefore the extended position, but an obstacle defeats the elastic recall and causes it to move to the retracted position.

[53] The foregoing can be summarized by considering that the means of deployment/retraction of a blade advantageously involves a combination of the centrifugal force that is applied to it during its cyclic movement, and an elastic return counteracting or increasing the effect of

this centrifugal force.

[54] The prior art documents set out solutions for moving vehicles slowly over soft or liquid ground, but they did not envisage high speeds. The means cited to obtain the deployment of a blade are limited to a spring-pack or motorized solutions.

[55] Since the invention of retractable paddle wheels in 2005, no one has found a way to get the blades out by operating only the throttle, without any special mechanism. The centrifugal force is however sufficient because it increases with the square of the speed, and the advantages are immense in terms of simplicity, rusticity and therefore cost price. Completing the device with an elastic reminder also ensures rapid retraction in contact with an obstacle or hard ground, even at high speed.

[56] An improvement consists in equipping the power transmission device with a means of adjusting the elastic resistance of this elastic reminder or the elastic reminder 3 1 (not shown), so that an operator or a computer can adjust it by means of a control device. This makes it possible, for example, to have a smooth clincher wheel to save energy when driving on a dry asphalt road, and to deploy blades when necessary.

[57] In order to prevent the vanes from deploying unexpectedly, and it may be necessary if the mass of the blade is too large for the speed of the cyclic movement of the power transmission device, to equip this device with a means of locking a blade in the retracted position. It is also possible to design a blade in such a way that the centrifugal force is reduced, for example with a counterweight or by tilting its trajectory in relation to the radius of the wheel.

[58] It is advantageous if the weight of a vehicle is sufficient to cause the blade(s) to retract in contact with hard ground, even at the maximum frequency of the cyclic blade movement. It is recommended that even the curb weight is sufficient for this.

[59] This is indeed an important rule to respect for the system to work. Since no one had considered using retractable paddle wheels to drive at high speeds on soft ground or on or in water, this feature was never proposed.

[60] What is most inventive is to have considered using retractable paddle wheels to drive very fast on soft ground or water.

[61] The deployment and retraction of a blade is advantageously done by sliding or rotating in all or part of the peripheral envelope. This displacement can be linear or curvilinear or rotary. It is advantageous that it follows a fixed trajectory in the peripheral envelope, i.e. without changing the angle of exit of the blade with the external surface of the peripheral envelope, which makes it possible to limit the size of the hole made through the peripheral envelope and therefore the possible entry of foreign bodies into the device.

[62] To limit friction, the blades are advantageously guided by rollers that can be mounted on ball bearings, as shown in Figure 13. In a simpler version, these ball-bearing rollers can be replaced by washers or bearings made of plastic materials with a low coefficient of friction, e.g. PTFE (Polytetrafluoroethylene or also called Teflon), POM (Polyoxymethylene also called acetal or Delrin), PEEK (Polyetheretherketone) or UHMWPE (Ultra-High Molecular Weight Polyethylene).

[63] The skilled person knows how to equip the power transmission device with means to prevent foreign bodies from slipping between the vanes and the fixed parts power transmission device, for example lips made of flexible and waterproof material or brushes. It can alternatively provide for clearance between the blades and the fixed parts that guide their deployment/retraction, and allow the expulsion of foreign bodies through its side walls.

[64] Figure 13 shows one such solution, which consists of leaving a gap between the blades and the tread, and providing openings in the side walls to allow mud and other foreign objects to escape.

[65] It is advantageous that a blade does not retract under the effect of a force applied to it, giving rise to a component favouring or disfavouring its cyclic movement, in the two directions of travel known as forward and reverse, if this component is less in the direction of forward than a first predetermined threshold, and in the direction of reverse to a second predetermined threshold. This force does not have to be parallel to the surface of the raceway. The designer of the device can freely determine the minimum angle of this force in relation to the surface of the raceway, taking into account in particular the forces associated with the retraction of the blade, and design the architecture of the device accordingly.

[66] The skilled person has many means at his disposal to prevent a blade in the extended position from moving into the retracted position under the effect of a force tangential to the external face of the peripheral casing applied to it, in the two directions of travel known as forward and reverse:

- if the blade retracts and deploys by sliding, the trajectory is perpendicular to the force
- if the blade retracts and deploys by rotation, the tangential force does not give rise to a rotational moment applied to it because the force exerted on the deployed part of the blade is aligned with its centre of rotation as shown in Figure 20.

[67] The rotation of the blade caused by a force with a tangential component can also cause it to hit an obstacle that prevents its retraction.

[68] The power transmission device can be equipped with blades of several different kinds. A blade can have all kinds of possible shapes (not shown), for example a flat surface parallel to the axis of rotation of the power transmission device, a set of surfaces forming a rafter, a portion of a sphere, depending on the intended use.

[69] The face of a blade arriving at the surface of a gaseous medium, liquid or soft ground is advantageously concave to cause the greatest possible resistance and therefore have the best possible propulsion. This leads to a direction being favoured as forward since the face arriving at the surface is not the same in reverse.

[70] In particular, a blade may have a rounded shape instead of a radial one, such as those shown in Figure 20, known as Poncelet vanes, which were developed by the engineer Poncelet and could have an efficiency of up to 80%. For the propulsion of vehicles, it may be preferable to make them work in reverse of what was proposed by this engineer

[71] This Figure 20 also illustrates the fact that, even without being rounded, a blade is advantageously angled from a radial position when extended, exerting a downward force

as it descends into the forward portion of the power transmission device, and causing little fluid or soft ground to rise as it rises into the rear portion of the device.

[72] Driving on water as on land is a very old dream, and all that the previous art proposes is to arrive at high speed on the water with a vehicle equipped with paddle wheels (the equivalent of blades) through a very gentle beach, and to try to go as far as possible, but as soon as the speed drops, the vehicle stops and can no longer start again under its own power. So it's not a solution.

[73] Using large pallets is not a solution either because you can't drive in good conditions if the blades are too big. This became possible with retractable vanes, but although they had been known for several decades, no one had thought of tilting the blades, which makes it very easy to overcome the speed at which the wheels hover over the surface of the medium on which they are rolling, and then to roll at high speed on the surface of soft ground or liquid, Because it allows you to replace the propellers with wheels where only the tips of the blades ensure the propulsion of the vehicle at high speed and support its weight.

[74] In a version not shown, a blade or part of a blade may tilt after it is deployed under the effect of the pressure exerted by its interaction with a fluid or soft soil. A blade can be deformable, for example flexible, to achieve the same result.

[75] The blades can also be telescopic to be longer when deployed, and/or hinged to change shape when deployed.

[76] Advantageously, a blade 21 has at least one portion of a disc located in a plane perpendicular to the axis of rotation of the power transmission device. This has the advantage of promoting the displacement of the power transmission device in this shot, like a rudder or the drift of a boat.

[77] This innovation is essential when you want to use large-area vanes and ensure that the vehicle has sufficient steering at high speeds.

[78] It was never offered, even though retractable paddle wheels were invented a long time ago.

[79] In a preferred solution, the vanes are designed so that, when all retracted, all of the vanes' ends and their disc portions form a means of continuous contact of the power device with the ground.

[80] This prevents the deployment of a blade when the vehicle is driving on hard ground by maximizing the portion of that blade that is in contact with the ground.

[81] We will see later that this innovation is also a condition to allow all the blades to retract automatically and quickly when the vehicle is driving on hard ground. This is essential to drive at high speed on the road without the blades deploying between two contacts of a blade with the ground, which would generate premature wear, vibrations and noise, and degrade the vehicle's handling.

[82] The deployment and retraction of a blade may also increase or decrease the surface area of the outer face of the peripheral envelope of the power transmission device and/or the circumference of the power transmission device, as shown in Figures 10 and 11.

[83] The same tyres can now be used in summer, at high speeds on dry roads, as well as on mud or fresh snow.

[84] This is an unexpected implementation of retractable paddle wheels. The man of the art only envisaged using it to allow vehicles to travel at low speed in rice fields or in water.

[85] This innovation can indeed be used to modify the surface condition of the outer face of the peripheral envelope of the power transmission device, as shown in Figure 21 which illustrates a particularly advantageous implementation of the invention in the case where the power transmission device is a wheel. Blades 21, 22, 23 and 24 can rotate around stops 201, 202, 203 and 204 respectively.

- Their resting position is displayed as shown in the top two illustrations. This position of the dawn is only possible when the ground is loose or liquid. When the vehicle accelerates, the part of the blade that is farthest from the wheel's axis of rotation on the ground exerts greater pressure on the ground, and the extended position can be maintained on less soft ground.

- At the bottom left, we can see that, when the ground is hard, its pressure on a single blade causes it to rotate so that the part furthest from the wheel's axis of rotation comes closer to it. Its outer face then comes closer to the tread and can be advantageously blended in with it. The blade thus switches to the retracted position.

- When the vehicle brakes, the blade deploys by tilting in the opposite direction, as shown in the illustration at the bottom right. The part of the blade that then comes out of the peripheral envelope may have special characteristics that increase braking capacity, and have studs (not shown), which only come out after a large deployment. Sudden braking can thus make it possible to bring out these studs and immobilize a vehicle on the ice.

This figure illustrates what is meant above and below by the range of displacement of the blade in question: it is not the set of possible distances between a blade and the axis of rotation of a wheel, but the set of positions that the different parts of a blade can have in relation to the said peripheral envelope.

The range of a dawn here includes all its possible positions between its three positions that have just been described. The rotation of the governor reduces this range of displacement by forcing all the blades to take only one of these possible positions in their respective displacement ranges.

[86] Some regulators are advantageously mechanically connected to the blades.

[87] Several types of regulators are available: those of a first type allow all the blades to be deployed and retracted simultaneously, those of a second type allow the blades to be deployed more in part of their cycle, those of a third allow to limit the displacement of a blade during part of the cycle, for example between two successive contacts with the ground.

[88] As shown in Figure 21, a regulator of the first type can move forward or backward slightly in rotation with respect to the peripheral envelope to simultaneously change the position of several blades, in this case of all the blades.

[89] This 200 regulator can also be in the form of a cable or a lanyard. The latter can be in the shape of a ring in the case where the power transmission device is a wheel.

[90] The blades are advantageously held elastically in a resting position, but simultaneously retract

or deploy when the angular position of the regulator in relation to the power transmission device is changed.

[91] Such a regulator can be equipped with vanes which are tread patterns like those of snow tires. In the resting position, a blade protrudes from the tread, but when the ground is hard, the force exerted by the ground pushes it inward from the tread, causing the governor to rotate in one direction, and this simultaneously causes all blades mechanically connected to the governor to retract.

[92] In this mode of implementation, an acceleration of the torque applied, for example by a motor, to the power transmission device when it comes into contact with the ground gives rise to a force tending to move the governor in relation to the peripheral envelope, and this advance leads to the deployment of one or more blades if such a displacement is possible.

[93] An improvement is that moving the governor in the opposite direction to the perimeter envelope causes the blades to retract or deploy another portion of the blades, which may be designed to increase the braking capabilities of the power transmission device. This second part of the blade can, for example, be made of a particular rubber and/or include studs. These studs may only come out for a greater recoil of the governor.

[94] Advantageously, such a governor has the effect that all the blades are retracted or deployed simultaneously, and that there is therefore no friction between a governor and the blades on the one hand and the rest of the peripheral envelope as long as the vehicle travels on the same type of terrain without accelerating or braking significantly.

[95] When a blade encounters an obstacle such as hard ground, it is probable that the downstream blade will also encounter this obstacle shortly afterwards, and that the same will be true of all the blades arriving one after the other in contact with this obstacle. Retracting all blades simultaneously limits wear and tear on their retractable deployment mechanisms, while optimizing mechanical performance and comfort in all circumstances.

[96] In combination with the innovation described above, which consists in designing the blades in such a way that, when they are all retracted, all of their ends and disc portions form a means of continuous contact of the power device with the ground, a very important advantage is obtained, which is that when a blade encounters an obstacle such as hard ground, the downstream blades are retracted at the same time as it. This is an example of the implementation of the major innovation of the present invention, the reduction of the displacement range of a plurality of blades, which is here a temporary reduction.

[97] An important advantage is that this synchronization makes it possible in particular to anticipate the impact by taking into account the position of the blades before they hit an obstacle.

[98] The combination of these two innovations, which are each very far from what is obvious to the man of art, is therefore particularly inventive.

[99] The device described above can be integrated into the design of a wheel or tyre, the assembly formed by the governor and the blade(s) being placed in a circular groove made in the outer face of the peripheral casing.

[100] It can also be an accessory that is attached to an existing wheel, like attaching chains, but with the advantage that the blades only come out when the vehicle is driving on soft

ground and retract automatically as soon as the ground becomes hard.

[101] Regulators of the first type may also have the form of a part of a disc, as shown in Figure 22, which rotates in one direction when the blades are deployed, but rotates in the other direction when only one blade touches the ground, which leads to its retraction and that of all the others.

[102] The second type of regulators allow a blade to be more extended in one part of the cycle, and less extended or retracted in the rest of the cycle.

[103] No prior art document has described blades that are retracted in any part of the cycle. However, it is a very effective method of navigating the water without being slowed down by waves that would pass over the wheel and push the boat in reverse, or to direct the movement of a submarine in all directions. This is an innovative example of the implementation of the major innovation of the present invention, the reduction of the displacement domain of a plurality of blades, which is here a sectoral reduction.

[104] In one of the possible configurations, a blade is in a more extended position in a lower part of the power transmission device to exert a thrust parallel to the surface on which the vehicle is travelling, to move it parallel to that surface.

[105] It is made possible by the present invention to overcome very easily the speed at which the wheels hover over the surface of the medium on which they are rolling, by using as shown above retractable vanes inclined with respect to a radial position when extended, but it is also possible by arranging the vanes, as shown in Figure 3, so that one blade is in a more extended position in a lower/forward part of the power transmission device.

[106] These two innovations, which have never been described, have two advantages. The first is to give rise to a force directed more downwards during the cyclic movement of the device in forward motion, which can make it possible to extract a vehicle from the mud, to push a vehicle navigating on water upwards in order to reduce its drag, or even to make it take off and fly in the air. The second is not to generate any downward force in forward gear by moving the blade in the low/rear part of the power transmission device, which has no propulsive effect but consumes energy by raising the fluid or soft ground on which the vehicle is travelling.

[107] Like the previous innovations, this one could have been implemented by the man of the art as soon as the invention of retractable vanes, and was not because it was far from obvious to him.

[108] For a sailing boat, or a towed land machine, a downward thrust can be obtained by reversing the forward/backward orientation of such a wheel or track. It is then the rear part of the transmission device that gives rise to an upward thrust, especially if its cyclic movement is slowed down.

[109] Several regulators of this second type are proposed.

[110] For example, a regulator may have a secondary shaft 40 parallel to the axis of rotation of the power transmission device, not confused with the axis of rotation of the power transmission device, as shown in Figures 1, 2, and 3. When the wheel is motorized by a shaft connecting a motor to the wheel, it is difficult to place the governor hub in the axis of

rotation of the wheel if this hub does not have a central obviously allowing the shaft connecting this motor to the wheel to pass (or if the hub of the wheel does not have a central obviously allowing the secondary shaft to pass through). The regulator hub is more cumbersome in this mode of implementation and can also be more expensive to manufacture, especially if it has ball bearings. One solution may be to place it on the side of the wheel opposite the vehicle frame as shown in Figures 15 and 16. Advantageously, the motor of a device according to the invention is located in the power transmission device itself. In a particularly advantageous mode of implementation, shown in Figure 19, the wheel no longer has a shaft to connect to the external drive hub, and the governor hub can be located in the axis of rotation of the wheel to determine the position of all the blades, while being located on the side of the wheel connecting it to the vehicle frame. It is also possible to use a wheel without a hub driven by its rim, to obtain the same advantage.

[111] A governor may also have a cam cooperating with a follower or a tappet, for example one or more fixed cams 401 and 402 as shown in Figures 6 and 7. The skilled person can use both concave and convex cams, or sets of both types, to change the position of the blades during the cycle.

[112] The deployment/retraction movement of a blade can also be controlled by a regulator implementing any system for transforming a rotary movement into a linear motion such as rack and pinion, screw-nut or connecting rod and crank for example.

[113] The architecture just described for the different types of devices according to the invention can be reversed without going beyond the scope of the present invention: it may be the rotation of the blade(s) or their deployment/retraction mechanisms that drives that of the peripheral envelope 2.

[114] The regulator can advantageously deform elastically and/or have flexible parts. This elasticity can also be used as the so-called elastic return 31 means allowing the vanes to be retracted when an obstacle prevents them from being deployed during the cycle, or the elastic return means opposing centrifugal force to avoid untimely deployment of the blades for a high rotational speed.

[115] It is a particularly simplified and rustic implementation of the present invention, never before envisaged.

[116] In a cost-effective version in many cases, not shown, the Regulator 200 may feature a cable consisting of a flexible sheath and an inner cable that slides inside the sheath and operates by pull or compression. This makes it possible to transmit mechanical movement over a certain distance, while adapting to non-straight routes thanks to its flexibility and has the advantage, in the case of airless tyres, of being compatible with the chosen shape of the connections between the hub and the tread.

[117] In order to limit the displacement of a blade during a part of the cycle, for example between two successive contacts with the ground, a device according to the invention comprises a means of damping the displacement of a blade with respect to the peripheral envelope. The advantage of this innovation is that a blade does not have time to move much between two successive contacts with the ground. It is also possible to equip the

device, according to the invention, with a means of preventing a blade from extending or retracting outside the part of the cycle during which it is in contact with the ground (versions not shown).

[118] Such damping is advantageously present on all types of regulators.

[119] Several different types of regulators can be combined with each other, the one shown in Figure 12 being able, for example, to slide along the secondary shaft 40, this sliding being used to define the average deployment of one or more blades, and the decentring of the secondary shaft 40 to determine a sector of the cycle in which the blades in question may be more extended than in another.

[120] The present invention is particularly suitable for power transmission devices comprising a so-called "airless" tire or track because their deformability is obtained by multiple elastically deformable connections between the tread on the one hand, and a hub in the case of a wheel or the support wheels in the case of a track on the other.

[121] In this case, all or part of the assembly formed by a blade and its mechanical connection with the deployment/retraction mechanism is advantageously placed between two of these links.

[122] Placing blades between their deformable bonds is a very important improvement in airless tyres. The combination of these two innovations brings both the comfort of the tires and the propulsion capabilities of the blades.

[123] These elastomer connections are often inclined to an axial plane perpendicular to the tread, either forward or backward, in planes close to each other. Such an inclination of the links has the advantage of increasing the flexibility of the tyre. In this case, the blades slide along a median plane between these two planes.

[124] The present invention is also adapted to tracks made according to the same principle of elastomer connections ensuring good deformability of the tracks, allowing high-speed circulation.

[125] Without going beyond the scope of the invention, a wheel according to the invention can be equipped with one or more circular flanges allowing it to roll on the ground. The same applies to a track according to the invention which would be equipped with an auxiliary track supporting part or most of the weight of the vehicle. Wheels or parts of wheels located between the power transmission devices according to the invention can be inflated at low pressure or made of very flexible materials to ensure a comfortable ride and efficient propulsion on uneven ground. This also applies to tracks or track links.

[126] Figure 5 illustrates a particularly advantageous implementation. The left wheel has blade extension/retraction controls (51 for blade 21) while the right wheel does not, the blades being either each positioned according to an autonomous deploy/retract device.

[127] The 210 housing in which a blade is retracted is advantageously attached only to the peripheral envelope of the power transmission device. This preserves the flexibility of the peripheral envelope. These housings can be rigid, which promotes blade deployment with low friction.

[128] The retraction of a blade in order not to generate an unwanted force in a part of the cycle

on a fluid or soft ground implies the presence of a peripheral envelope in which the blade can retract, but this peripheral envelope can be distinct from its storage location as shown in Figure 14. Peripheral casing 2 can be flexible or equipped with an elastic coating like a tyre (version not shown).

[129] The principle illustrated in Figure 14 also shows how a device according to the invention can be embedded in the body of a land, water or air vehicle, only to come out of it when it is put into service, in the same way as it comes out of the tread here.

[130] The device according to the invention thus makes it possible to propel a land vehicle whose wheels are totally submerged, a submarine, or a land vehicle or a boat that becomes a submarine. This also makes it possible to use wheels according to the invention with existing vehicles undergoing only a slight transformation, preventing the blades from hitting the wheel arch in the bodywork. This can be achieved by many means available to the skilled person, for example a stop attached to the vehicle chassis preventing the deployment of the blades in the upper part of the perimeter envelope 2.

[131] A power transmission device according to the invention may be an accessory to a conventional wheel or track. This device according to the invention can be removable, and can only be installed in case of necessity, for example when the vehicle is stuck in the mud or has to cross a river. In this case, the set of blades is an accessory fixed on one of its sides as shown in Figure 15.

[132] Advantageously, a plurality of blade assemblies are attached to a plurality of wheels on the same side of a vehicle, and are connected by a connecting element which constitutes the fixed part of each of the power transmission devices considered (version not shown).

[133] A blade can be rigid or flexible, and can advantageously be bent and stowed in a position that limits the size of the vehicle and the proximity of the blades to the surface on which the vehicle is travelling, as shown in Figure 16.

[134] A device according to the invention may also comprise one or more parts comprising blades, and one or more parts which are conventional tyres, which makes it possible to benefit from the advantages of the invention and the lightness of inflated tyres. Figure 17 illustrates this implementation and shows a wheel with a 1000 gap inflated by pressurized air.

[135] A conventional track can have vanes organized like those of a wheel depending on the invention, the track constituting the peripheral envelope of the device. The blade assemblies can be placed next to the track or in the same volume if the track is equipped with holes allowing the vanes to pass through. Each set of blades may be equipped with a wheel, and each wheel may be one of the track rollers (not shown).

[136] A power transmission device according to the invention may also be a track attached to the periphery of a conventional wheel, or of several such wheels, or of an existing track (not shown). Advantageously, the deployment of a blade does not deform the peripheral envelope. A blade can pass through the peripheral envelope as shown in most figures.

[137] To maintain the physical continuity of the peripheral casing and its watertightness, or for other reasons, a blade may also be located inside the outer face of the tread and deform it

without passing through it by pressing on its inner face when it moves to the extended position.

[138] It may also be embedded in this retracted tread without passing through it and move away from it towards the outside of the power transmission device in the extended position as shown in Figure 21.

[139] The travel of a blade can be greater than that from the retracted position to the extended position, both towards the inside of the peripheral envelope to reach a position called extreme retraction, and towards the outside to reach the a so-called extreme deployment position.

[140] The assembly consisting of a blade and its deployment/retraction mechanism can, in one of its possible positions, be located in part in the internal volume of the peripheral envelope.

[141] The extreme retraction position may, for example, correspond to the fact that all the blades are placed in a position in which they are not united in cyclic motion of the peripheral envelope (not shown).

[142] The extreme extension position can, for example, cause the studs to come out of the blade.

[143] A gyroscope or other known means can be used to determine the position of the device in space to determine the position in the cycle of a blade, but in a simplified version, the governor can be mechanically linked to the vehicle, and use the vehicle as a reference point to determine the position in the cycle of a blade. The machine according to the invention therefore comprises in the latter case the fixed part of the regulator which does not rotate with the wheel or the track as the case may be, and optionally a means of modifying the configuration and/or a means of adjusting the elastic resistance of the elastic reminder 31.

[144] [144] The vehicle may also be equipped with a means of controlling one or the other of these means of modification and adjustment, which may be operated by a person or by a computer. The person or computer in question can be placed on or outside the vehicle, for example by using remote control means, without going beyond the scope of the present invention.

[145] An elastic means may be provided so that, when a blade has been placed in its position of extreme retraction, retracted, extended or extreme extension, it remains in equilibrium. In either of these two cases, the function of the regulator or other mechanical means may be to place a blade in either of these equilibrium positions. This solution is one of the proposed means of keeping all blades in a stable position during the whole cyclic movement of the power transmission device, without friction between the blade and another part of the power transmission device.

[146] For example, fixed magnets or electromagnets can be used to push the blades into or hold them in the retracted position in part of the power transmission device, and other magnets or electromagnets to move the blades to the extended position on command. These magnets or electromagnets can be located at unique locations along the cycle. Magnets can be moved to be active or inactive or flipped to have the opposite effect. A single electromagnet may be sufficient to move the blades from the retracted position to the extended position or vice versa.

[147] Depending on the configuration, the blades can be for example:
- either all in the retracted position,
- either all in the extended position,
- either those which are in a part of the cycle in a more extended position, and those which are in another part of the cycle in a less extended or retracted position.

[148] A particularly advantageous implementation is illustrated in Figure 19. The device according to the invention shown on the left is a constituent of a Segway. It is equipped with a 400 chassis that has two foot supports and can function like vehicles often referred to as single-wheelers.

[149] The one shown on the right allows a swimmer or a floating device to be pulled or pushed on the water or in the water by the AI wheel, or on skis on snow (it is then a personal ski lift that can be equipped with a saddle), or on roller skates or skateboarding on a road. The direction is determined by the tilt of the 301 handlebars to one side or the other. Controls 302 and 303 control the speed of the device's cyclic movement and configuration. For safety, as soon as you let go of the handles, the engine stops. In a liquid or gas, you can freely choose the orientation of the propulsion forward, up, or down. Instead of having a control means to determine the configuration, the user can simply tilt the power transmission device forward or backward. Simple handles attached to the device shown on the left (not shown) can in this case allow a swimmer to do this maneuver work.

[150] This autonomous wheel device is advantageously equipped with control means similar to those of one- or two-wheeled Segways. It can be remotely controlled or even managed by a computer, which can use artificial intelligence. In the latter cases, it can be commanded to follow the pilot when he no longer needs to be towed by the Segway. A simple rope can also be enough to pull a person or a land or water device. To tow a heavy machine, several of such devices can be combined in series or in parallel.

[151] Reversing may involve the manual or even automatic reversal of the part of the power transmission device cycle in which the blades are in the extended position, by a means that can be easily designed by the skilled person.

[152] To allow a large number of blades to deploy simultaneously, the deployment of one blade may result in the deployment of another blade and its retraction may result in the retraction of another blade. The man of the art knows many ways to achieve this result, whether the objective is to drive a nearby or distant dawn.

[153] This makes it possible to simplify a regulator, but also makes it possible, in the implementation illustrated in Figure 18, to retract all the tread patterns 21 22 and following when only one, the one in contact with a hard ground, is pushed by the ground in the retracted position. Similarly, it is enough for a sculpture in contact with the ground to encounter a soft ground such as powdery snow, for all the sculptures to move into the deployed position. This is how, without any complicated mechanism, a tyre switches from a summer configuration to a winter configuration and vice versa.

[154] Figure 18 illustrates a particularly advantageous device: a tyre that automatically transforms into a snow tyre as soon as the ground becomes soft, but returns to its classic

structure when it returns to a cuttlefish road. A very important advantage is that, once the configuration of the sculptures has been changed in this way, there is no longer any friction and no more wear during cyclic movement of the power transmission device.

[155] The spring that pushes the entire sculpture into its extended or retracted position can be placed in multiple possible locations. There can be a spring between each tread pattern and the base of its location in the tread, as well as a single spring or more springs rotating the 60 ring so that all the tread patterns are deployed. A command such as those described in Figure 12 allows you to force the tread to extend or retract.

[156] The man of the art can obviously combine several devices such as those described above, to be able to deploy or retract different types of blades, sculptures or other elements. The controls of these devices can be separated or coupled.

[157] It is advantageous to be able to change the nature of a blade according to the extent of its deployment. For example, the deployment of a tyre tread pattern may, if it is larger, cause studs to protrude from the tread in question. More generally, the deployment of a blade can thus lead, in one part of this movement of deployment, to the deployment of another blade of the dawn under consideration, in one or more different directions. The skilled person has many known means of achieving this, and this can make it possible to deploy blades with a larger surface area than that of the blade considered when it is in the retracted position. Different parts of a blade can also be deployed in different directions to provide a larger bearing surface on the medium in or over which the vehicle is moving (versions not shown).

[158] Wide tyres or tracks have the advantage of good grip, good stability when cornering, short braking distance and driving comfort. It is therefore advantageous that the deployment of a blade can lead to an increase in the tread area.

[159] To save energy, a wide tread leads to higher fuel consumption, it is also advantageous that the retraction of a blade can lead to a reduction in the tread area.

[160] In one of its so-called energy-saving configurations, the surface area of the outer face of the peripheral envelope is advantageously less than half its value in another configuration called maximum efficiency.

[161] Figure 10 shows a way to vary the geometry of the outer face of the tread, illustrating three different configurations, obtained by simply changing the distance from the blades to the wheel's axis of rotation, showing that the same tire can be used in many different use cases. It should be noted that the device used in this invention not only makes it possible to reduce the surface area of the outer surface of the peripheral envelope but also to increase it.

[162] Figure 11 shows a particular tyre casing adapted to the present invention. It comprises sub-assemblies of 5001 coaxial, 5002 radial and 5003 diagonal cables intersecting at a single point 5000, and sets of blades 21 to 24 located on either side of this single point 5000.

[163] It is advantageous that, in the first stage of their deployment, the blades are deployed simultaneously.

[164] A low deployment of the blades can thus concern all the blades of the device

simultaneously, while a larger deployment concerns only a part of them.

[165] The optimal configuration can be controlled by a user, but also in real time by a computer that takes into account the speed and trajectory of the vehicle, its load and the state of the environment on or in which it is travelling. The power transmission device then advantageously includes sensors to evaluate these parameters.

[166] In the so-called energy-saving configuration, the outer face of the perimeter envelope may not have a positive or negative tread pattern (also known as a groove) of more than 0.5% of the total height of the power transmission device.

[167] In this so-called energy-saving configuration, the peripheral envelope advantageously comprises one or more coaxial continuous or discontinuous rings with the peripheral envelope, each of a width smaller than that of the peripheral envelope

[168] The regulator can advantageously be built in a material or have an architecture that allows it to undergo elastic deformation. The effect of this is that, in the event that the force causing a blade to move from one position to another exceeds a certain threshold, the regulator may deform to cease to produce the intended effect, and thus refrain from causing a deterioration of the blade in question or of the regulator.

[169] In a particular design, the wheels or tracks constituting the power transmission device according to the invention may be less dense than the water in order to contribute to the buoyancy of the vehicle when it rolls on the water. They can even provide buoyancy on their own.

[170] A stationary vehicle can produce energy by the cyclic movement of a power transmission device according to the invention, both by exploiting the kinetic energy of the vehicle when descending or braking, or that of the current of a fluid when the vehicle is stationary. The invention is therefore a means of exploiting kinetic energy and can be used as a wind turbine as well as a tidal turbine.

[171] The invention may also make it possible to turn the wheels of an aircraft before landing by using the movement of air caused by its speed, so that they rotate fast enough before touching the ground, thus saving the rubber usually lost during landing. It should be noted that, unlike other processes contemplated in the prior art, this one is lightweight and does not increase the size of the landing gear. In particular, the blades can be very thin and arranged between the cables forming the tyre casing, which are particularly necessary when braking.

[172] A vehicle according to the invention can also produce electricity during the recovery of energy during braking, or when it is stationary in a current of air or water. It can be seen that a power transmission device according to the invention can be used as a wind turbine or a tidal turbine.

[173] The invention is also a machine such as a vehicle or a means of exploiting kinetic energy equipped with a power transmission device such as those described below. Such a vehicle advantageously includes the part of the governor which does not rotate with the power transmission device, and/or a means of modifying the configuration and/or a means of adjusting the elastic resistance of the 3 1 elastic recall, and/or a means of controlling these

two means of adjustment or modification.

[174] The prior art did not allow for the construction of vehicles that could be propelled with the same wheels or tracks, whether on hard ground or on soft ground or on or into a fluid, either slowly or quickly, and to free it from a soft medium when it sank into it.

[175] Not only does the present invention solve these two problems, but it also makes it possible to create vehicles whose configuration automatically adapts to the conditions encountered, effectively and continuously optimizing its mechanical efficiency, speed control, lane keeping, and comfort.

[176] The implementation of power transmission devices according to the invention constitutes a differentiating element of a machine.

[177] Even if with a planing hull, a boat with a planing hull can be very fast, the blades of a vehicle of the same power according to the invention, whose wheels are all driven and connected to the vehicle by long-travel suspensions can reach a similar speed, while the vehicle according to the invention will behave better in high-speed waves; it will go faster with better comfort. At low speeds, this vehicle, according to the invention, will go faster than this boat of the same power, and will be more efficient thanks to its suspensions that will reduce the impact of the waves. The device according to the invention could therefore drastically transform the world market for motorboats of all sizes, especially since a boat according to the invention no longer needs a port since it can park on dry land, and even drive to the residence of its pilot.

[178] A land vehicle becomes capable of freeing itself from mud or snow and driving on or in environments that were not conceivable. An amphibious vehicle no longer needs a propeller. A kinetic energy harness acquires new possibilities of use.

[179] The integration of a retractable blade power transmission device into a machine usually involves structural and functional transformations of the vehicle. To take advantage of the invention, it may be necessary to modify the chassis structure, make electronic or electrical adaptations, transform existing mechanical systems or create dedicated technical interfaces.

[180] In many cases, there is even a new technical interaction between the device and the vehicle:

- such a machine has the fixed part of the regulator which does not rotate with the wheel or the track;
- it may also include a means of modifying the configuration and/or a means of adjusting the elastic resistance of a elastic recall;
- It may also include a means of controlling the means of modifying the configuration and/or the means of adjusting the elastic resistance of a elastic recall.

[181] The invention also provides the method of operating a machine such as a vehicle or a means of kinetic energy exploitation equipped with a power transmission device according to the invention, by a human operator or a computer. This process provides an original technical solution and is not a simple adaptation of known methods. The innovation relates to the sequence of actions, the use of new control devices and the interaction between

different vehicle systems: the manoeuvre of the vehicle includes a step of modifying its configuration by means of controlling a means of modifying this configuration and/or a step of adjusting the elastic resistance of the elastic rebound 31 by means of controlling the means of adjusting this resistance.

Applications

[182] The present invention applies to all land vehicles, from bicycles to trucks to passenger vehicles, to save energy and/or allow automatic adaptation to traffic conditions.

[183] The most amazing applications are land vehicles that can travel on roads as well as on uneven or muddy ground and sail on water, a large or small boat that can land on a beach and cross shoals without damage, a submarine navigating in water or rolling on the bottom, or an aircraft that can take off and land vertically and fly in all directions.

[184] In particular, the invention makes it possible to replace boat propellers with devices that are more efficient at all speeds, that are better able to withstand waves and that are safer, more environmentally friendly and without danger of destruction in the event of shoals or encounters with floating obstacles.

[185] These vehicles can be used for leisure or work, rescue, public works but also for military combat.

[186] They can be piloted by humans, whether they are passengers or not using remote control means, or by computers.

[187] The main vehicles likely to benefit from the invention are the following: - motor vehicles of all kinds, and in particular amphibious or all-terrain vehicles, military land drones, certain tanks, artillery means or launchers, and more generally equipment which must be able to be transported autonomously from one point to another,

- cargo or passenger vessels, whatever their size and weight, and in particular fishing vessels in rivers or ponds, or in swamps, tenders of pleasure craft, motor and sailing vessels, pushed or towed or self-propelled barges, and recreational barges,
- public works or agricultural machinery which must cross wet or muddy or snowy areas,
- aircraft of all kinds,
- recreational vehicles, including Segways, monowheels/unicycles, devices for pulling or pushing a person with skis or wheeled or tracked systems, hoverboards/gyroskates, electric scooters, personal watercraft, etc.
- and remotely operated vehicles such as toys.

Claims

[Claim l] A power transmission device such as a wheel (IA) or a track (1B) whose cyclic motion drives or is driven by the movement of a vehicle in relation to its solid, fluid or gaseous environment, comprising:

- an element known as the peripheral envelope (2), - one or more cyclic pressure generating elements, hereinafter referred to as vanes (21, 22 et seq.),
- a means known as deploying/retracting enabling a blade or part of a blade to deploy by moving in a direction from the inside to the outside of said peripheral envelope, and conversely to retract by moving in the opposite direction, the set of possible positions of all the parts of a blade in relation to said peripheral envelope forming a domain known as the original displacement domain of the blade in question, characterized in that:
- when a blade encounters an obstacle, it shall be retracted if it is partially or fully extended and prevented from deploying if it is partially or totally retracted,
- and said power transmission device comprises a means called a regulator (200) for reducing said displacement range by one blade in relation to the original range, it being specified that a pressure generating element means an element whose orientation and geometry are designed to interact with a fluid or soft medium in order to generate a propulsive force, unlike a tire stud whose main function is to improve grip by its grip on solid ground.

[Claim 2] A power transmission device according to claim I characterized in that a blade deploys under the effect of centrifugal force.

[Claim 3] A power transmission device according to Claim 1 or Claim 2, characterized in that the means by which a blade deploys comprises a combination of the centrifugal force applied to it during its cyclic motion and an elastic return counteracting or increasing the effect of that centrifugal force.

[Claim 4] A power transmission device according to claim 3, characterised in that it comprises a means for adjusting the elastic resistance of said elastic retract.

[Claim 5] A power transmission device according to any one of the preceding claims, characterized in that it is provided with a means of locking a blade in the retracted position.

[Claim 6] A power transmission device according to any one of the preceding claims, characterized in that the weight of said vehicle
causes the blade(s) to retract in contact with hard ground, even at the maximum frequency of the cyclic blade movement.

[Claim 7] A power transmission device according to any one of the preceding claims, characterised in that it has openings in its side walls.

[Claim 8] A power transmission device according to any one of the preceding claims, characterized in that a blade does not retract under the effect of a force applied to it, giving rise to a component favoring or disfavoring its cyclic movement, in the two

directions of travel called forward and reverse, if this component is less in the direction said forward than a first predetermined threshold, and in the so-called reverse direction to a second predetermined threshold.

[Claim 9] A power transmission device according to any one of the preceding claims, characterized in that a blade follows a fixed path in said peripheral envelope, without changing the angle of exit of the blade with said external face of said peripheral envelope.

[Claim 10] A power transmission device according to any of the preceding claims, characterized in that the face of a blade reaching the surface of a liquid medium or soft ground is concave.

[Claim 1 1] A power transmission device according to any of the preceding claims, characterized in that a blade is rounded like those known as Poncelet blades.

[Claim 12] A power transmission device according to any of the preceding claims, characterized in that a blade is tilted to a radial position when extended, exerting a downward force as it descends into the part forward of the power transmission device.

[Claim 13] A power transmission device according to any of the preceding claims, characterized in that a blade or part of a blade can tilt after its deployment under the effect of the pressure exerted by its interaction with a fluid or soft soil.

[Claim 14] A power transmission device according to any of the preceding claims characterized in that the deployment and retraction of a blade increases or decreases the surface area of said outer face of said peripheral envelope said power transmission device and/or the circumference of said power transmission device.

[Claim 15] A power transmission device according to any of the preceding claims, characterized in that a blade (21) comprises at least one portion of a disk (2101) located in a plane perpendicular to the axis of rotation of said power transmission device.

[Claim 16] A power transmission device according to claim 15, characterized in that all the ends of the blades and said disc portions form a means of continuous contact of said power device with the ground when the blades are all retracted.

[Claim 17] A power transmission device according to any of the preceding claims, characterized in that the deployment and retraction of a blade modifies the surface condition of the outer face of the peripheral envelope of said power transmission device.

[Claim 1 8] A power transmission device according to any of the preceding claims, characterized in that a blade is more extended in one part of the cycle, and less extended or retracted in the rest of the cycle.

[Claim 19] A power transmission device according to claim 18 characterized in that a blade is more extended in a lower part of the cycle.

[Claim 20] A power transmission device according to claim 18 characterized in that a blade is more extended in a front/lower part of the cycle.

[Claim 21] A power transmission device according to any of the preceding claims characterized in that said regulator comprises a secondary shaft (40) parallel to the axis of rotation of said power transmission device, not confused with said axis of rotation of said power transmission device.

[Claim 22] A power transmission device according to any one of Claims 1 to 20, characterized in that said regulator comprises a cam cooperating with a follower or a tappet.

[Claim 23] A power transmission device according to any of the preceding claims, characterized in that said regulator simultaneously retracts or deploys all the blades.

[Claim 24] A power transmission device according to claim 23, characterized in that the assembly formed by said regulator and the blade(s) is placed in a circular groove in said outer face of said peripheral envelope (2).

[Claim 25] A power transmission device according to claim 23 or claim 24 characterized in that in said resting position a blade protrudes from said tread, and that when the ground is hard, the force exerted by the ground pushes it inward from said tread, which causes the governor to rotate in a direction that simultaneously causes the retraction of all the blades mechanically connected to the said regulator.

[Claim 26] A power transmission device according to any one of claims 23 to 25, characterized in that an acceleration of the torque applied to the power transmission device causes an advance of said regulator
slightly in relation to the peripheral envelope when it comes into contact with the ground, which results in the deployment of one or more blades.

[Claim 27] A power transmission device according to any of the preceding claims, characterized in that said regulator can deform elastically and/or have flexible parts.

[Claim 28] A power transmission device according to any of the preceding claims, characterized in that it comprises a means of damping the displacement of a blade with respect to said peripheral envelope.

[Claim 29] A power transmission device according to any of the preceding claims, characterized in that it comprises a means of preventing a blade from extending or retracting outside the part of the cycle during which it is in contact with the ground.

[Claim 30] A power transmission device according to any of the preceding claims, characterized in that said regulator slides along said secondary shaft (40) and that this sliding makes it possible to define the average deployment of one or more blades.

[Claim 31] A power transmission device according to any of the preceding claims, the deformability of which is obtained by multiple elastically deformable connections between, on the one hand, the tread, and on the other hand, a hub in the case of a wheel, or the support wheels in the case of a track, characterized in that all or part of the assembly formed by a blade and its mechanical connection with said deployment/retraction mechanism is placed between two of the said connections when it is in the retracted position.

[Claim 32] A power transmission device according to any of the preceding claims, characterized in that the housing in which a blade is retracted is attached only to said peripheral casing of said power transmission device.

[Claim 33] A power transmission device according to any one of the preceding claims, characterized in that the deployment of a blade does not deform said peripheral envelope.

[Claim 34] A power transmission device according to any of the preceding claims, characterized in that it is an accessory to a conventional wheel or track.

[Claim 35] A power transmission device according to any of the preceding claims, characterised in that it is a constituent of a Segway.

[Claim 36] A power transmission device according to any of the preceding claims, characterized in that the deployment of one of the
they can cause another blade to unfold and its retraction can cause another blade to retract.

[Claim 37] A power transmission device according to any of the preceding claims, characterized in that the electronic control of said regulator is coupled with artificial terrain recognition intelligence.

[Claim 38] A machine as a vehicle or a means of exploiting kinetic energy characterized in that it is equipped with a power transmission device according to any one of the preceding claims.

[Claim 39] A machine according to claim 38 characterized in that it comprises the fixed part of said regulator which does not rotate with said wheel or track.

[Claim 40] A machine according to claim 38 or claim 39 characterized in that it comprises a means for modifying the configuration of said regulator and/or a means for adjusting the elastic strength of a elastic recall.

[Claim 41] A machine according to one of claims 38 to 40, characterised in that it comprises a means for controlling said means, modifying the configuration of said regulator and/or means for adjusting the elastic resistance, said elastic reminder (31).

[Claim 42] A method consisting of operating a machine according to any one of claims 38 to 41, by a human operator or a computer, characterized in that the operation of said machine comprises a step of modifying its configuration by means of controlling a means of modifying said configuration and/or a step of adjusting said elastic resistance of said elastic recall, (31) by means of controlling said means of adjusting said elastic resistance. resistance.

Abstract

[188] The invention is a power transmission device such as a wheel or track that comprises retractable vanes or growths that can be put into service to assist in the propulsion of the vehicle by pressing them on fluid or soft ground such as sand, snow, mud or earth.

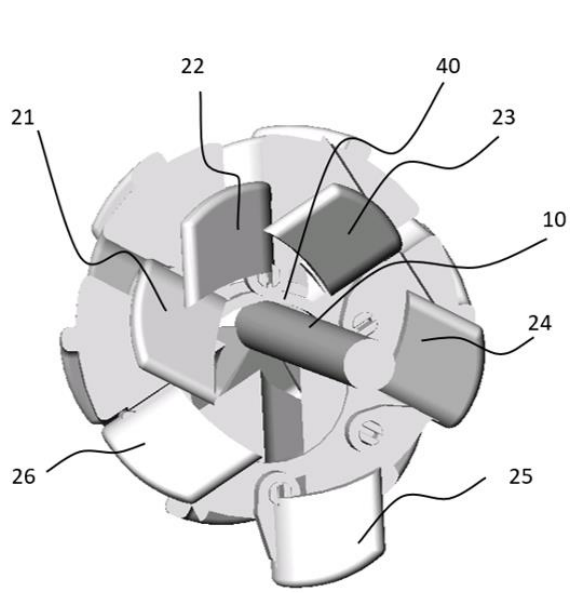
[189] This device includes a means called a regulator which reduces the range of deployment/retraction of the blades according to the use of the vehicle and the conditions encountered.

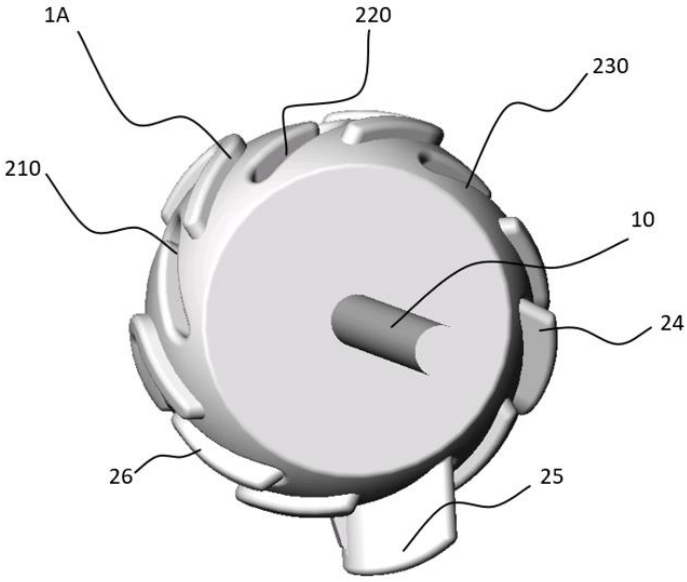
[190] The main applications are

- land vehicles whose devices according to the invention make it possible to adapt their tread to save energy at low speeds or to widen it or to equip it with protruding tread when necessary, and to travel in mud or on water or in water,
- boats whose devices according to the invention replace propellers and allow them to roll on shoals,
- aeroplanes whose devices according to the invention make it possible to turn the wheels before landing,
- and the means of exploiting kinetic energy.

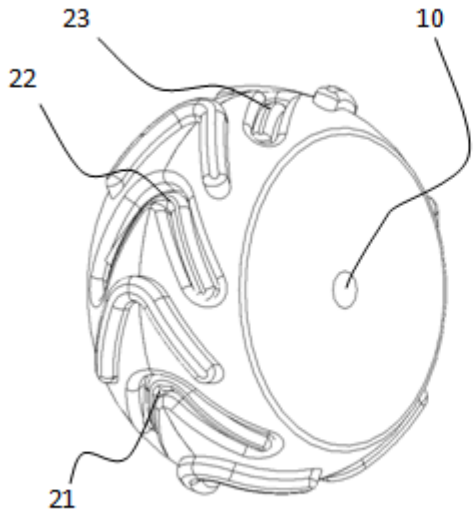
[191] Figure of the abstract: Fig. 3

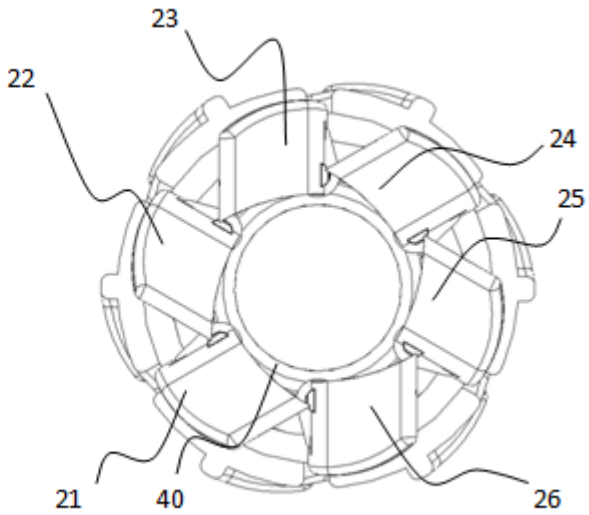
[Fig 1]



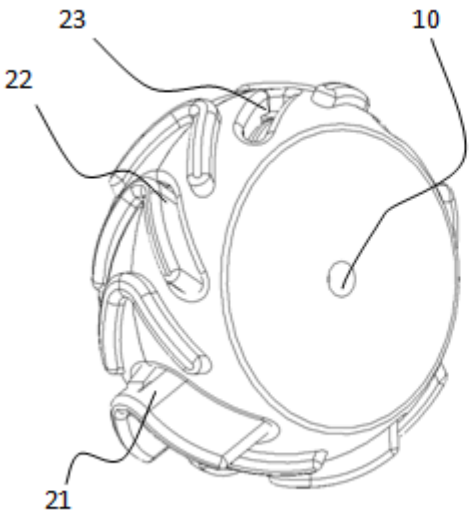


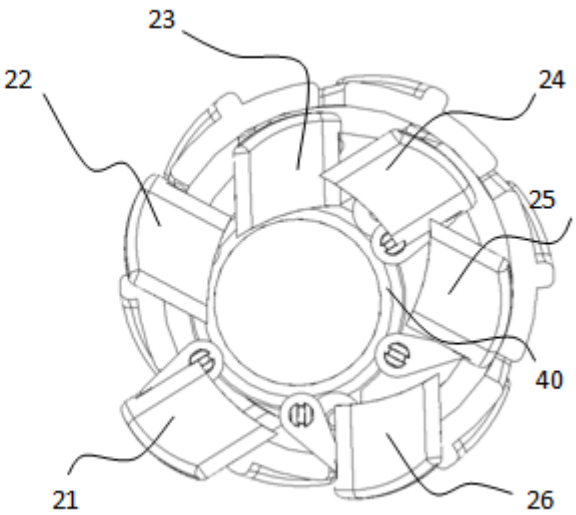
[Fig 2]



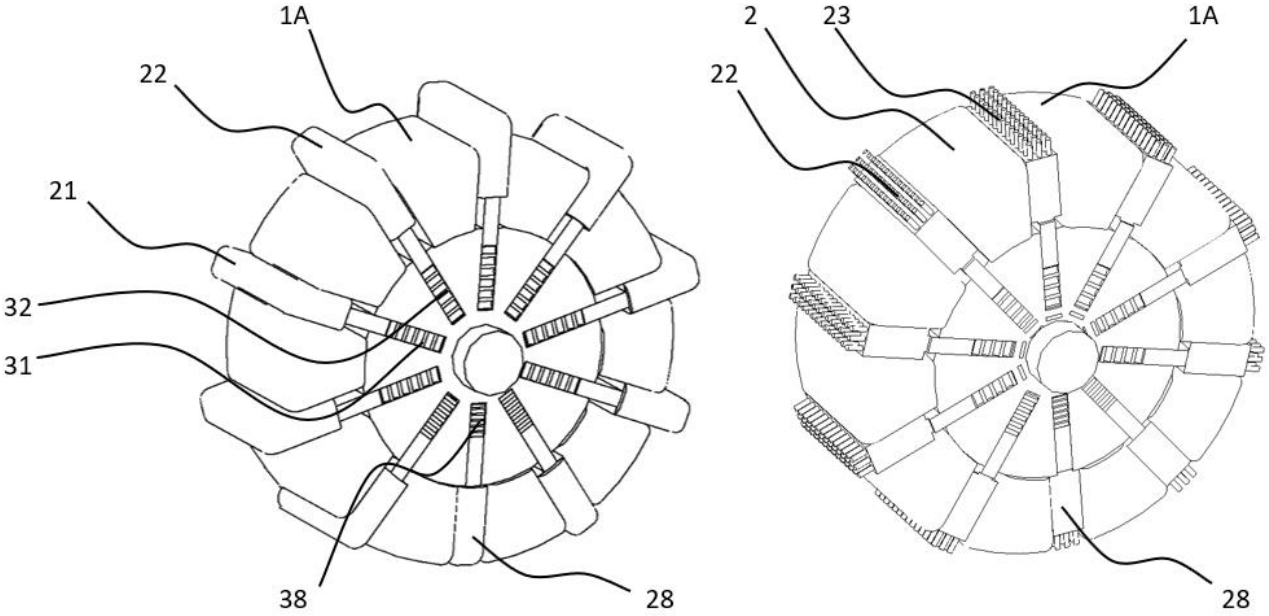


[Fig 3]

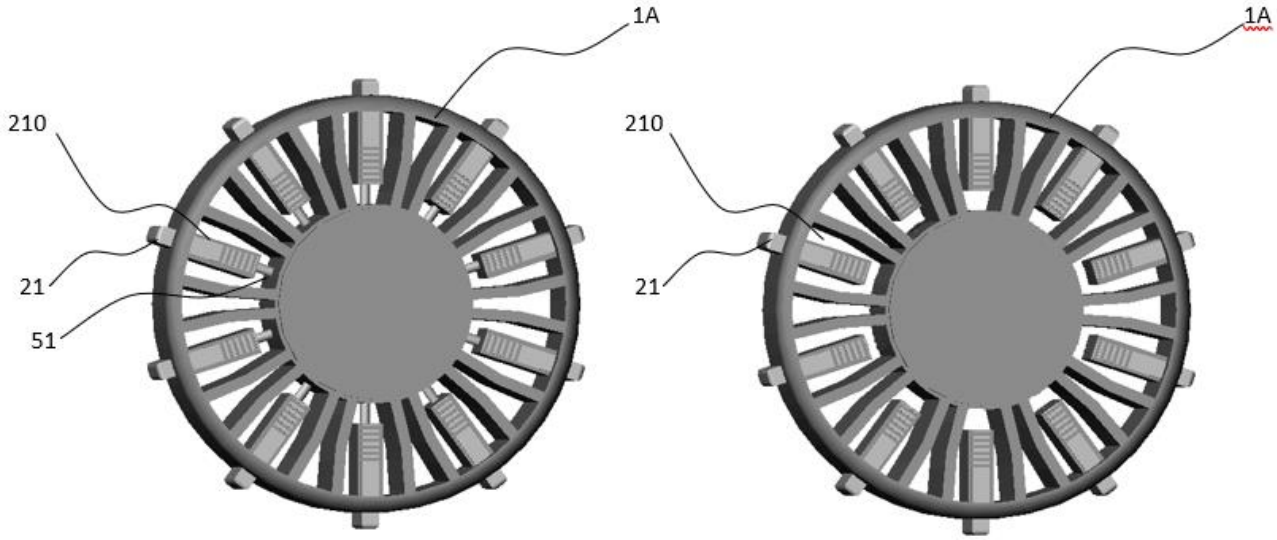




[Fig 4]



[Fig 5]



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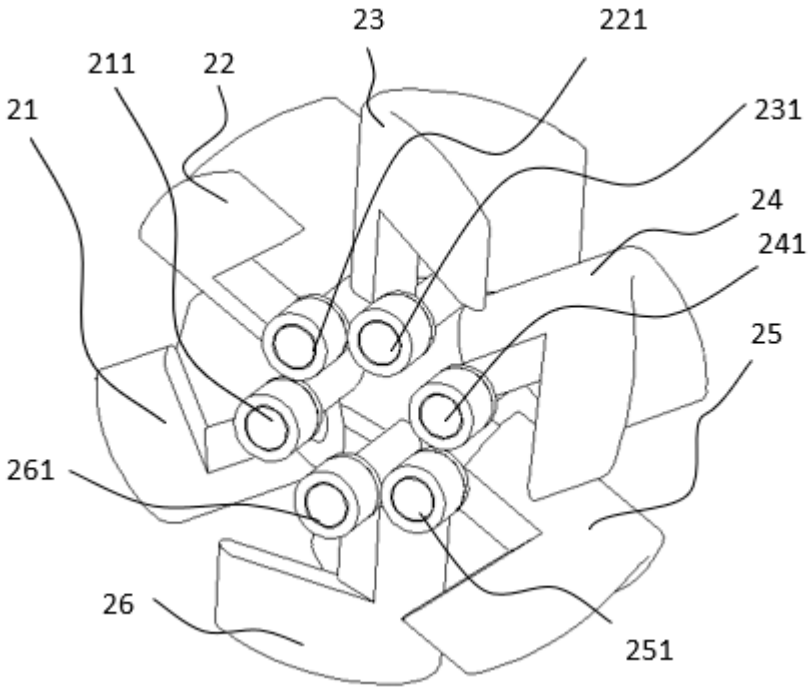
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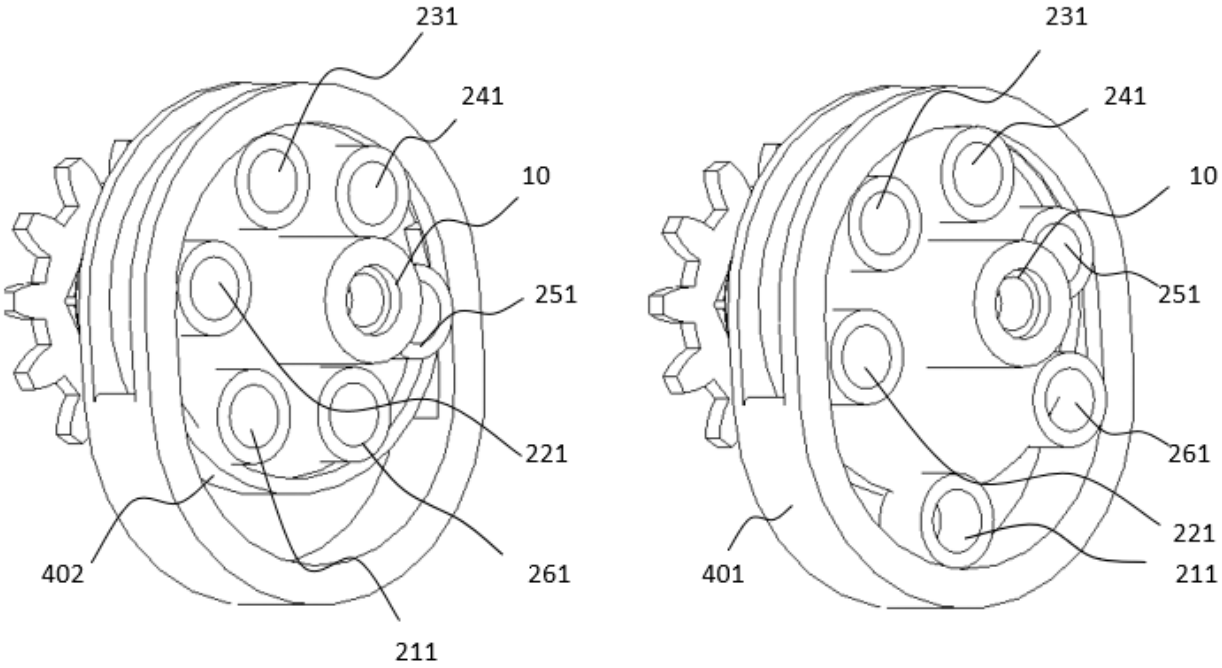
[Fig 7]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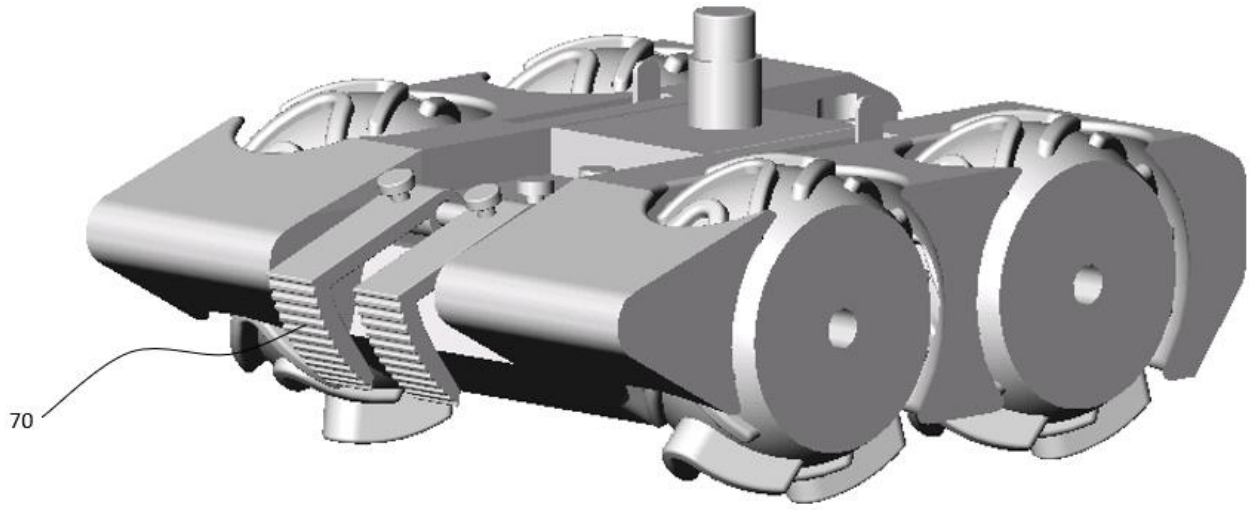
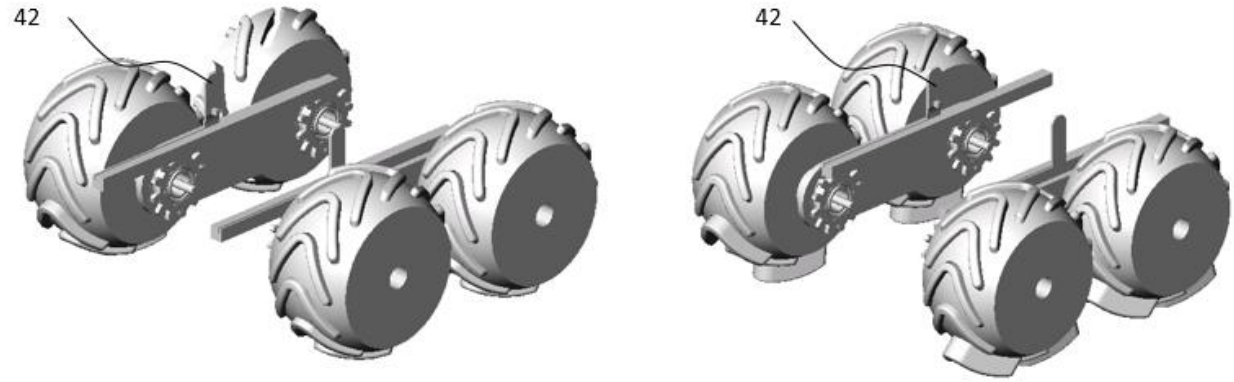
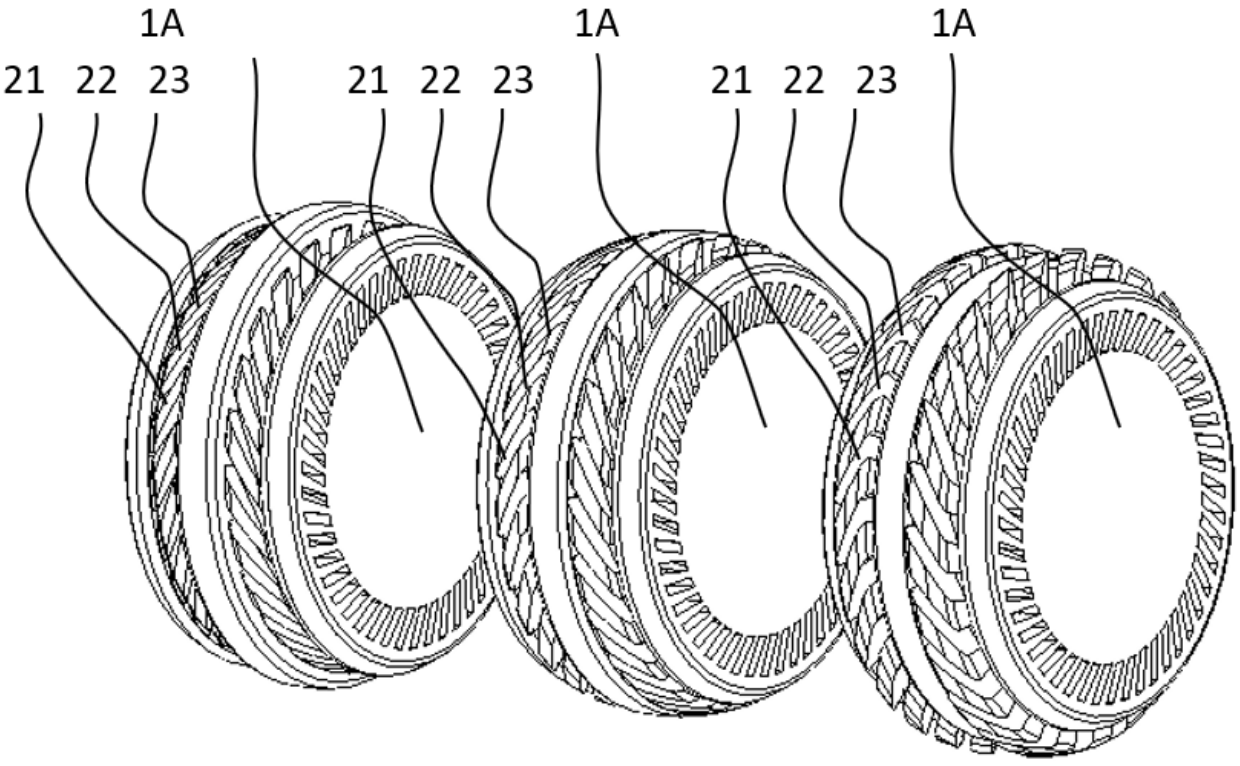
[Fig 8]



[Fig 9]



[Fig 10]



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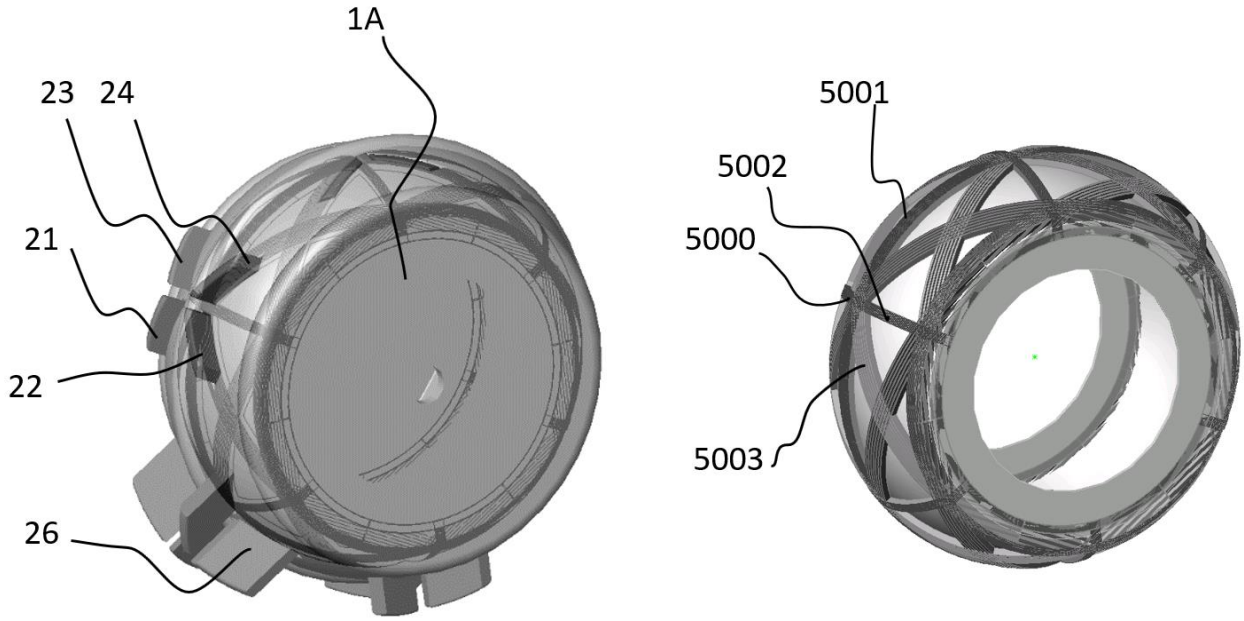

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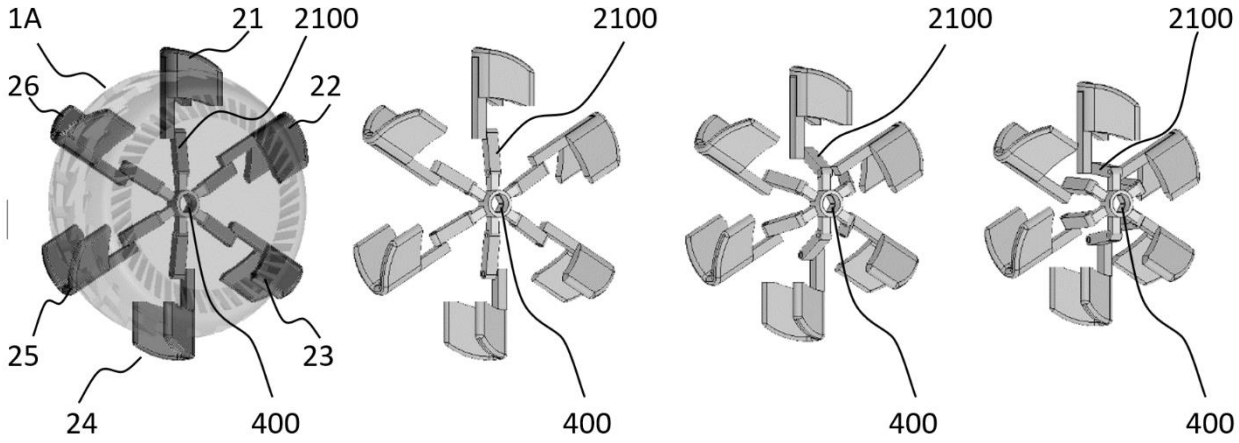

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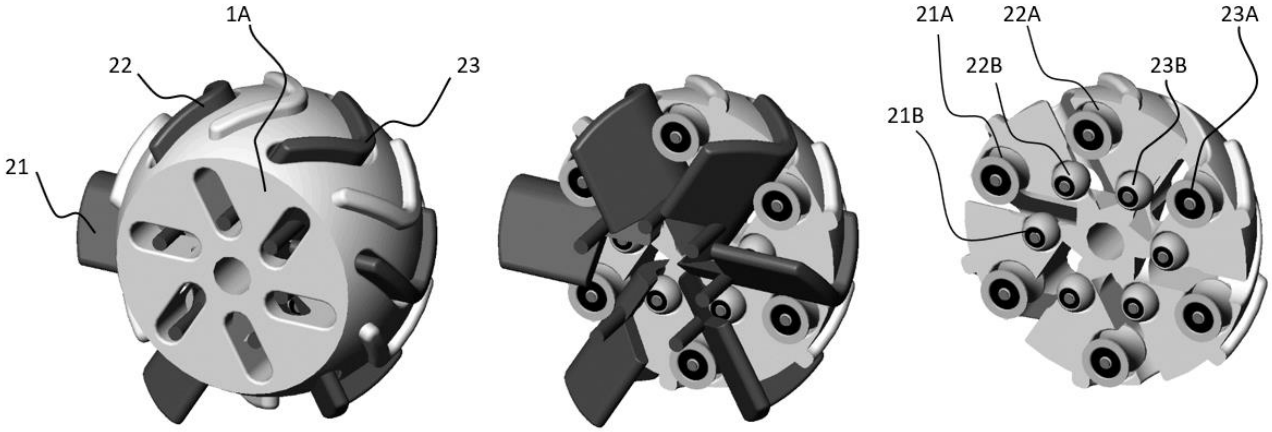

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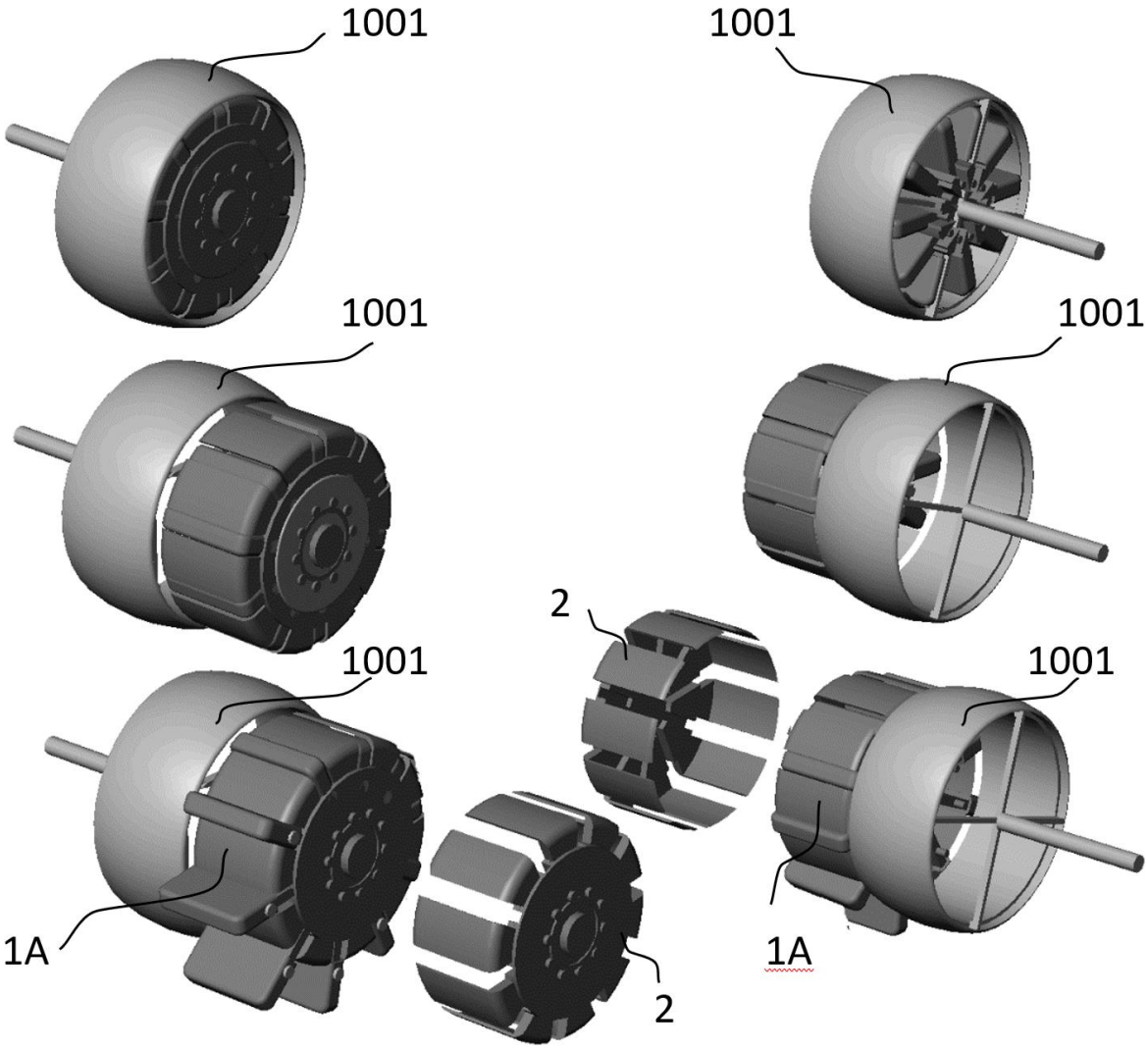

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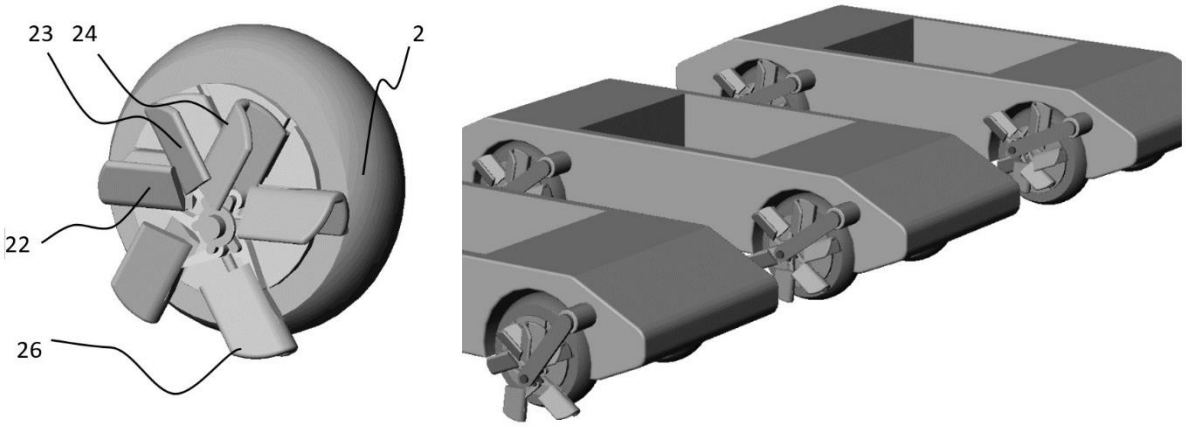

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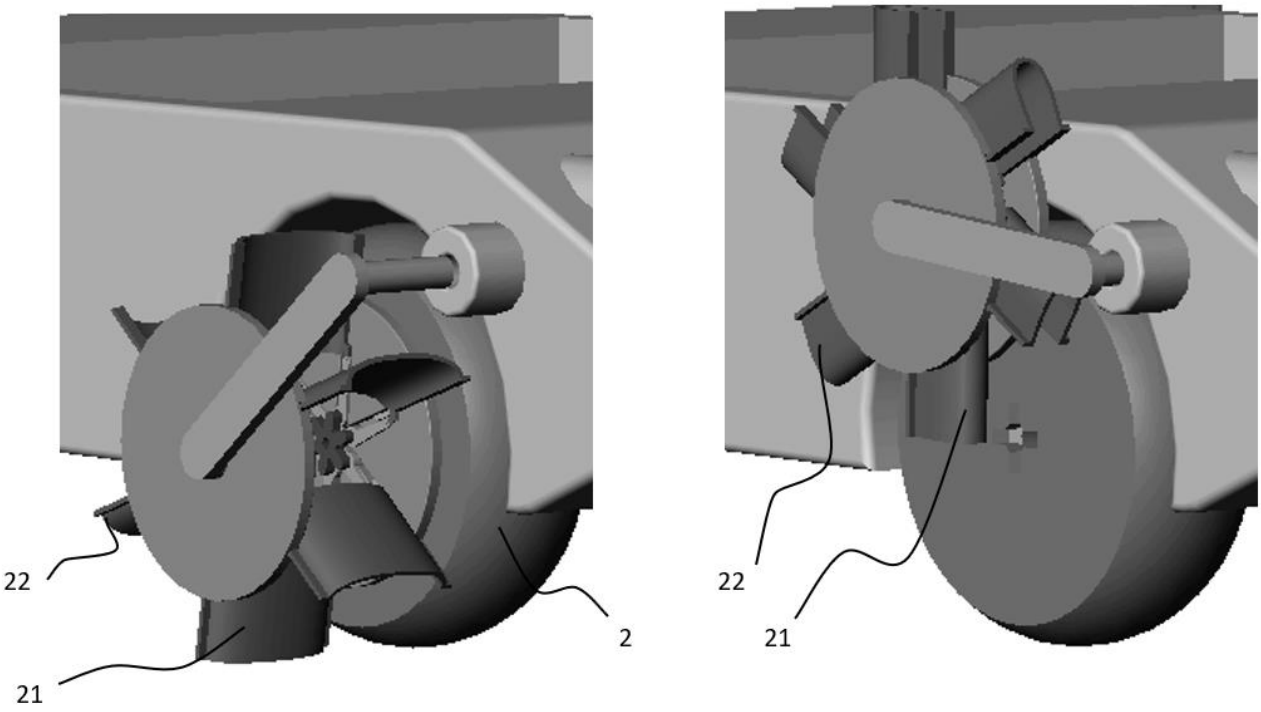

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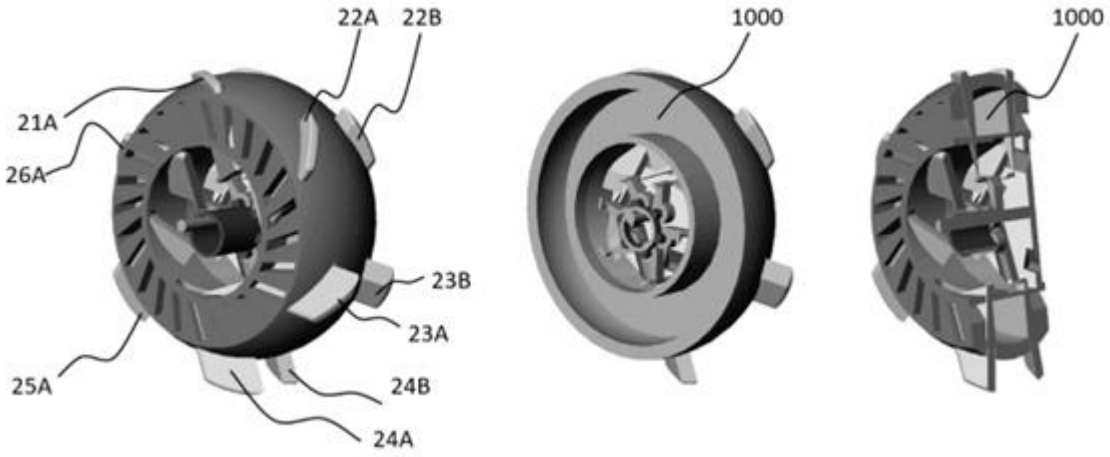

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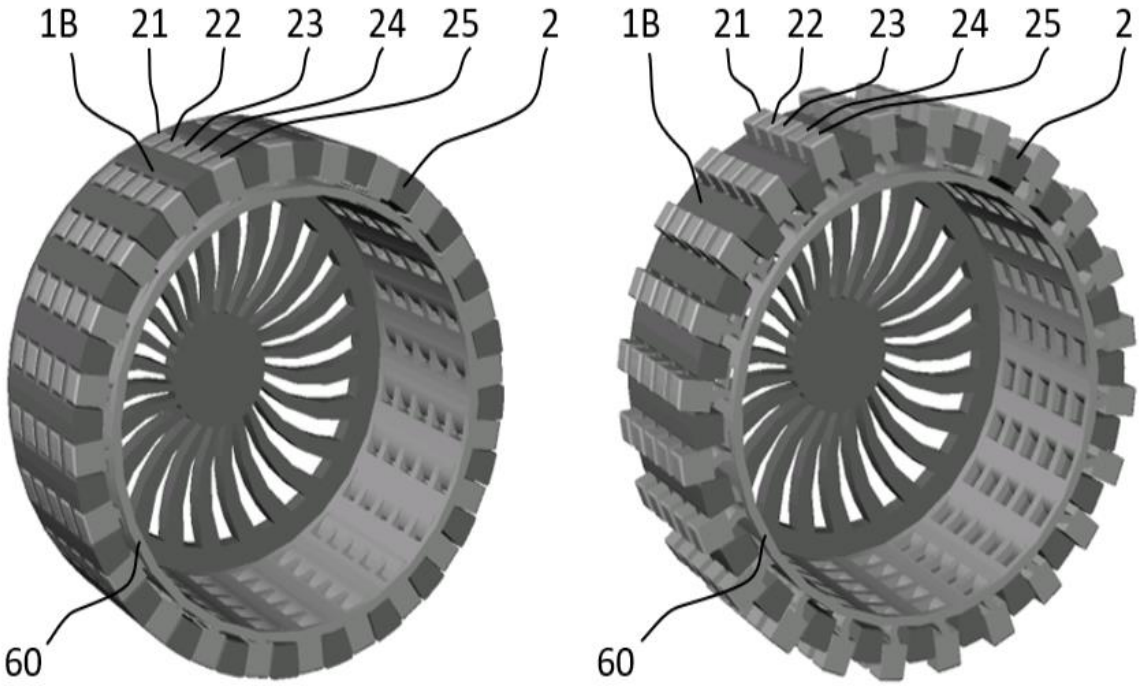
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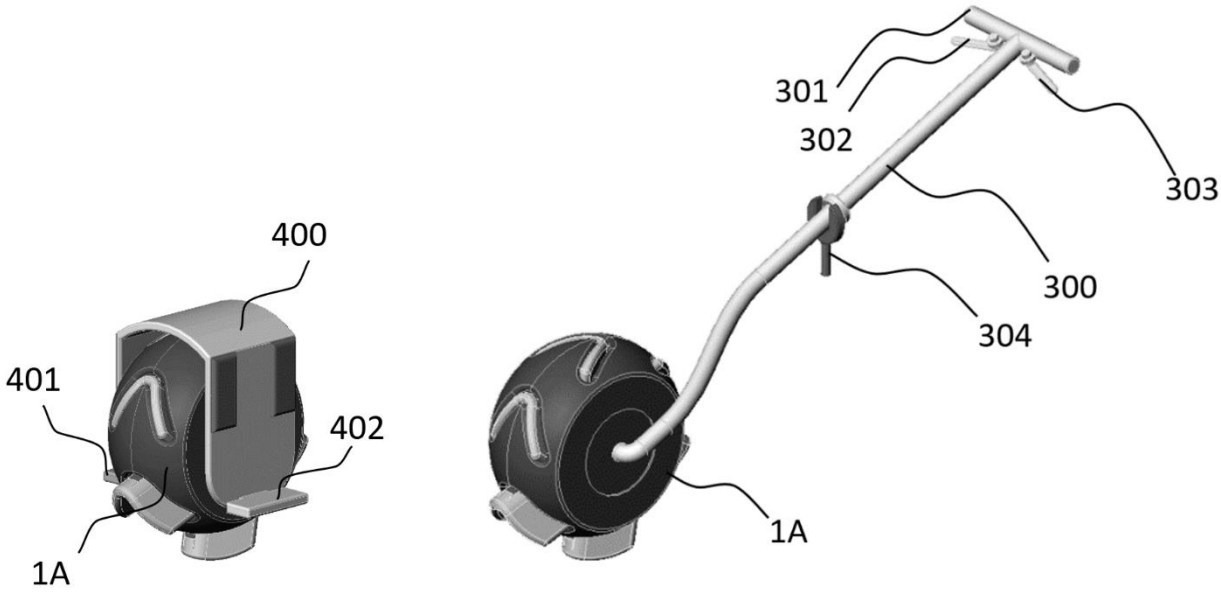
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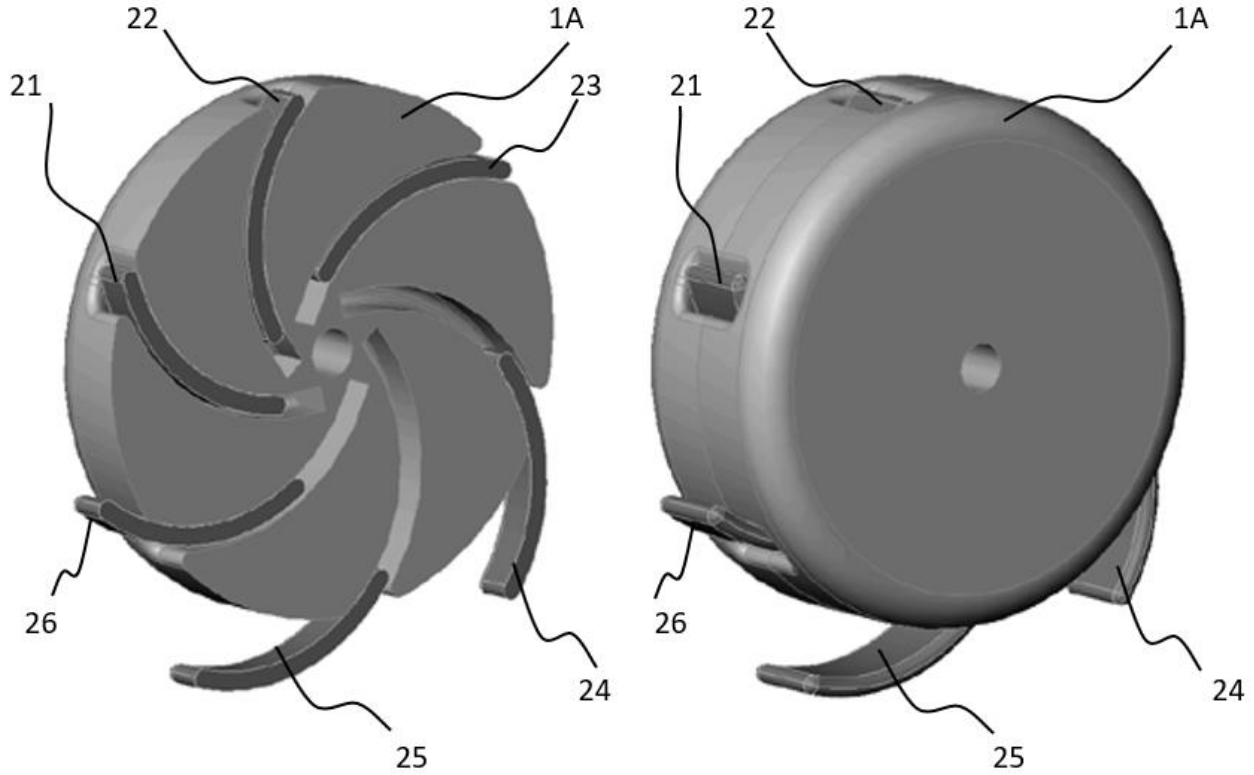
[Fig 20]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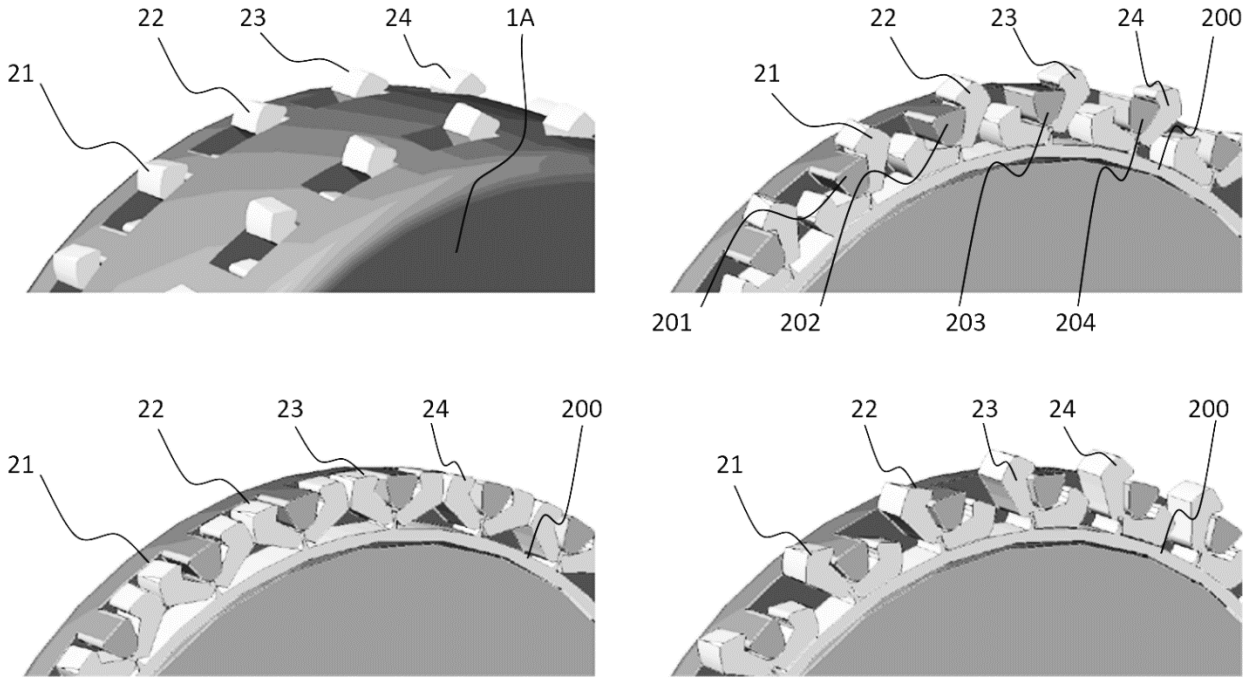
[Fig 21]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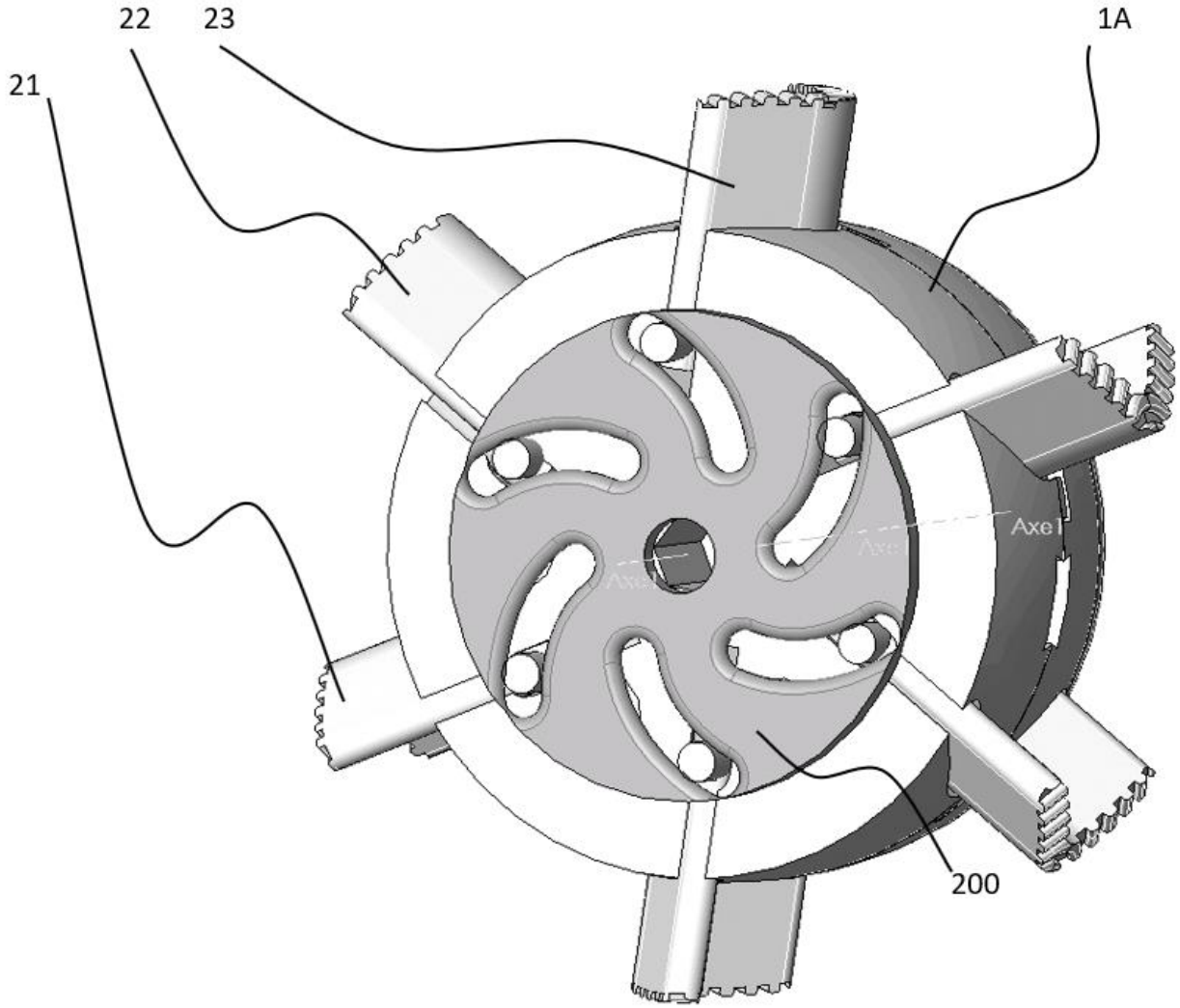
[Fig 22]



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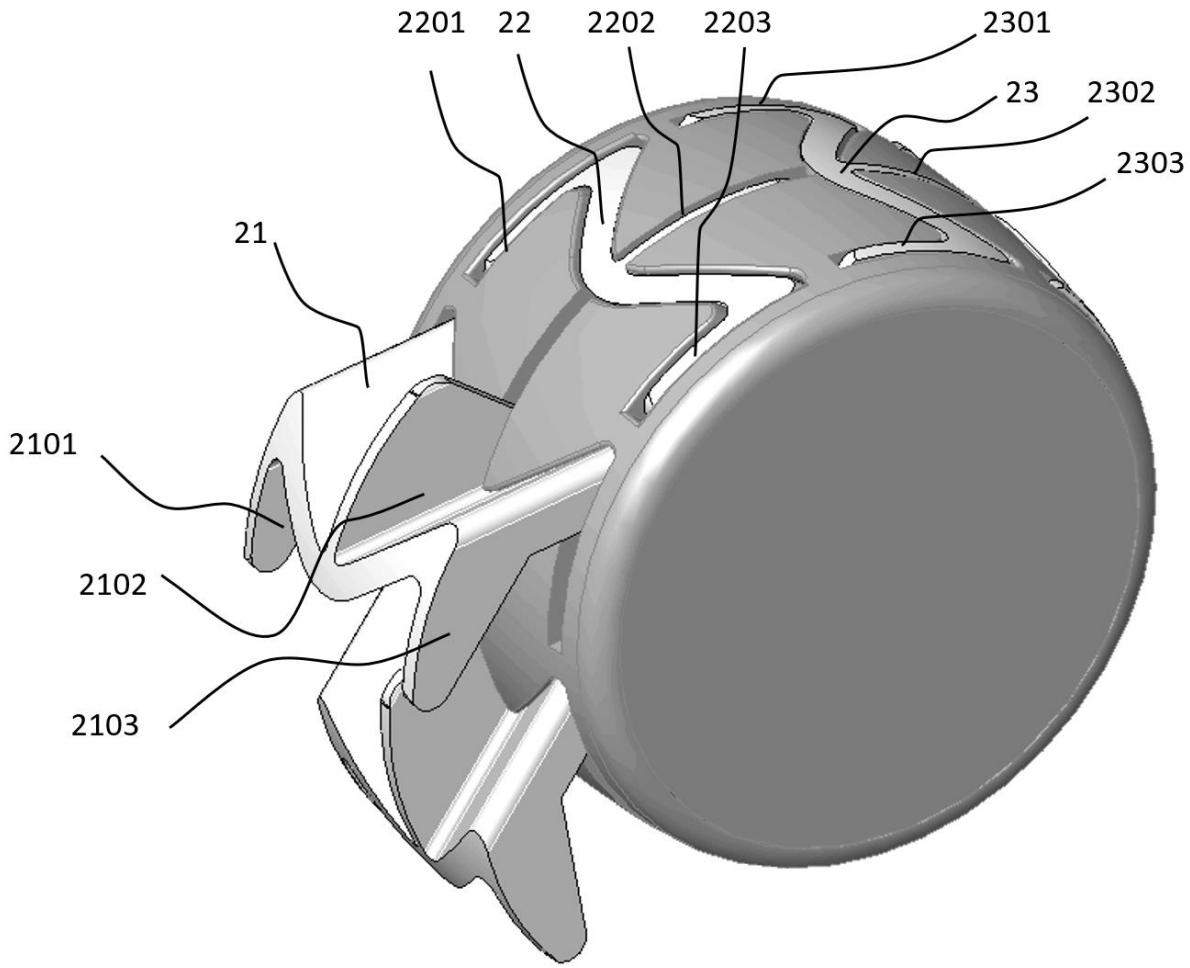
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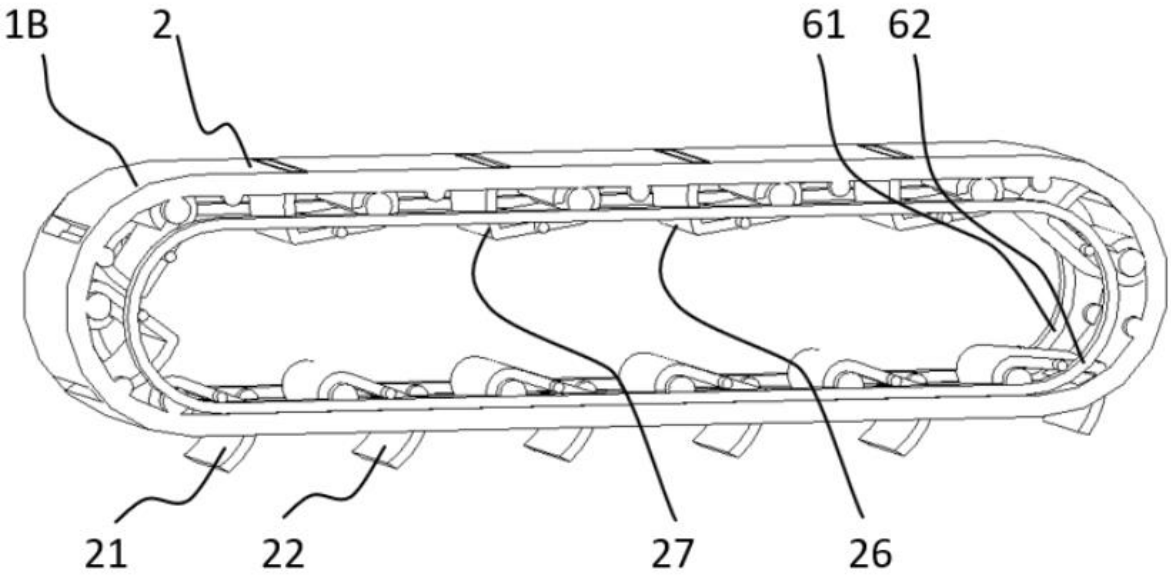
[Fig 24]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