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(54) **INDUCED HOLLOW SCREW DRIVING APPARATUS**

(57) An induced hollow spiral driving apparatus comprises a shell (6) shaped like a round pipe and having a central through hole in an axial direction; a motor rotor (1) is disposed in the through hole of the shell (6) through two bearings (4) and has a central through hole in an axial direction; spiral rings (2.1 and 2.2) used for driving are disposed on an inner wall of the through hole of the motor rotor (1); a drive block (5) is inserted in the sealed shell (6) to induce an outer wall (3) of the rotor (1), so as to drive the rotor (1) to rotate. The spiral ring driving manner of the driving apparatus has small friction and noise, and the overall driving efficiency thereof exceeds that of existing driving devices such as a propeller; the driving apparatus further has advantages such as being no leakage, no coupling, no spark, no cavitation, capable of self-speed regulation, capable of turning, magnetizable and extendable, capable of self-cleaning, maintenance-free, and having a long service life.

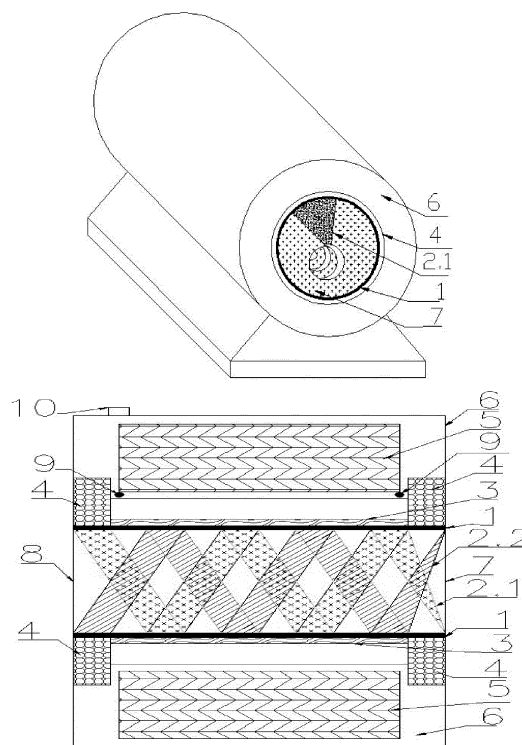


FIG. 1

Description

FIELD OF THE INVENTION

[0001] The present disclosure relates to an induced hollow spiral driving apparatus of a novel structure. The induced hollow spiral driving apparatus uses integral spiral rings (2.1, 2.2) to work on a driven object inside a hollow motor rotor (1) so as to move the driven object. The driven object includes liquid, gas, soft material, particulate solids, mixtures of liquid and particulate solids, mixtures of gas and liquid, and various mixture fluids. With the present disclosure, the flow volume and the driven stroke of the driven object are increased and the overall driving efficiency becomes higher than those of conventional pumps, propellers, fans, screw compressors, and screw excavating equipments. The spiral rings are of a shaft-less hollow ring structure having a plurality of turns, and are driven directly through induction. The sealed shell (6) is totally isolated from the ambient environment, i.e., the friction between isolated objects and the shaft as well as the friction between a driving mechanism and the rotor are eliminated, so noise pollution is reduced. The induced hollow spiral driving apparatus can automatically and directly sense the environment of the driven object so as to regulate the rotation speed thereof and to rotate in a forward direction or in a reverse direction. Moreover, the driving apparatus is provided with a comprehensive interface (10) driven by external energy.

[0002] When the driven object is liquid or gas, the induced hollow spiral driving apparatus can completely avoid leakage of the driven object to the ambient environment. In particular, when the driven object is combustible liquid or gas, the driving apparatus is safe and reliable because it is friction-free and spark-free. Under poor working conditions, the driving apparatus can effectively avoid being tangled with, impacted by or blocked by other foreign matters in the driven object. Built-in sensors (9) for sensing the temperature and the pressure as well as external sensing signal instructions are utilized by the induced hollow spiral driving apparatus to automatically regulate the speed thereof and to stop for protection. In the case of driven object containing hot water, the driving apparatus can automatically clear the incrustation to avoid blockage of a channel. When food or biochemical objects are transported through the induced hollow spiral driving apparatus, they can be used for other purposes after being magnetized automatically. The driving apparatus can automatically clean the dirt from the driven object without being disassembled after it stops operation. The induced hollow spiral driving apparatus utilizes the comprehensive interface (10) so that it can be driven without using electrical energy. Due to these structural features, in addition to an improved efficiency, the induced hollow spiral driving apparatus further has advantages such as being 0 leakage, no coupling, no spark, having low noise, capable of self-speed regulation, capable of reverse turning, magnetizable and extenda-

ble, capable of self-cleaning, maintenance-free, and having a long service life.

BACKGROUND OF THE INVENTION

[0003] Currently, rotational driving apparatuses include pumps, propellers, fans, screw compressors, screw extruding equipments and screw excavating equipments.

[0004] Pumps are mainly divided into centrifugal pumps, screw pumps, screw centrifugal pumps, magnetic driving pumps, and Archimedes pumps in structure. However, under some application conditions, the efficiency of the centrifugal pumps is only 30%. It is complicated to drive and connect the screw pumps and moreover, the maintenance cost of the screw pumps is high. The screw centrifugal pumps are novel comprehensive pumps, but leakage tends to occur at a driving shaft thereof. The magnetic driving pumps only solve the leakage at the shaft of the pumps, but the efficiency thereof is not improved greatly. The Archimedes pumps are driven by a motor shaft, so they also have the leakage issue due to friction between the shaft and a sealing ring.

[0005] The transmission and driving efficiency of the centrifugal pump is relatively low mainly because an impediment force is generated after the channel of the pump is bent for 90 degrees when the driven object is driven; next, the centrifugal blades of the pump are relatively large and the swing amplitude thereof is big when the blades are operating, so clearance between the blades and the shell of the pump is relatively large. Thus, the pump has no self-priming function, and cannot operate under conditions where the liquid level is relatively low.

[0006] To improve the efficiency of the motor of the pump, a brushless motor has been utilized for direct driving. However, it is still complicated to connect the pump, the driven object still tends to leak out from the connection of the pump shaft, and the pump shaft and the sealing ring generate loud noise.

[0007] Moreover, the pump body typically needs to be disassembled to clean the dirt inside after a long-term operation, so the pump is incapable of self-cleaning.

[0008] The propeller has a central shaft, and the blades thereof is distributed around the shaft in the sheet form, power is input from the central shaft, and the driven object is liquid or gas.

[0009] Relatively large driving force can only be obtained when the propeller operates at a relatively large angle of attack between the cross sections of the propeller and the resistance generated by the driven object, and relatively high efficiency can only be obtained when a resistance torque is relatively small. When the propeller is operating, the axial speed does not change as the radius changes while the tangential speed changes as the radius changes. Therefore, at a position close to the blade tip, the radius is relatively large and a flow angle is relatively small, and a corresponding blade angle is also relatively small. However, at a position close to the

blade root, the radius is relatively small and the flow angle is relatively large, and the corresponding blade angle and the impact on the axis are also large. The radial friction is always doing futile centrifugal work in the tangential direction at the blade tip, the central shaft of the propeller takes up more than 20% of the total area and blocks the movement of the driven object, so the efficiency of the propeller gradually decreases when it is operating at a high speed.

[0010] Meanwhile, bearing wear and shaft seal issues of the propeller cannot be solved completely, inter-shaft friction generates noise that affects the ambient environment when the propeller is operating, and the propeller requires regular maintenance and frequent replacement.

[0011] Additionally, the propeller is driven mainly by electric power, and shaft connection thereof is complicated and the operating energy consumption is great even when a high-efficient motor is adopted for driving.

[0012] Fans are similar to the propellers, and the driven object is gas. Soft foreign matters in the gas would adhere to blades of the fan automatically after the fan has operated for a long time, which reduces the operating efficiency. Although a high-efficient motor is adopted by the fan for driving, the overall efficiency decreases because the diameter at the distal end of the blades decreases as the air flow is getting larger when the fan is operating at a high speed.

[0013] Screw compressors usually adopt rotating lever driving mechanisms and are driven by motors, but negative work done by distortion friction resulting from shaft lever distortion cannot be avoided even when the high-efficient motors are utilized, and this makes the screw compressors have a low efficiency and require frequent maintenance.

[0014] Screw extruding equipments usually adopt shaft-lever driving mechanisms where a central screw takes up a lot of the space of an extruding box, an extruded object along the periphery tends to leak out from a crack at the distal end of screw blades, the driving and the connection are complicated, and the overall volume thereof is relatively large. Moreover, if an outlet of the screw extruding equipment is blocked, then the screw will be deformed or damaged.

[0015] Screw excavating equipments usually adopt shaft-lever driving mechanisms, and power is transferred through the shaft lever. When the equipment is advancing, the connection part between a central root and the shaft lever is likely to bend because the screw radius is relatively large. As a result, the shaft lever is deformed, and torque transmission is compromised, and the equipment is even unable to operate in severe cases.

[0016] Further, conventional screw driving apparatuses are driven mainly by electric power, but simple connection and driving without the need of transformation cannot be achieved in environment where mechanical energy, and liquid or gas pressure energy are abundant.

[0017] Application technologies of the conventional rotating apparatuses are specifically described in combi-

nation with the practical application of the conventional screw driving apparatuses. For example:

[0018] Cooling water pumps used in vehicle-mounted motors have drawbacks such as water seal wear, leakage of cooling liquid and that components thereof require frequent replacement and maintenance. When the running water is used as the cooling liquid, incrustation will accumulate and the pump in the cooling system is incapable of self-cleaning, so the resistance of the pump gradually increases and finally damages the pump. The cooling water pump has no self-regulation function, so it keeps operating ineffectively along with the motor for a long time and this is a waste of resources.

[0019] Hot water pumps used for the central heating system cannot automatically clean the incrustation accumulated therein so that the pipelines gradually become narrower, and as a result, the pump body needs to be disassembled manually for maintenance after a long period of time.

[0020] For pumps used in air conditioning systems for central heating and cooling, leakage occurs at the pump shaft during the transmission, and the noise generated by the pumps is relatively loud because series motors are adopted for driving. Even through high-efficient motors are adopted for driving, the shaft connection is still complicated and frequent maintenance is still required.

[0021] Dust collectors all utilize centrifugal pumps and high-speed series commutator motors, so the noise is loud and the efficiency is relatively low. Moreover, dust particles will block the pump, so the dust collectors need to be disassemble manually to be cleaned and frequent maintenance is required.

[0022] Air pumps for ventilation all utilize centrifugal pumps and high-speed series commutator motors, so the connection and the driving are complicated and the noise generated by the inter-shaft friction is very loud. Exhaust fans and hair driers also have the aforesaid problems, and the noise generated by them is higher than 80 decibels.

[0023] Compressors adopt centrifugal pumps to compress and evacuate air, so they have a low efficiency and generate loud noise; and moreover, leakage at the clearance between pump shafts is severe, and this is a waste of energy.

[0024] Household inflators and air pumps are not provided with hand cranks, so children, the elder, and the disabled cannot operate them with short arms and less effort.

[0025] Electric locomotive extracting oil pumps usually adopt centrifugal insertion structures, even through high-efficient brushless DC motors are adopted for driving, the pumps are still disadvantageous because the connection thereof is complicated, the volume thereof is very large and takes up a lot of the internal space of a fuel tank, the pumps need to be retrieved and then disassembled manually for cleaning, and frequent maintenance is required.

[0026] Ventilators used in smoke exhausters adopt

single-phase induction motors that have long service life for driving, but the central shaft thereof and the motor block air flow and greasy dirt, so the structure of the ventilators is complicated and it is tedious to clean the greasy dirt.

[0027] Pumps used in fish tanks, biochemistry, and printing and dyeing cannot automatically avoid being tangled with soft foreign matters, and are incapable of automatically sensing changes in the environment, so motors of the pumps keep operating for a long period of time and waste a lot of energy, and keeping many half-load high-powered pumps operating is also a waste. Conventional pumps used in food and medical industries cause noise pollution, and leakage at the pump shafts cannot be effectively avoided when liquid food is transported so that cross contamination might be generated between the food and the ambient environment, and moreover, the nutrition of the food cannot be improved.

[0028] Screw extrusion molding equipments adopt screw driving mechanisms for extrusion, and when a molding orifice is blocked, the equipments cannot respond quickly due to a complicated sensing and linkage structure, and as a result the screws of the equipments might be twisted or damaged. Moreover, a shaft lever takes up a lot of the volume of the extruding box, so the extruded object along the periphery moves in a reverse direction, and a distal end of the rotating blades can even be deformed in case the driving force is extremely large, and this causes the larger extruded object to move in a reverse direction and be left out.

[0029] When underwater propellers are advancing, friction noise generated between a revolving shaft and a water seal will propagate to the surround waters, and the outside water will get into the operation room, and therefore, a very large tailshaft stuffing box is required to discharge the water with pressure. Meanwhile, operators have relatively short sight underwater; when the propeller is advancing, the connection part at the root of the shaft lever that is bared outside tends to bend because the radius of the resisting arm of a destructive force is relatively large, and once the propeller collides with something else, then it cannot operate.

[0030] When aircraft propellers are rising, landing or flying, unbalanced forces on the blade tip will cause an overall unstable flight; meanwhile, the resistance of the central shaft increases as the rotation speed of the propeller increases, and in this case, interference from an unexpected flyer is likely to cause the flight out of balance. The propellers need to be regulated manually so as to adjust the airflow transportation speed, so large-scale machines with propellers cannot take off or land directly in small places.

[0031] Conventional screw mining machines adopt screw rod structures, and when the mining machines are advancing at large power, the radius of a screw digging head is larger than the radius of a connection part at the root, so a bending force is likely to be generated at the connection part between the central root and the shaft

lever when the digging task is arduous. As a result, the screw rod is deformed, the operating efficiency is decreased or the screw rod is even unable to work, and the excavated objects cannot be directly transport.

[0032] Intelligence module propellers (IMP) produced by Westing House Corporation, US directly drive the magnetic integral blades of the conventional propellers in a radial direction through induction, but the shaft lever and the bearing of the conventional propellers have not been eliminated, so the overall efficiency is only improved very limitedly.

[0033] An existing Chinese patent (patent number: 201120220709.4) relates to a magnetic screw transmission apparatus. The magnetic screw transmission apparatus has magnets fixed on a screw shaft, the magnets are arranged on the screw shaft in a screw form to form a magnetic screw, and two adjacent magnetic screw lines are N poles alternating with S poles when observed from the external surface of the magnetic screw. Magnets are fixed on an inner surface of a nut, the magnets are arranged inside the nut in a screw form to form a magnetic nut, and two adjacent magnetic screw lines are N poles alternating with S poles when observed from the internal surface of the magnetic nut.

As a result, the transmission efficiency is not improved, and only the driving manner is innovated.

[0034] An existing Chinese patent (patent number: 200510085572.5) provides a novel electric rotating apparatus; an electric fan, an electric air blower utilizing the apparatus; and apparatuses utilizing the novel motor but without an rotating shaft, such as electric air blowers, electric propellers, washing machines of which the inner roller rotates directly, air blowers in a circular air duct, and pumps. The existing electric rotating apparatuses such as electric fans or air blowers generally have blades mounted on an output shaft of the motor, and the blades are driven by the motor to rotate so as to achieve air blow. Thus, the motor has to be disposed at the central position of the blades, and as a result, the flow of the air is blocked by the motor and the air blow efficiency is reduced. In order to achieve driving without using the existing motor and reduce weight of the apparatus, coils are wound onto a torus in the present disclosure, and permanent magnets are mounted on blades corresponding to the inner circumference of the torus, and in this way, a magnetomotive force can be obtained easily and then transformed into motive power. As a result, the central shaft of the fan is not improved or eliminated and thus the efficiency is only improved very limitedly.

[0035] An existing Chinese patent (patent number: 200510017430.5) relates to a motor shaft screw pump which can be manufactured easily and has a low production cost. An inner end of an end cover of the motor is provided with a bearing seat, bearings are mounted on the bearing seat, the inner race of the bearing is fixed on the motor shaft, and several screw suction cavities are provided within the motor shaft. An outer end of the end cover of the motor is provided with a screw oil seal seat,

and the screw oil seal seat is threadly connected to internal threads of the end cover, an oil seal is mounted on the screw oil seal seat, and the oil seal and the motor shaft are sealed mechanically. The outer end of the end cover of the motor is further provided with outer joint threads, and the outer joint threads fit with a lock nut to fix outer joint components of a liquid inlet and a liquid outlet. The present disclosure is simple in structure, has a low production cost, can be moved and used very conveniently, and moreover, can be used for ground operations, underwater operations, and diving operations, and so on. Thus, the present disclosure is an updated product of conventional liquid pumps. However, the water seal has not been eliminated, complete isolation is not achieved, the specific implementing structure of the threads is not specified, and no specific requirement is made on the structure of the motor. Obviously, it is only an improvement for a hollow shaft.

[0036] An existing Chinese patent (patent number: CN99254564.1) discloses a submersible pump. A transmission shaft of the motor of the submersible pump is hollow, a primary impeller for water diversion is installed at a lower end of the hollow shaft, and a secondary impeller for water drainage is installed at an upper end of the hollow shaft. In addition to the function of transferring the torque, the hollow shaft can further directly dissipate the heat generated inside the motor when the motor is operating through the water in the water channel thereof so that the heat generated by a stator and the rotor of the motor can be dissipated simultaneously. As a result, only the position of the impeller is improved, and no specific requirement and description are made on the structure of the motor.

[0037] An existing Chinese patent (patent number: 200610109279. 2) is provided to solve problems of conventional screw pumps used in oil fields, such as the energy consumption is large and the maintenance cost is high because the screw pumps utilize a conventional three-phase motor to transfer power through a belt and a speed reducer. An axial cone bearing (10) is inserted into a lower end cover (11) of the motor, a rotating shaft (7) of the motor is hollow, a hollow seal pipe (9) is provided within the shaft, a mechanical seal apparatus is fixed between the hollow seal pipe (9) and the rotating shaft (7) of the motor, a static plate (2) of the mechanical seal apparatus and a dynamic plate (5) of the mechanical seal apparatus together form a working surface, a seal pipe alignment bearing (6) is fixed between the outer wall of the hollow seal pipe (9) and the inner wall of the rotating shaft (7) of the motor, the bottom of the hollow seal pipe (9) is threaded, and a fixed gland (14) is threadly connected to the bottom of the hollow seal pipe (9). This motor with a hollow shaft is used in screw pumps for direct driving and features a simplified transmission mechanism, a high transmission efficiency, a low maintenance cost and high operating security. However, only the structure is improved with respect to the screw pump, and no specific requirement and description are made

on the structure of the motor.

[0038] An existing Chinese patent (patent number: 200920033713.2) relates to a hollow shaft motor designed specifically for screw pumps. The hollow shaft motor comprises an enclosure, a stator and a rotor with a rotating shaft are mounted inside the enclosure, the rotating shaft is a hollow shaft provided with a through hole in an axial direction, and one end of the rotating shaft is provided with a rotor friction brake disc. The present disclosure has a reasonable design and a simple structure, and a pressure pump can be formed immediately by assembling a specifically designed screw pump with the hollow shaft. However, it is only an improvement for the motor shaft.

[0039] An existing Chinese patent (patent number: 201210056337.5) relates to a self-priming pressure liquid pump. The pump comprises a pump shell, an impeller installed within the pump shell, and a driving apparatus provided specifically for the impeller. The pump shell is provided with a liquid inlet, a liquid outlet and a liquid chamber in communication with the liquid outlet and the liquid inlet. The impeller comprises a hub and at least one cylinder-shaped blade, the hub is disposed eccentrically with respect to the liquid chamber, and the blade is retractable in a radial direction with respect to the hub and is mounted rotatably on the hub. When the hub is rotating, the blade stretches out due to a centrifugal force, and the end of the blade that is stretched out cooperates with an internal surface of the liquid chamber to drive the water flow. Accordingly, on the one hand, when the hub is rotating at a high speed, the blade is smooth and is unlikely to be stuck by foreign particles, so the self-priming function of the pump is reliable, the water flow of the pump is large and smooth, and the water pumping effect is good; and on the other hand, the cylinder-shaped blade effectively reduces the friction at a contact surface between the blade and the hub, so the noise is small and the service life is long. However, the driving structure is not improved and no specific requirement and description are made on the structure of the motor.

[0040] The seal of the conventional pumps, fans, compressors, screw extruding equipments, screw excavating equipments, underwater propellers, aircraft propellers, screw mining machines, etc., belongs to dynamic seal.

SUMMARY OF THE INVENTION

[0041] To overcome the technical drawbacks of the conventional rotational driving apparatuses, the present disclosure relates to an induced hollow spiral driving apparatus of a novel structure. The induced hollow spiral driving apparatus comprises a shell (6) shaped like a round pipe and having a central circular hollow through hole in an axial direction and being sealed around the through hole, a motor rotor (1) has a central circular hollow through hole in an axial direction, spiral rings (2.1, 2.2) used for driving are disposed on an inner wall of the through hole of the rotor (1), a drive block (5) is inserted

in the sealed shell (6) to induce an outer wall (3) of the rotor (1) so as to drive the rotor (1) to rotate, and the motor rotor (1) is fixed in the central circular hollow through hole of the shell (6) by two bearings (4) at an inlet opening (7) and an outlet opening (8) of the shell (6). The induced hollow spiral driving apparatus uses the rotor (1) with integral spiral rings (2.1, 2.2) so that the driven volume and the driven stroke of the driven object in unit time are increased and the overall driving efficiency becomes higher than those of conventional pumps, propellers, fans, screw compressors, and screw excavating equipments. Meanwhile, the induced hollow spiral driving apparatus has advantages such as being 0 leakage, no coupling, no spark, having low noise, capable of self-speed regulation, capable of reverse turning, magnetizable and extendable, capable of self-cleaning, maintenance-free, and having a long service life.

[0042] The product of the present disclosure further comprises:

1. molded spiral rings (2.1, 2.2), at least comprising: (1) an insertion length (L) thereof is greater than an axial length of the shell; (2) a spacing (D) therebetween is smaller than 50% of a length of the rotor (L); (3) a thickness of a root (T) is smaller than 50% of the insertion length (L); (4) the number of the rings is at least one; (5) a sum of fan angles of the spiral rings is at least greater than 2π ; and (6) an angle (G) included between the pushing surface of the spiral rings and a cross section of the motor rotor is smaller than 90° .
2. an outer wall (3) of the rotor, at least comprising a fixing device having a magnetic permanent magnet material and having at least one pair of N pole and S pole distributed in a radial direction, or comprises a material that enables an induction motor to rotate automatically after an induced current is generated.
3. the drive block (5), at least comprising an electromagnetic coil winding and an electronic and electrical circuit around the central through hole, or an output end device of a mechanical shaft around the central through hole, and comprises a conducting magnetic material for attraction with a passive object.
4. the shell (6), at least comprising: (1) the shell (6) is made of a non-conducting magnetic material that is the material other than iron or other conducting magnetic material through integrally casting or formed by using fasteners to assemble separate components thereof and sealing the components into the shell; (2) sensors (9) for sensing the temperature, the pressure and the rotor position are disposed at a front section and a back section inside the shell; (3) a comprehensive interface (10) for receiving electric cables, external signals and energy is disposed outside the central through hole of the shell, and (4) a thickness of an inner wall at the position of the central through hole of the shell is smaller than an effective radius of magnetic lines of force of

the drive block (5) and the rotor (1).

5. a connection structure between the spiral rings (2.1, 2.2) and the inner wall of the rotor (1) is formed at least through (1) integrally casting, (2) inserted riveting or (3) welding.

6. the electronic and electrical circuit at least (1) is capable of receiving various instructions and making logic operations automatically; (2) is capable of generating magnetic forces of difference polarities through the operations and processing to operate the rotor, stop the rotor, rotate the rotor in a forward direction or in a reverse direction or regulate the rotation speed of the rotor; and (3) is provided with an external instruction input interface; and (4) has a plurality of internal sensors.

7. a clearance between the outer wall of the central through hole of the shell (6) and the outer wall (3) of the rotor is smaller than 50% of a diameter (Φ) of the rotor (1).

BRIEF DESCRIPTION OF THE DRAWINGS

[0043]

FIG. 1 is an overall structural view of a product according to the present disclosure, including a schematic structural perspective view of the product and an axial sectional A-A view of the product (see FIG. 1 in the specification).

Note:

- 1: Motor rotor
- 2.1: Spiral ring 1
- 2.2: Spiral ring 2
- 3: Outer wall of the rotor
- 4: Bearing
- 5: Drive block
- 6: Shell
- 7: Inlet opening
- 8: Outlet opening
- 9: Sensors
- 10: Comprehensive interface

FIG. 2 is a schematic view of spiral rings of the product according to the present disclosure, including a schematic axial view of the molded spiral rings, a schematic radial sectional view of the molded spiral rings and a schematic perspective view of a single-turn spiral ring (see FIG. 2 in the specification).

Note:

- 2.1: Spiral ring 1
- 2.2: Spiral ring 2
- L: Length of the spiral rings
- T: Root thickness of the spiral rings
- D: Spacing between the spiral rings
- K: Thickness of a blade portion of the spiral rings
- H: Height of an inclined pushing surface of the

spiral rings, which means a distance from the root to the blade on the pushing surface of the spiral rings

FIG. 3 is a schematic view illustrating the electrical principle of the product according to the present disclosure (see FIG. 3 in the specification).

Note:

1. When a rotating magnetic force is output by a stator that utilizes an electromagnetic coil as the drive block, the corresponding rotor is a permanent magnet material for performing the magnetic induction function, and the corresponding rotor may also be an induction coil material for performing the magnetic induction function.
2. When a mechanical dragging conducting magnetic material is used as the stator to generate the rotating magnetic force, the corresponding rotor is a conducting magnetic material with opposite poles for performing the magnetic induction function.
3. Sensors at least comprise internal signals and input signals outside the shell.

[0044] Hereinbelow, the product of the present disclosure will be further described with reference to the attached drawings.

DETAILED DESCRIPTION OF THE INVENTION

[0045] Referring to FIG. 1 for a product according to the present disclosure, after the product is powered on from a comprehensive interface (10), a drive block (5) in a shell (6) generates a rotating magnetic field immediately after it is powered on and receives instructions from a default logic and sensors (9). The magnetic field emanates towards an outer wall of a central through hole, and according to the principle that opposite poles attract and like poles repel, an outer wall (3) of a rotor is instantly affected by the induced magnetic force so that the whole rotor (1) rotates synchronously. At the same time, a driven object at the inlet opening (7) of the shell (6) is immediately indrawing. As shown in FIG. 2, the driven object passes through a blade portion (K) of spiral rings and keeps being moved along an inclined pushing surface (H) of the spiral rings, and is rotated at a root (T) of the spiral rings (2.1, 2.2) through a driving force. The driving force overcomes the negative work done by a friction force along a length (L) of the spiral ring, and does positive work on the driven object in every turn until the driven object is output from an outlet opening (8) of the shell (6).

[0046] A formula for calculating a driving power p is as follows: $p = (f1 + mg \delta 1) / S$.

f : Driving force

1: Driving displacement

m : Mass

5 δ : Friction coefficient

s : Time

[0047] According to the aforesaid formula, in addition to reducing the negative work done by the friction force, the positive work done by the driving volume of the driven object in unit time should be improved in order to improve the driving efficiency. The volume depends on a spacing (D) between the spiral rings (2.1, 2.2), a height (H) of the pushing surface of the spiral rings and the rotation speed. The driving force f depends on a product of the number of the spiral rings and the number of turns. Different ring surfaces are fixed on an inner wall of the same rotor (1), so they have a same linear speed, and thus the driving force f is equivalent to the sum of the driving force of each single turn. Meanwhile, the thickness of the root (T) of the spiral rings (2.1, 2.2) can provide sufficient sustaining strength to ensure the complete output of the driving force. Although the friction force increases as the number of the turns and the number of the rings increase, the friction coefficient δ of the pushing surface is greatly reduced because the driving action keeps happening, and thus the negative work done by the friction force decreases gradually.

[0048] During the driving process, the driven object firstly is moved to the root of the spiral rings as the driving force overcomes the negative work done by the friction force in the rings. The root (T) of the rings is integrally connected with a driving force generation point, and this is equivalent to that a power arm is lengthened automatically, while the action point of a resisting arm is still at the center of a ring (H). According to the principle that it is labor-saving when the power arm is longer than the resisting arm, the larger the radius of the spiral rings will be, the higher the driving efficiency will be.

[0049] The angular speed of the blade portion (K) of the spiral rings (2.1, 2.2) is the same as the angular speed of the root (T), and the distance between the rotating radius of the blade portion (K) and the mechanical origin is close to 0, so the negative work done by the friction in the tangential direction is almost 0. Therefore, the driven object passes through a channel between the spiral rings and is moved to the root (K) of the ring, and in this case, the force generating point does positive work.

[0050] The wear of the blade portion of the spiral rings (2.1, 2.2) will reduce the height (H) after a long-term use of the spiral rings, so the height (H) of the rings will be smaller than 50% of a radius (Φ) of the rotor after the spiral rings have practically operated for a certain period of time. As a result, part driven object will certainly be left out and the efficiency is reduced. Thus, the blade portion (K) of the spiral rings needs to be anti-friction treated. However, when the height (H) of the rings is larger than

50% of the radius (Φ) of the rotor, the driving force is increased, and the driving speed decreases. Thus, when the height (H) is equal to 50% of the radius (Φ), optimum combination between the speed and the driving force can be obtained.

[0051] When an angle (G) included between the pushing surface of the spiral rings (2.1, 2.2) and a cross section of the rotor (1) is 90° , the driving power of the spiral rings is 0. Thus, the smaller the angle will be, the higher the driving efficiency will be; and in this case, the number of the turns (1 turn = 2π) of the rings and the number of the rings may be set to be high, but the negative work done by the friction will also increase correspondingly. Therefore, during specific implementation, an optimum parameter needs to be calculated according to a multivariate equation model. The tangent line of the blade portion (K) of the rings may also be kept parallel to the tangent line of the rotor (1), while the angle included between the pushing surface and a cross section of the rotor is reduced to less than 90° ; i.e., the driven object can be grabbed to avoid sliding or being left out.

[0052] In the apparatus of the present disclosure, a clearance exists between the outer wall (3) of the rotor and the outer wall of the central through hole of the shell (6), and usually the clearance only needs to be smaller than 10% of the diameter of the rotor (1). Two bearings of the apparatus only block instead of driving the driven object, so there is no power consumption. However, solid residues of the driven object would enter into the clearance after a long-term use, which causes the friction and the wear of the rotor. Therefore, the bearings have to be disassembled manually for complete cleaning after an appropriate period.

[0053] If the rotating magnetic field is output by a stator that utilizes an electromagnetic coil as the drive block (5), then the outer wall (3) of the corresponding rotor is a permanent magnet material or an induction coil material for performing the magnetic induction function, i.e., it complies with the rotating principle of brushless synchronous motors or asynchronous motors.

[0054] If a mechanical dragging conducting magnetic material is used as the stator to generate the rotating magnetic field, then the outer wall (3) of the corresponding rotor is a conducting magnetic material with opposite poles for performing the magnetic induction function. With this structure, energy other than electric power can be input through the comprehensive interface (10) so that the mechanical apparatus can drive the conducting magnetic material to generate the rotating magnetic field, and thereby the rotor (1) is induced to directly drive the integral spiral rings (2.1, 2.2) to rotate synchronously.

[0055] The blade portion (K) of the spiral rings need to be cleaned after the apparatus of the present disclosure has operated for a long time. Because the drive block (5) can rotate both in a forward direction and in a reverse direction, the spiral rings (2.1, 2.2) can automatically rotate clockwise or anticlockwise without detaching the inlet opening (7) and the outlet opening (8). When the appa-

ratus is provided with power supply or external energy, the dirt on the blade portion (K) in the tangential direction can be removed by the driven object moving in an anti-tangential direction simply by reactivating the apparatus to rotate in the reverse direction after it has completely stopped rotating, i.e., the apparatus is capable of self-cleaning.

[0056] As compared to pumps, propellers, fans, screw compressors, screw extruding equipments and screw excavating equipments, the spiral rings (2.1, 2.2) of the apparatus of the present disclosure rotate in a pipe structure, so theoretically the driving efficiency thereof is improved a lot, and the following drawbacks are eliminated: when the conventional rotational driving apparatuses are rotating, the centrifugal force does negative work in the radial direction; the central shaft lever and the bearings block the driven object and do negative work so that the driven object cannot move smoothly; and when the apparatuses are operating at a high speed, the distal end of the blades are bent so that the radius is reduced, the linear speed is reduced and ineffective driving is increased.

[0057] When the apparatus of the present disclosure that is used as a water pump to operate in water meets with soft foreign matters, there is no obstacle or blade in the spiral rings (2.1, 2.2) that can be blocked by or entangled with the foreign matters, so the foreign matters would be pushed out from the smooth pushing surface of the rings, and thus the apparatus is maintenance-free. The sensors (9) can automatically sense the change in water pressure so as to regulate the rotation speed automatically.

[0058] When the apparatus of the present disclosure is used as a vacuum pump to evacuate air, the sensors (9) automatically sense the air pressure during the transportation so as to regulate the rotation speed automatically.

[0059] When the apparatus of the present disclosure is used as a pump to transport biochemical food, the shell (6) is completely sealed, so cross contamination between the biochemical food and the ambient environment can be avoided. In the present disclosure, the shell (6) has a sealed structure which belongs to no dynamic seal. No dynamic seal means static seal. However, in the conventional pumps, fans, compressors, screw extruding equipments, screw excavating equipments, underwater propellers, aircraft propellers, screw mining machines, etc., mentioned in the Background, the seal of these apparatus belongs to dynamic seal. The sensors (9) automatically sense different environments of the driven objects during the driving process so as to regulate the rotation speed. Meanwhile, the nutrition of the food is magnetized automatically for other purposes through the conducting magnetic material of the outer wall (3) of the rotor during the transportation.

[0060] When the apparatus of the present disclosure operates as a vehicle-mounted water pump to dissipate heat, transmission apparatuses and leakproof compo-

nents are unnecessary, and it is only required to directly align with the inlet opening (7) and the outlet opening (8). The sensors (9) automatically sense the water temperature in the driven hot water so as to regulate the rotation speed. Moreover, the incrustation can be automatically magnetized and then dissolved through the conducting magnetic material of the outer wall (3) of the rotor, i.e., the incrustation can be automatically removed. When the apparatus of the present disclosure operates as a vehicle-mounted oil pump, it can be directly mounted at a cover of an oil tank, and this increases the space of the oil tank and makes the maintenance for the oil supply system simple.

[0061] When the apparatus of the present disclosure is used as a fan for ventilating, the air flow can automatically move in the reverse direction without detaching the inlet opening (7) and the outlet opening (8) because the drive block (5) can rotate both in the forward direction and in the reverse direction. Meanwhile, the sensors (9) can automatically sense different signal instructions during the transportation of the air so as to automatically regulate the rotation speed. Particularly, when the apparatus of the present disclosure works as a dust collector and operates at a high speed, the motor rotor (1) is driven through induction, and there is no friction between the rotor (1) and the shell (6), so the noise is lowered, and the wear of the original series rectifier carbon brush is avoided.

[0062] When the apparatus of the present disclosure is used as an electric hair drier to generate hot or cold air, the motor rotor (1) for driving the integral spiral rings (2.1, 2.2) is driven through induction, so the noise is lowered, and the wear of the original series rectifier carbon brush is avoided. Meanwhile, the connection structure of the apparatus is simplified, so the volume thereof is smaller. The sensors (9) automatically sense the air temperature in the driven hot or cold air so as to regulate the rotation speed. When the apparatus of the present disclosure is used as a hot steam humidifier, or an ion disinfecting fan, it can be implemented in the similar way.

[0063] When the apparatus of the present disclosure operates as an inflator and an air pump with a hand crank, inflation or evacuation of the air can be achieved simply by connecting a linkage structure of a hand mechanical apparatus to the comprehensive interface (10) so that a rotating magnetic field is generated by the drive block (5).

[0064] When the apparatus of the present disclosure operates as an underwater propeller, electric power or mechanical transmission may be adopted for driving through the comprehensive interface (10). The diameter of the shell (6) is larger than the diameter of the rotor (1) with the spiral rings (2.1, 2.2) while the diameter of the shaft lever of the existing propeller is much smaller than the diameter of the propeller, so the rotor (1) can be protected from damage even when the propeller bumps into obstacles such as a submerged reef when it is moving forward. There is no friction between the rotor (1) and the sealed shell (6), so the noise is lowered, and the wear

of the shaft and the water seal of the conventional propeller is also avoided. Because the shell (6) is a hermetically sealed structure which belongs to no dynamic seal, the outside water can be completely prevented from getting into the operation room in the deepwater area. Because the drive block (5) can rotate both in the forward direction and in the reverse direction, the spiral rings (2.1, 2.2) can automatically rotate in the reverse direction by activating a driven instruction without detaching the inlet opening (7) and the outlet opening (8). In this way, the underwater propeller can achieve diving or surfacing without turning around, and the propeller can also brake instantly to stay at a certain depth underwater.

[0065] When the apparatus of the present disclosure operates as an aircraft propeller, the inlet opening (7) and the outlet opening (8) may be disposed to be perpendicular to the ground with the inlet opening (7) upward and the outlet opening (8) downward. After the built-in power supply is activated, the aircraft propeller can directly achieve liftoff or landing when the driving force is balanced with the gravity force and the air resistance. Moreover, the sensors (9) automatically sense the air pressure in the air to regulate the rotation speed so as to automatically regulate the balance of the flight. Because the drive block (5) can rotate both in the forward direction and in the reverse direction, the air flow can automatically rotate in the reverse direction without detaching the inlet opening (7) and the outlet opening (8). In this way, the aircraft propeller can brake instantly to stay at a certain depth in the air without turning around.

[0066] When the apparatus of the present disclosure operates as a spiral compressor, the shell (6) is completely sealed, so the friction between the air seal and the shaft and the resulting noise are avoided as compared to the conventional apparatuses, and the compressed air is unlikely to leak out. Because the motor rotor (1) for driving the integral spiral rings (2.1, 2.2) is driven through induction, the overall structure is relatively simple and the volume is reduced.

[0067] When the apparatus of the present disclosure operates as a spiral extruding equipment, it is only required to match the inlet opening (7) and the outlet opening (8) with the inlet and the outlet of the extruding equipment. The spiral rings (2.1, 2.2) are cone-shaped, or the shell (6) is cone-shaped, the inlet opening (7) corresponds to the big opening end of the cone, and the height (H) of the spiral rings (2.1, 2.2) may also be increased appropriately to increase the driving force. As compared to the extruding box of the conventional screw extruding apparatuses, double screw extrusion is utilized, so the volume is small and the space of the extruding box is extended. Moreover, as compared to the conventional screw driving, the extruded object along the periphery is prevented from leaking out from the crack at the distal end, the driving structure is simple, and the overall volume is reduced. When the extruding outlet is blocked, the internal pressure would be increased, and in this case, the sensors (9) or an external automatic detector

will automatically detect the change in the pressure through the comprehensive interface (10), and then the equipment immediately stops operating automatically. Thus, as compared to the conventional extruding apparatuses, the equipment of the present disclosure can make response rapidly and brake timely. When solid-liquid separation is required in the extruding process, a separating hole is disposed at the back side of the rotor (1) and a liquid drainage hole is disposed at the outlet opening (8) of the shell.

[0068] When the apparatus of the present disclosure operates as a spiral excavating equipment, the spiral rings (2.1, 2.2) at the inlet opening (7) of the shell can be connected to the inlet opening (7) and the outlet opening (8) correspondingly after being particularly treated to have high strength and hardness. When the equipment is operating at a large power, the diameter of the spiral rings is relatively large and the central part thereof is hollow, so the connection part at the shaft lever is unlikely to bend as compared to the conventional mining machines. When the equipment needs to operate at a relatively large power, the diameter of the shell (6) is much larger than the diameter of the rotor (1) with the spiral rings (2.1, 2.2) while the diameter of the conventional screw rod is much smaller than the diameter of the spiral digging head, so the rotor (1) can be protected to operate normally. Moreover, the excavated objects can be automatically transported to the outside directly through the rear end of the spiral rings (2.1, 2.2).

[0069] What described above are only the embodiments of the present disclosure, but are not intended to limit the scope of the present disclosure. Any equivalent structures or equivalent process flow modifications that are made according to the specification and the attached drawings of the present disclosure, or any direct or indirect applications of the present disclosure in other related technical fields shall all be covered within the scope of the present disclosure.

Claims

1. An induced hollow spiral driving apparatus, at least comprising: a shell (6) shaped like a round pipe, having a central circular hollow through hole in an axial direction and being sealed around the through hole, wherein a motor rotor (1) has a central circular hollow through hole in an axial direction, spiral rings (2.1, 2.2) used for driving are disposed on an inner wall of the through hole of the rotor (1), a drive block (5) is inserted in the sealed shell (6) to induce an outer wall (3) of the rotor so as to drive the rotor (1) to rotate, and the motor rotor (1) is fixed in the central circular hollow through hole of the shell (6) by two bearings (4) at an inlet opening (7) and an outlet opening (8) of the shell (6).
2. The induced hollow spiral driving apparatus of claim

1, wherein the spiral rings (2.1, 2.2) formed in the apparatus at least comprises: (1) a length (L) thereof is greater than an axial length of the shell; (2) a spacing (D) therebetween is smaller than 50% of a length of the rotor (L); (3) a thickness of a root (T) is smaller than 50% of the insertion length (L); (4) the number of the rings is at least one; (5) a sum of fan angles of the spiral rings is at least greater than 2π ; and (6) an angle (G) included between the pushing surface of the spiral rings and a cross section of the motor rotor is smaller than 90° .

3. The induced hollow spiral driving apparatus of claim 1, wherein the outer wall (3) of the rotor at least comprises a fixing device having a magnetic permanent magnet material and having at least one pair of N pole and S pole distributed in a radial direction, or comprises a material that enables an induction motor to rotate automatically after an induced current is generated.
4. The induced hollow spiral driving apparatus of claim 1, wherein the drive block (5) thereof at least comprises an electromagnetic coil winding and an electronic and electrical circuit around the central through hole, or an output end device of a mechanical shaft around the central through hole, and the drive block (5) comprises a conducting magnetic material for attraction with a passive object.
5. The induced hollow spiral driving apparatus of claim 1, wherein the shell (6) at least comprises: (1) the shell (6) is made of a non-conducting magnetic material that is the material other than iron or other conducting magnetic material through integrally casting or formed by using fasteners to assemble separate components thereof and sealing the components into the shell; (2) sensors (9) for sensing the temperature, the pressure and the rotor position are disposed at a front section and a back section inside the shell; (3) a comprehensive interface (10) for receiving electric cables, external signals and energy is disposed outside the central through hole of the shell, and (4) a thickness of an inner wall at the position of the central through hole of the shell is smaller than an effective radius of magnetic lines of force of the drive block (5) and the rotor (1).
6. The induced hollow spiral driving apparatus of claim 2, wherein a connection structure between the spiral rings (2.1, 2.2) formed in the apparatus and the inner wall of the rotor (1) is formed at least through (1) integrally casting, (2) inserted riveting or (3) welding.
7. The induced hollow spiral driving apparatus of claim 4, wherein the electronic and electrical circuit of the drive block (5) at least (1) is capable of receiving various instructions and making logic operations au-

tomatically; (2) is capable of generating magnetic forces of difference polarities through the operations and processing to operate the rotor, stop the rotor, rotate the rotor in a forward direction or in a reverse direction or regulate the rotation speed of the rotor; and (3) is provided with an external instruction input interface; and (4) has a plurality of internal sensors. 5

8. The induced hollow spiral driving apparatus of claim 1, wherein a clearance between the outer wall of the central through hole of the shell (6) and the outer wall (3) of the rotor is smaller than 50% of a diameter (Φ) of the rotor (1). 10

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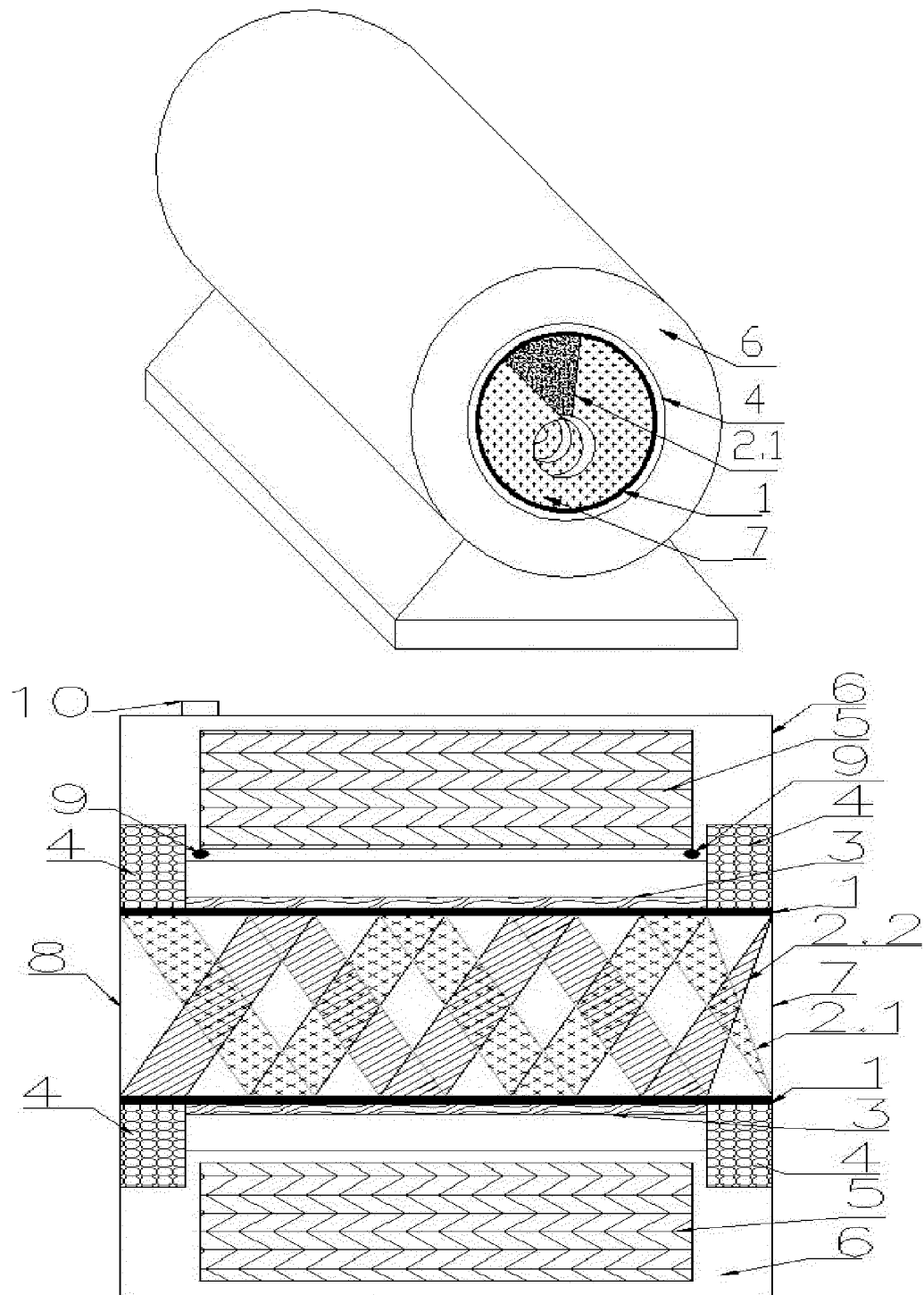


FIG. 1

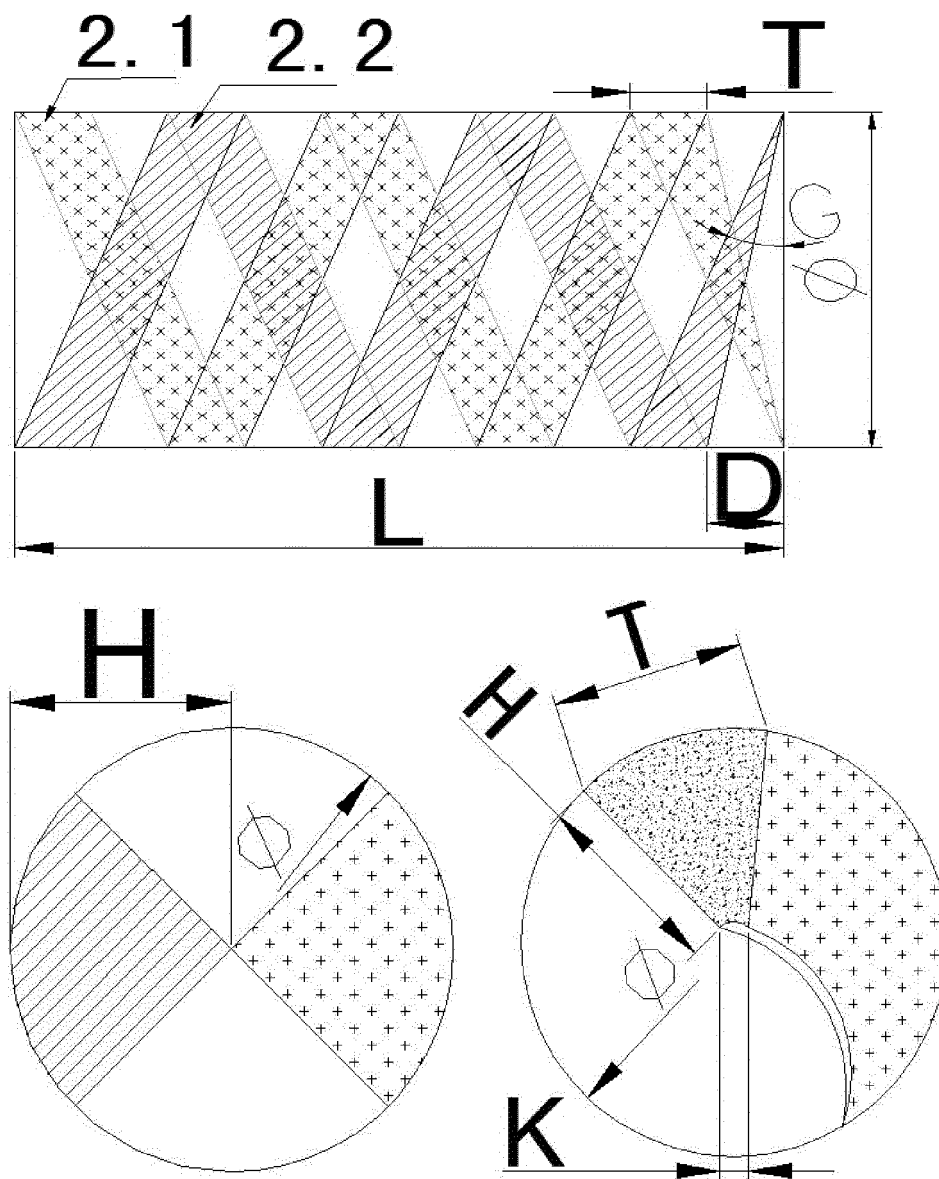


FIG. 2

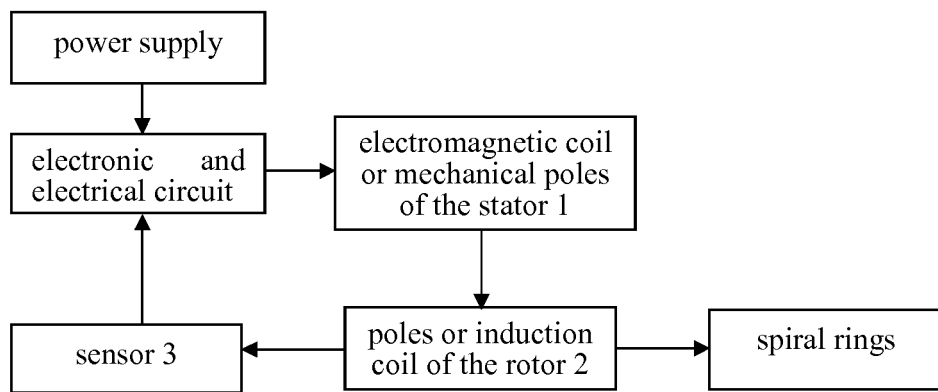


FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2013/085275

A. CLASSIFICATION OF SUBJECT MATTER

B63H 19/00 (2006.01) i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: B63H 19/00, 1/14, 1/00, H02K 7/10, 7/00, 29/00

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

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

CNPAT, CNKI, WPI, EPODOC: electric motor, sense, spiral, motor, propell+, magnet+, rotor?

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 101546939 A (HARBIN ENGINEERING UNIVERSITY), 30 September 2009 (30.09.2009), description, pages 2-3, and figures 1-3	1-8
A	CN 2447984 Y (SUNONWEALTH ELECTRIC MACHINE INDUSTRY CO., LTD.), 12 September 2001 (12.09.2001), the whole document	1-8
A	CN 101001041 A (YANG, Guangsun et al.), 18 July 2007 (18.07.2007), the whole document	1-8
A	CN 2534726 Y (HE, Lei), 05 February 2003 (05.02.2003), the whole document	1-8
A	JP 9-99896 A (MITSUBISHI HEAVY INDUSTRIES, LTD), 15 April 1997 (15.04.1997), the whole document	1-8
A	US 5411422 A (ROBERTSON, D.H.), 02 May 1995 (02.05.1995), the whole document	1-8

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	
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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	"&" document member of the same patent family

Date of the actual completion of the international search 06 December 2013 (06.12.2013)	Date of mailing of the international search report 02 January 2014 (02.01.2014)
Name and mailing address of the ISA/CN: State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No.: (86-10) 62019451	Authorized officer XU, Libo Telephone No.: (86-10) 62413204

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/CN2013/085275

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 101546939 A	30.09.2009	None	
CN 2447984 Y	12.09.2001	None	
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CN 2534726 Y	05.02.2003	None	
JP 9-99896 A	15.04.1997	None	
US 5411422 A	02.05.1995	None	

Form PCT/ISA/210 (patent family annex) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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