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(71) Applicant: **Cong, Yang**
Shenzhen, Guangdong 518034 (CN)

(72) Inventor: **Cong, Yang**
Shenzhen, Guangdong 518034 (CN)

(74) Representative: **Manitz, Finsterwald & Partner GbR**
Martin-Greif-Strasse 1
80336 München (DE)

(54) MULTISTAGE COMPRESSED GAS ENGINE AND MOTOR VEHICLE

(57) Disclosed is a multistage compressed gas engine, comprising: impellers and at least one impeller chamber where the impeller is installed, the impellers including a first impeller and a second impeller; a plurality of working chambers being formed by the side plates on both sides between the teeth on the circumferential surface of the first and second impellers, and a plurality of gas chambers allowing relative sealing of injected gas being formed by inner surface of the impeller chamber where the impeller is installed and each of the working chambers; the impeller chamber where the first impeller is installed being provided correspondingly with a first-stage compressed gas injection hole and a first-stage compressed gas discharge hole, and the impeller chamber where the second impeller is installed being provided correspondingly with a second-stage compressed gas injection hole and a second-stage compressed gas discharge hole, the first-stage compressed gas discharge hole being connected at its output to the second-stage compressed gas injection hole. Also disclosed is a motor vehicle equipped with the above compressed gas engine.

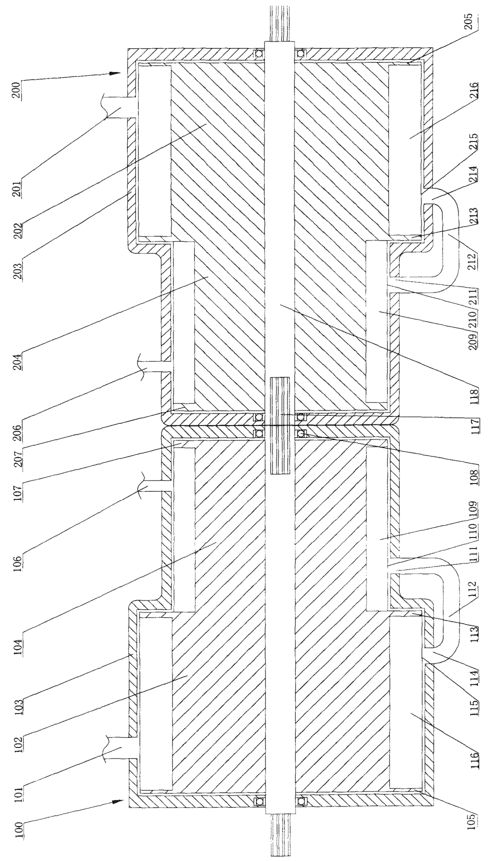

Fig. 4

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Description

TECHNICAL FIELD

[0001] The present application relates to an engine, and belongs to the field of machinery. This engine can be installed in a variety of power machinery, and particularly suitable for installation in a motor vehicle.

PRIOR ART

[0002] Engines using fuels as energy source consume a large amount of fuels, and discharge a large amount of waste gases and hot gases, which pollute the environment. In order to save fuel energy and protect the global environment, there is a need for engines that do not consume fuel, discharge waste gases and hot gases or cause pollution.

[0003] The applicant of the present application filed a Chinese patent application with publication number of CN1828046 titled " Wind-Powered Pneumatic Engine, Namely Engine Substituting Wind Pressure for Fuel Energy Source". This application disclosed a wind-power pneumatic engine and a motor vehicle equipped with the engine, which comprises at least one impeller chamber, an impeller arranged in the impeller chamber, and an air jet system for jetting compressed gas into the impeller chamber. This application is characterized mainly in that the impeller chamber is provided with an air inlet for receiving external wind resistance airflow and an air-jet system. During operation, the wind-powered pneumatic engine of this application, installed at a power-driven machine (especially a motor vehicle) that can run, can directly utilize the wind resistance airflow that the power-driven machine encounters during running by being provided with the air inlet for receiving the external wind resistance airflow, thereby transforming the resistance into power. With the air-jet system and the compressed gas as prime power, there is no fuel consumption, no waste gases or hot gases discharging, and no pollution.

[0004] Furthermore, the applicant further filed a patent application with application number of 200780030483.8 titled "Combined Wind-Powered Pneumatic Engine and Motor Vehicle". The main feature of this application is to provide respectively a multistage compressed gas engine and a wind resistance engine having a separate structure, and the impeller and vane can be designed respectively on purpose according to the features that the compressed gas has a high flow rate and is relatively concentrated while the windage airflow has a low flow rate and is relatively dispersive, so as to enable the compressed gas and wind resistance airflow to be better used in cooperation.

[0005] However, this new type of new-energy motor vehicles with compressed gas as power still needs further improvement.

SUMMARY

[0006] An object of the present application is to further improve the utilization efficiency of compressed gas.

[0007] The object can be accomplished by the following technical solutions:

[0008] A multistage compressed gas engine is provided, comprising: impellers and at least one impeller chamber where the impeller is installed; the impellers being comprising a first impeller and a second impeller, both of which being provided on their circumferential surface with a plurality of teeth and side plates on both sides of the teeth; a plurality of working chambers being formed by the teeth on the circumferential surface of the impeller and the side plates on both sides between the teeth, a plurality of gas chambers allowing relative sealing of injected gas being formed by the inner surface of the impeller chamber where the impeller is installed and each of the working chambers; the impeller chamber where the first impeller is installed being provided correspondingly with a first-stage compressed gas injection hole for ejecting compressed gas to the teeth of the first impeller and a first-stage compressed gas discharge hole for discharging the compressed gas temporarily stored in each of the working chambers of the first impeller, and the impeller chamber where the second impeller is installed being provided correspondingly with a second-stage compressed gas injection hole for ejecting compressed gas to the teeth of the second impeller and a second-stage compressed gas discharge hole for discharging the compressed gas temporarily stored in each of the working chambers of the second impeller, the first-stage compressed gas discharge hole being connected at its output to the second-stage compressed gas injection hole.

[0009] A compressed gas engine is provided, comprising: at least two stages of the compressed gas engine, each stage of the compressed gas engine including at least one impeller chamber and at least one impeller installed in the impeller chamber through a shaft, and the impeller being provided with teeth; each stage of the impeller chamber being provided with at least one air inlet and at least one air outlet, the air outlet on the front stage of the impeller chamber being in communication with the air inlet on the rear stage of the impeller chamber; and each stage of the impeller being output power through the shaft.

[0010] A motor vehicle is provided, comprising: a drive shaft and a multistage compressed gas engine; the multistage compressed gas engine being including impellers and at least one impeller chamber where the impellers are installed; the impellers being including a first impeller and a second impeller, both of which being provided on their circumferential surface with a plurality of teeth and side plates on both sides of the teeth; a plurality of working chambers being formed by the teeth on the circumferential surface of the impeller and the side plates on both sides between the teeth, and a plurality of gas chambers allowing relative sealing of injected gas being formed by the inner surface of the impeller chamber where the impeller is installed and each of the working chambers; the impeller chamber where the first impeller is installed being provided correspondingly with a first-stage compressed gas injection hole for ejecting compressed gas to the teeth of the first impeller and a first-stage compressed gas discharge hole for discharging the compressed gas temporarily stored in each of the working chambers of the first impeller, and the impeller chamber where the second impeller is installed being provided correspondingly with a second-stage compressed gas injection hole for ejecting compressed gas to the teeth of the second impeller and a second-stage compressed gas discharge hole for discharging the compressed gas temporarily stored in each of the working chambers of the second impeller, the first-stage compressed gas discharge hole being connected at its output to the second-stage compressed gas injection hole; the drive shaft of the motor vehicle being driven by the power outputted by the multistage compressed gas engine.

[0011] Furthermore, the at least one impeller chamber includes separately a first and a second impeller chambers, the first impeller being installed correspondingly in the first impeller chamber, the second impeller being installed correspondingly in the second impeller chamber.

[0012] Furthermore, there is only one impeller chamber; the first and second impellers are of an integral structure processed as a whole and are installed in the impeller chamber.

[0013] Furthermore, the first impeller and the second impeller have different diameters; the impeller chamber has different inner diameters to match the first and second impellers installed therein, so as to enable the inner surface of the impeller chamber to relatively seal the compressed gas in the working chamber of the first impeller and the compressed gas in the working chamber of the second impeller.

[0014] Furthermore, the first impeller and the second impeller are installed coaxially on the same power output shaft.

[0015] Furthermore, the second impeller is greater in diameter than the first impeller.

[0016] Furthermore, the second impeller is greater in thickness than the first impeller.

[0017] Furthermore, the first-stage compressed gas discharge hole has a diameter 2-10 times as long as that of the first-stage compressed gas injection hole, and the second-stage compressed gas discharge hole has a diameter 2-10 times as long as that of the second-stage compressed gas injection hole, the diameter of the second-stage compressed gas injection hole being no smaller than that of the first-stage compressed gas discharge hole.

[0018] Furthermore, the impeller chamber corresponding to the first impeller is provided on its inner surface with an air-jet import slot arranged along the rotational circumferential surface and communicated with the first-stage compressed gas injection hole.

[0019] Furthermore, the length of the air-jet import slot is greater than the distance between two adjacent teeth.

[0020] Furthermore, the impeller chamber is provided on its inner surface with an exhaust export slot in parallel with the axis of the shaft, the exhaust export slot being connected with the compressed gas discharge hole.

[0021] Furthermore, the distance between one end of the air-jet import slot and the adjacent exhaust export slot is greater than the distance between two adjacent teeth.

[0022] A compressed gas engine equipped with the above multistage compressed gas engines which are located symmetrically on the left and right is provided, wherein the multistage compressed gas engines are coaxially installed on the same power output shaft.

[0023] In the present application, the "multistage compressed gas engine" can be a compressed gas engine having two or more stages, wherein the compressed gas is discharged and entered into the next stage of the impeller to continue to do work after doing work to the front stage of the impeller.

[0024] With the above technical solution, the present application has the following beneficial technical effects:

[0025] The first impeller and the second impeller are in communication with each other front and rear. First, the energy of the compressed gas having done work to the first impeller can be ejected into the second impeller to continue to do work for a second time, which improves the energy utilization rate of the compressed gas. Second, through doing work for the second time, not only the energy utilization rate of the compressed gas is improved, but also a very good silencing effect is achieved. Third, with the pre- and post- stages structure of the first and second impellers, the compressed gas can be decompressed and stabilized only through the first impeller without using a decompression tank, which greatly reduces the energy loss during decompression and stabilization of the compressed gas.

[0026] With a left-right symmetrical structure, the compressed gas engine can achieve better force balance while working.

[0027] With the air-jet import slot having a length at least greater than the distance between two adjacent teeth, work can be done through one air inlet simultaneously to more than two teeth, which improves the power performance of the engine.

[0028] With the exhaust export slot, the gas having done work to the impeller can be successfully discharged timely.

[0029] By setting the distance between one end of the jet import slot and the nearest exhaust export slot to be greater than the distance between two adjacent teeth, the gas just injected can be prevented from being discharged directly from the exhaust export slot.

BRIEF DESCRIPTIONS OF THE DRAWINGS

[0030]

Fig. 1 is a structural schematic view of a multistage compressed gas engine.
Fig. 2 is a structural schematic view of the first-stage compressed gas engine as shown in Fig. 1.
Fig. 3 is an enlarged schematic view of the partial structure of the impeller chamber as shown in Fig. 2.
Fig. 4 is a structural schematic view of another multi-stage compressed gas engine.
Fig. 5 is a structural schematic view of another multi-stage compressed gas engine.

DETAILED DESCRIPTION

[0031] The present application will further be described below in detail with reference to drawings and embodiments.

[0032] Example 1: A motor vehicle is provided, as shown in Figs. 1-3, comprising a compressed gas engine on the left side, a compressed gas engine on the right side and a drive shaft 19, the compressed gas engines on the left and right sides are positioned symmetrically. Taking the compressed gas engine on the left side as an example, which includes a first-stage compressed gas engine 1 and a second-stage compressed gas engine 2, the first-stage compressed gas engine 1 including a first impeller 20 and a first impeller chamber 15, the second-stage compressed gas engine 2 including a second impeller 26 and a second impeller chamber 25. Except for different reference sizes, the first-stage compressed gas engine 1 and the second-stage compressed gas engine 2 have the same structure. The first-stage compressed gas engine 1 and the second-stage compressed gas engine 2 are coaxially installed on a same shaft 3, and the power generated by the compressed gas engines on both left and right sides drives the drive shaft of the motor vehicle via the shaft 3 and a clutch 5.

[0033] The structure of the compressed gas engine will be described in detail hereinafter by taking the first-stage compressed gas engine 1 as an example: as shown in Figs. 2 and 3, the first-stage compressed gas engine 1 includes a first impeller chamber 15 and a first impeller 20 installed in the first impeller chamber 15 through the shaft 3; the first impeller chamber 15 is provided with three groups of symmetrically arranged first-stage compressed gas injection holes 11 for ejecting compressed gas to the teeth 16 of the first impeller 20, and three groups of symmetrically arranged first-stage compressed gas discharge holes 12, the first-stage compressed gas injection hole 11 being provided with a nozzle 17; the first impeller 20 is provided on its circumferential surface with a plurality of uniformly distributed teeth 16 and side plates 23 located on both sides of the teeth 16; a plurality of working chambers 24 are formed by the teeth 16 on the circumferential surface of the first impeller 20 and the side plates 23 on both sides between the teeth 16, and a plurality of gas chambers allowing relative sealing of the gas injected from the first-stage compressed gas injection hole 11 are formed by the inner surface of the first impeller chamber 15 where the first impeller 20 is installed and each of the working chambers 24; when the working chamber 24 temporarily containing compressed gas is rotated to a position where the first-stage compressed gas discharge hole 12 is located, the compressed gas in the working chamber 24 is ejected outward to do work via the first-stage compressed gas discharge hole 12, further pushing the impeller 20 to rotate. The first-stage compressed gas discharge hole 12 on the first impeller chamber 15 is in communication with the second-stage compressed gas injection hole 21 on the second impeller chamber 25.

[0034] The diameter of the first impeller 20 of the first-stage compressed gas engine 1 is smaller than that of the second impeller 26 of the second-stage compressed gas engine 2, so as to increase the blade surface of the teeth of the second-stage compressed gas engine 2. In order to make gas flow smoothly, the first-stage compressed gas discharge hole 12 has a diameter 2-10 times as long as that of the first-stage compressed gas injection hole 11, while the second-stage compressed gas discharge hole 22 has a diameter 2-10 times as long as that of the second-stage compressed gas injection hole 21. The times can be set flexibly.

[0035] As shown in Figs. 2 and 3, in order to improve the power performance, the impeller chamber 15 is provided on its inner surface with an air-jet import slot 13 arranged along the rotational circumferential surface and communicated with the first-stage compressed gas injection hole 11, the air-jet import slot being deep and wide near to the injection hole 11 while shallow and narrow away from the injection hole 11 (Fig. 3); the air-jet import slot 13 has a length greater than the distance L (marked as 18) between two adjacent teeth 16, enabling the compressed gas exported from the air-jet import slot 13 to be applied simultaneously to two or more teeth 16 on one hand, and to be applied to the desired teeth portion along a preset export path on the other hand, so as to generate a stronger thrust. Besides, in order to increase air-jet intensity, two nozzles 17 are arranged on the same air-jet import slot 13 in the example.

[0036] The first impeller chamber 15 is provided on its inner surface with an exhaust export slot 14 in parallel with the axis of the shaft, the exhaust export slot 14 being in communication with the first-stage compressed gas discharge hole 12. In order to better exhaust the gas, the exhaust export slot 14 has a width substantially consistent with the width of the first impeller 20.

[0037] To prevent leakage and prevent the gas just injected from being directly discharged from the exhaust export slot 14, the distance between the end of the air-jet import slot 13 and the nearest exhaust export slot 14 should be greater than the distance L between two adjacent teeth.

[0038] During operation, the compressed gas is first injected into the first-stage compressed gas engine 1, and then enters the second-stage compressed gas engine 2 after being decompressed and stabilized by the first-stage compressed gas engine 1. The first-stage compressed gas engine 1 not only has functions of decompression and stabilization, but also allows full utilization of the energy generated in the process of releasing the compressed gas, as well as provides part of the power at the same time. The second-stage compressed gas engine 2 provides main power.

[0039] Example 2: Another compressed gas engine is provided, as shown in Fig. 4, comprising a two-stage compressed gas engine on the left side and a two-stage compressed gas engine on the right side. The two-stage compressed gas engine on the left side is a first-stage compressed gas engine 100, while the two-stage compressed gas engine on the right side is a second-stage compressed gas engine 200. The first-stage compressed gas engine 100 and the second-stage compressed gas engine 200 have the same structure, and are positioned symmetrically at left and right. The first-stage compressed gas engine 100 and the second-stage compressed gas engine 200 are coaxially installed on a shaft 118, and connected with a spline sleeve 117 through a bearing 108. The power generated by the two-stage compressed gas engines (100 and 200) on the left and right sides is outputted through the shaft 118 for driving the drive shaft of the motor vehicle.

[0040] Taking the first-stage compressed gas engine 100 as an example, the first-stage compressed gas engine 100 includes an impeller chamber 103 as well as a first impeller 104 and a second impeller 102 installed in the impeller chamber 103 through the shaft 118. The impeller chamber 103 has different inner diameters matched with the diameters of the first impeller 104 and the second impeller 102 installed therein, so as to enable the inner surface of the impeller chamber 103 to relatively seal the compressed gas in the working chambers 109 of the first impeller 104 and the compressed gas in the working chambers 116 of the second impeller 102. The impeller chamber 103 is provided respectively with a first-stage compressed gas injection hole 106 for injecting compressed gas to the first impeller 104, a first-stage compressed gas discharge hole 111 for ejecting compressed gas from the first impeller 104, a second-stage compressed gas injection hole 114 for injecting compressed gas to the second impeller 102, and a second-stage compressed gas discharge hole 101 for discharging compressed gas from the second impeller 102. The first-stage compressed gas discharge hole 111 is in communication with the second-stage compressed gas injection hole 114 via a pipe 112, for injecting the compressed gas from the first impeller 104 into the second impeller 102 to continue to do work.

[0041] The first impeller 104 is provided on its rotational circumferential surface with a plurality of uniformly distributed teeth 110 and side plates 107 located on the right side of the teeth 110; the second impeller 102 is provided on its rotational circumferential surface with a plurality of uniformly distributed teeth 115 and side plates 105 located on the left side of the teeth 115 as well as side plates 113 located on the right side of the teeth 115. The gas circuit of the first impeller 104 is isolated from that of the second impeller 102 through the side plates 113. The structures of the teeth 110 on the first impeller 104 and the teeth 115 on the second impeller 102 are similar to those in Example 1. A plurality of working chambers 109 are formed by the teeth 110 on the circumferential surface of the first impeller 104 and the side plates (107 and 113) on both sides between the front and rear teeth 110, and a plurality of gas chambers allowing relative sealing of injected compressed gas are formed by the inner surface of the impeller chamber 103 where the first impeller 104 is installed and each of the working chambers 109. A plurality of working chambers 116 are formed by the teeth 115 on the circumferential surface of the second impeller 102 and the side plates (105 and 113) on both sides between the front and rear teeth 115, and a plurality of gas chambers allowing relative sealing of the gas injected from the second-stage compressed gas injection hole 114 are formed by the inner surface of the impeller chamber 103 where the second impeller 102 is installed and each of the working chambers 116.

[0042] The first impeller 104 is smaller in diameter than the second impeller 102, so as to increase the stressed area of the teeth on the second impeller 102. In order to make gas flow smoothly, the first-stage compressed gas discharge hole 119 has a diameter 2-10 times as long as that of the first-stage compressed gas injection hole 106, while the second-stage compressed gas discharge hole 101 has a diameter 2-10 times as long as that of the second-stage compressed gas injection hole 121. The times can be set flexibly.

[0043] In particular, due to the high requirement of rotational speed of the compressed gas engine (3000-15000 rpm), if the first impeller 104 and the second impeller 102 are processed separately, it is difficult to guarantee the concentricity of the two (coaxial performance) because of the errors of machining accuracy as well as complex processing technique and high processing cost. In order to improve the concentricity of the impeller and simplify the processing technique, the first impeller 104 and the second impeller 102 are designed to have an integral structure processed as a whole.

[0044] The second-stage compressed gas engine 200 includes an impeller chamber 205, a third impeller 204 and a fourth impeller 202. Apart from the difference in marks from the first-stage compressed gas engine 100, the second-stage compressed gas engine 200 has a structure similar to the structure of the first-stage compressed gas engine 100 (which will not be repeated herein).

[0045] During operation, the compressed gas is first injected into the first-stage compressed gas engine 100, and then enters the second-stage compressed gas engine 200 after being decompressed and stabilized by the first-stage compressed gas engine 100. The first-stage compressed gas engine 100 not only has functions of decompression and stabilization, but also allows full utilization of the energy generated in the process of releasing the compressed gas, as well as provides part of the power at the same time. The second-stage compressed gas engine 200 provides main power. More particularly, the compressed gas injected from the first-stage compressed gas injection hole 106 to the teeth 110 of the first impeller 104 pushes the first impeller 104, and is simultaneously stored temporarily in each of the working chambers 109; when the working chamber 109 temporarily containing compressed gas is rotated to a position where the first-stage compressed gas discharge hole 111 is located, the compressed gas in the working chamber 109 is ejected outward to do work via the first-stage compressed gas discharge hole 111, further pushing the first impeller 104 to rotate. Meanwhile, because the first-stage compressed gas discharge hole 111 on the impeller chamber 103 is in communication with the second-stage compressed injection hole 114, the compressed gas discharged from the first-stage compressed gas discharge hole 111 continues to push the teeth 115 of the second impeller 102 to rotate to do work via the second-stage compressed injection hole 114. The injected compressed gas is simultaneously stored temporarily in each of the working chambers 116; when the working chamber 116 temporarily containing compressed gas is rotated to a position where the second-stage compressed gas discharge hole 101 is located, the compressed gas in the working chamber 116 is ejected outward to do work via the second-stage compressed gas discharge hole 101, further pushing the second impeller 102 to rotate to do work.

[0046] Example 3: Another multistage compressed gas engine is provided, as shown in Fig. 5, comprising a two-stage compressed gas engine on the left side and a two-stage compressed gas engine on the right side. The two-stage compressed gas engine on the left side is a first-stage compressed gas engine 300, while the two-stage compressed gas engine on the right side is a second-stage compressed gas engine 400. The first-stage compressed gas engine 300 and the second-stage compressed gas engine 400 have the same structure, positioned symmetrically left and right. The first-stage compressed gas engine 300 and the second-stage compressed gas engine 400 are coaxially installed on a shaft 318, and connected with a spline sleeve 317 through a bearing 308. The power generated by the two-stage compressed gas engines on the left and right sides is outputted through the shaft 318 for driving the drive shaft of the motor vehicle.

[0047] Taking the first-stage compressed gas engine 300 as an example, the first-stage compressed gas engine 300 includes an impeller chamber 303, as well as a first impeller 303 and a second impeller 302 installed in the impeller chamber 304 through the shaft 318; the impeller chamber 303 has an inner diameter matching the diameters of the first impeller 304 and the second impeller 302 installed therein, so as to enable the inner surface of the impeller chamber 303 to relatively seal the compressed gas in the working chambers (309 and 316) of the first impeller 304 and the second impeller 302. The impeller chamber 303 is provided respectively with a first-stage compressed gas injection hole 306 for injecting compressed gas to the first impeller 304, a first-stage compressed gas discharge hole 311 for ejecting compressed gas from the first impeller 304, a second-stage compressed gas injection hole 314 for injecting compressed gas to the second impeller 302, and a second-stage compressed gas discharge hole 302 for discharging compressed gas from the second impeller 301. The first-stage compressed gas discharge hole 311 is in communication with the second-stage compressed gas injection hole 314 via a pipe 312, for injecting the compressed gas from the first impeller 304 into the second impeller 302 to continue to do work.

[0048] The first impeller 304 is provided on its rotational circumferential surface with a plurality of uniformly distributed teeth 310 and side plates 307 located on the right side of the teeth 310; the second impeller 302 is provided on its rotational circumferential surface with a plurality of uniformly distributed teeth 315 and side plates 305 located on the left side of the teeth 315 as well as side plates 313 located on the right side of the teeth 315. The gas circuit of the first impeller 304 is isolated from that of the second impeller 302 through the side plate 313. The structures of the teeth 310 on the first impeller 304 and the teeth 315 of the second impeller 302 are similar to those in Example 1. A plurality of working chambers 309 are formed by the teeth 310 on the circumferential surface of the first impeller 304 and the side plates (307 and 313) on both sides between the front and rear teeth 310, and a plurality of gas chambers allowing relative sealing of injected compressed gas are formed by the inner surface of the impeller chamber 304 where the first impeller 303 is installed and each of the working chambers 309. A plurality of working chambers 316 are formed by the teeth 315 on the circumferential surface of the second impeller 302 and the side plates (305 and 313) on both sides between the front and rear teeth 315 , and a plurality of gas chambers allowing relative sealing of the gas injected from the second-stage compressed gas injection hole 314 are formed by the inner surface of the impeller chamber 302 where the second impeller 303 is installed and each of the working chambers 316.

[0049] This example is different from Example 2 in that: in Example 2, the first impeller 204 and the second impeller 202 are the same in width but different in diameter, wherein the second impeller 202 is greater in diameter than the first impeller 204, and the stressed area of the teeth on the second impeller 102 is increased by increasing the diameter of the second impeller 202. The impeller chamber 103 has different inner diameter to match the diameters of the first impeller 104 and the second impeller

102 installed therein. However, in this example, the first impeller 304 and the second impeller 302 are the same in diameter, the first impeller 304 and the second impeller 302 installed in the impeller chamber 303 are the same in inner diameter, and the second impeller 302 is greater in width than the first impeller 304, wherein the stressed area of the teeth on the second impeller 302 is increased by increasing the width of the second impeller 302.

[0050] The above contents are further detailed description of the present application with reference to the specific embodiments, and the embodiments of the present application cannot be thought to be limited to these contents. For those skilled in the art, some simple deduction or replacement can further be made under the premise of not departing from the idea of the present application, and should all be regarded as falling within the protection scope of the present application.

Claims

1. A multistage compressed gas engine, comprising impellers and at least one impeller chamber where the impellers are installed, **characterized in that**: the impellers comprises a first impeller and a second impeller, both of which are provided on their circumferential surface with a plurality of teeth and side plates on both sides of the teeth; a plurality of working chambers are formed by the teeth on the circumferential surface of the impeller and the side plates on both sides between the teeth, and a plurality of gas chambers allowing relative sealing of injected gas are formed by the inner surface of the impeller chamber where the impeller is installed and each of the working chambers; the impeller chamber where the first impeller is installed is provided correspondingly with a first-stage compressed gas injection hole and a first-stage compressed gas discharge hole, and the impeller chamber where the second impeller is installed is provided correspondingly with a second-stage compressed gas injection hole and a second-stage compressed gas discharge hole, the first-stage compressed gas discharge hole being connected at its output to the second-stage compressed gas injection hole.

2. The multistage compressed gas engine according to claim 1, **characterized in that**: the at least one impeller chamber comprises independently a first and a second impeller chambers, the first impeller being installed correspondingly in the first impeller chamber, the second impeller being installed correspondingly in the second impeller chamber.

3. The multistage compressed gas engine according to claim 1, **characterized in that**: there is just one impeller chamber; the first and second impellers are of an integral structure processed as a whole and are installed in the impeller chamber.

4. The multistage compressed gas engine according to claim 3, **characterized in that**: the first impeller and the second impeller have different diameters; the impeller chamber has different inner diameters to match the first and second impellers installed therein, so as to enable the inner surface of the impeller chamber to relatively seal the compressed gas in the working chamber of the first impeller and the compressed gas in the working chamber of the second impeller.

5. The multistage compressed gas engine according to any one of claims 1-4, **characterized in that**: the first impeller and the second impeller are installed coaxially on the same power output shaft.

6. The multistage compressed gas engine according to any one of claims 1-4, **characterized in that**: the second impeller is greater in diameter than the first impeller.

7. The multistage compressed gas engine according to any one of claims 1-4, **characterized in that**: the second impeller is greater in thickness than the first impeller.

8. The multistage compressed gas engine according to any one of claims 1-4, **characterized in that**: the first-stage compressed gas discharge hole has a diameter 2-10 times as long as that of the first-stage compressed gas injection hole, and the second-stage compressed gas discharge hole has a diameter 2-10 times as long as that of the second-stage compressed gas injection hole, the diameter of the second-stage compressed gas injection hole being no smaller than that of the first-stage compressed gas discharge hole.

9. The multistage compressed gas engine according to any one of claims 1-4, **characterized in that**: the impeller chamber corresponding to the first impeller is provided on its inner surface with an air-jet import slot arranged along the rotational circumferential surface and communicated with the first-stage compressed gas injection hole.

10. The multistage compressed gas engine according to claim 9, **characterized in that**: the length of the air-jet import slot is greater than the distance between two adjacent teeth.

11. The multistage compressed gas engine according to any one of claims 1-4, **characterized in that**: the impeller chamber is provided on its inner surface with an exhaust export slot in parallel with the axis of the shaft, the exhaust export slot being connected with

the compressed gas discharge hole.

12. The multistage compressed gas engine according to claim 9, **characterized in that**: the impeller chamber is provided on its inner surface with an exhaust export slot in parallel with the axis of the shaft, the exhaust export slot being connected with the compressed gas discharge hole.

13. The multistage compressed gas engine according to claim 11, **characterized in that**: the distance between an end of the air-jet import slot and the adjacent exhaust export slot is greater than the distance between two adjacent teeth.

14. A compressed gas engine, comprising multistage compressed gas engines positioned symmetrically at left and right, which have the structure as described by any one of claims 1-4 and are coaxially installed on the same power output shaft.

15. A motor vehicle provided with the multistage compressed gas engine according to any one of claims 1-4, wherein the power outputted by the multistage compressed gas engine drives the drive shaft of the motor vehicle.

16. A compressed gas engine, comprising: at least two stages of the compressed gas engine, each stage of the compressed gas engine comprising at least one impeller chamber and at least one impeller installed in the impeller chamber through a shaft, the impeller being provided with teeth, each stage of the impeller chamber being provided with at least one air inlet and at least one air outlet, the air outlet on the front stage of the impeller chamber being in communication with the air inlet on the rear stage of the impeller chamber, and each stage of the impeller being output power through the shaft.

17. The compressed gas engine according to claim 16, **characterized in that**: at least the impeller chamber of the first-stage compressed gas injection hole for introduction of compressed gas is provided on its inner surface with an air-jet import slot arranged along the rotational circumferential surface and communicated with the first-stage compressed gas injection hole.

18. The compressed gas engine according to claim 17, **characterized in that**: the impeller chamber for being connected with the air outlet is provided on its inner surface with an exhaust slot in parallel with the axis of the shaft.

19. The compressed gas engine according to claim 18, **characterized in that**: the length of the air-jet import slot is at least greater than the distance between two adjacent teeth, and the distance between the end of the air-jet import slot and the nearest exhaust slot is greater than the distance between two adjacent teeth.

20. A motor vehicle provided with the compressed gas engine according to any one of claims 16-19, wherein the power outputted by each stage of the impellers drives the drive shaft of the motor vehicle.

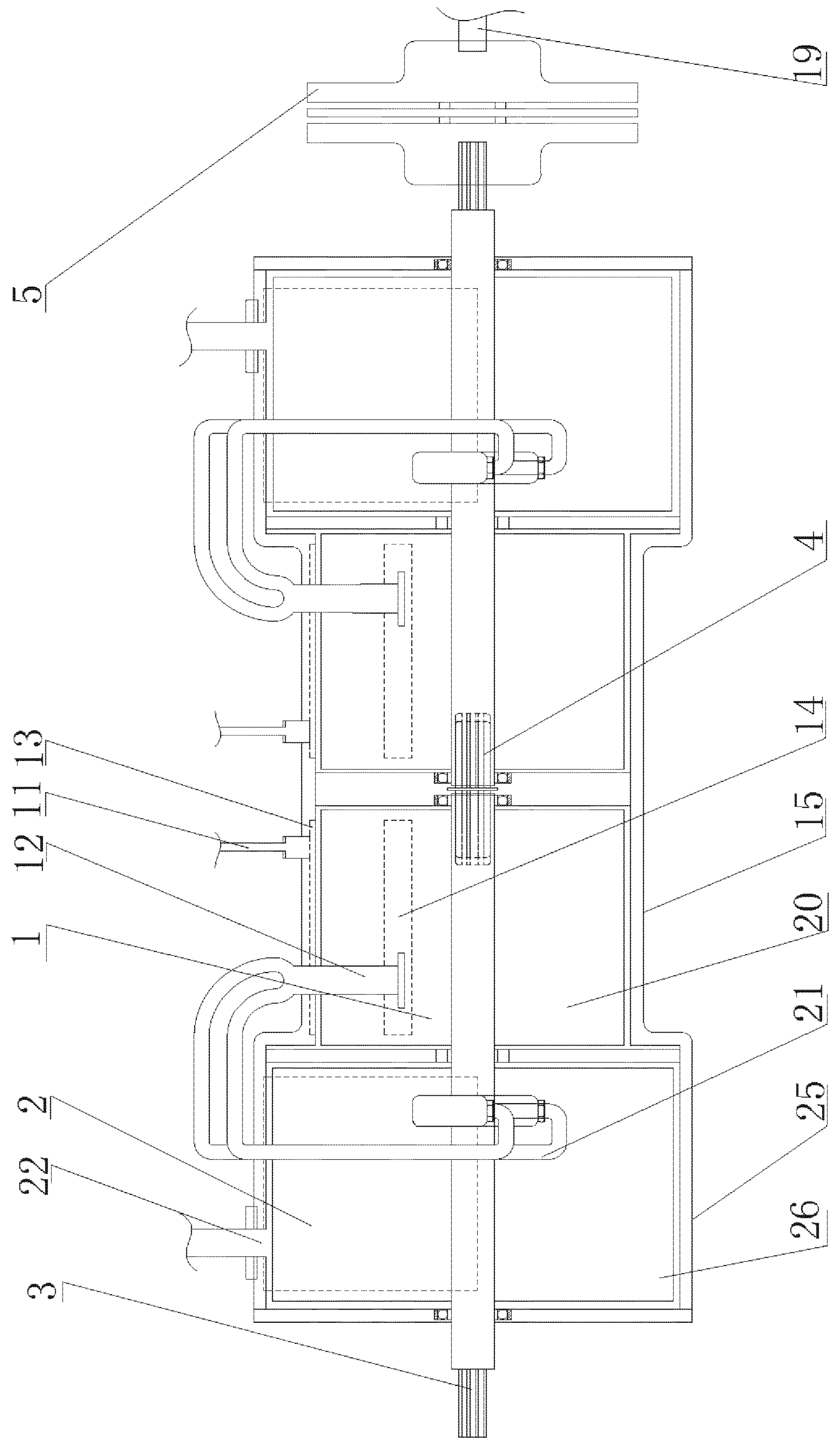

Fig. 1

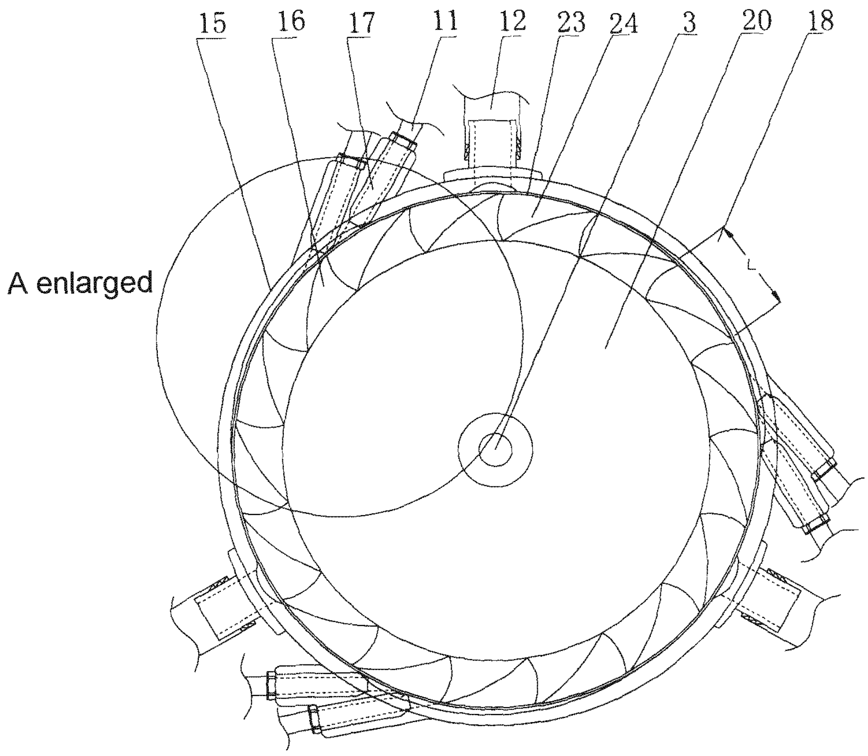

Fig. 2

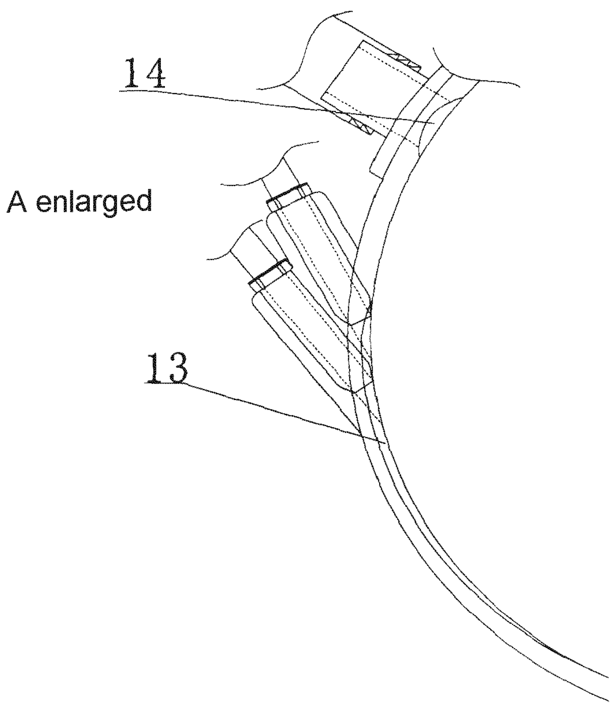

Fig. 3

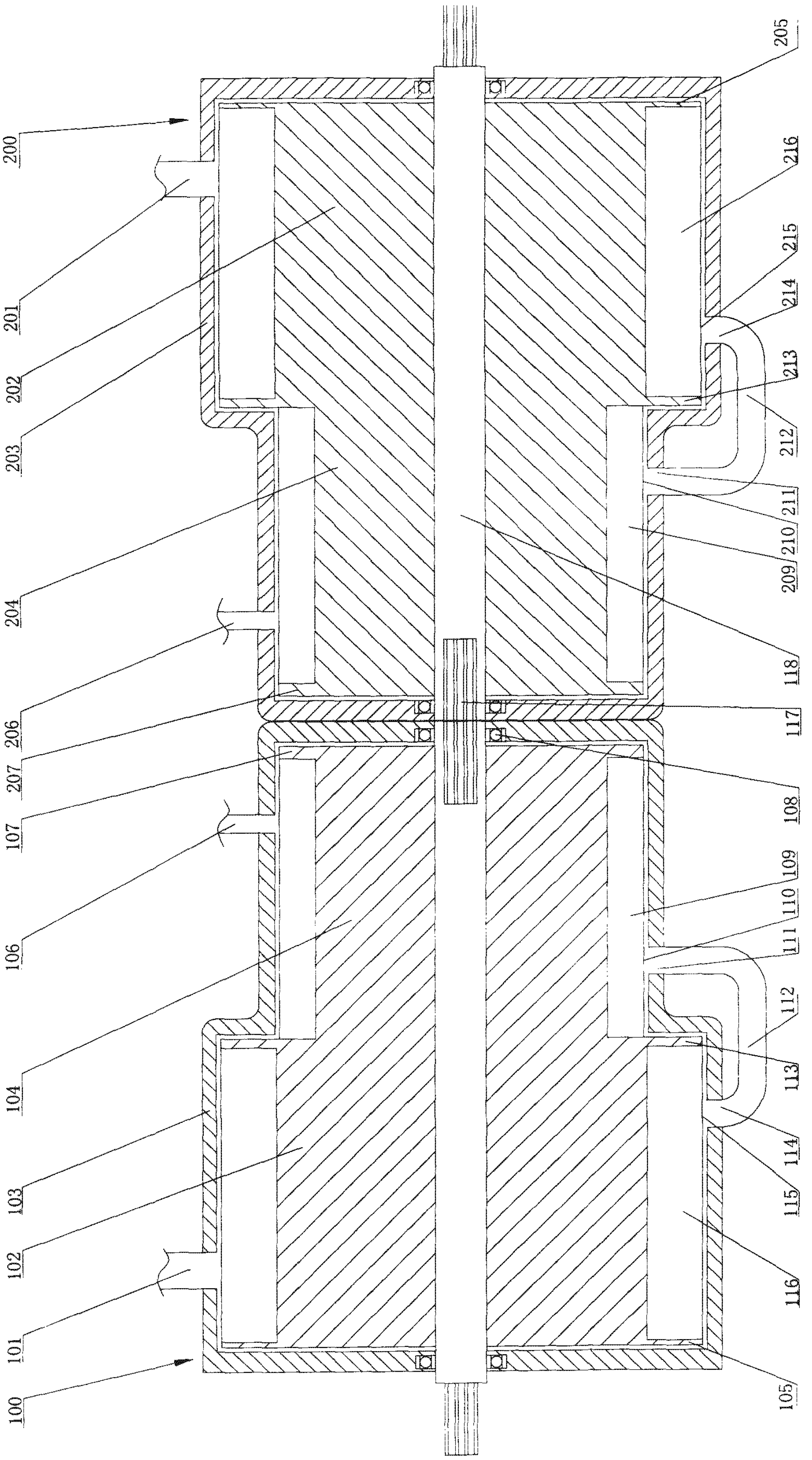
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Fig. 4

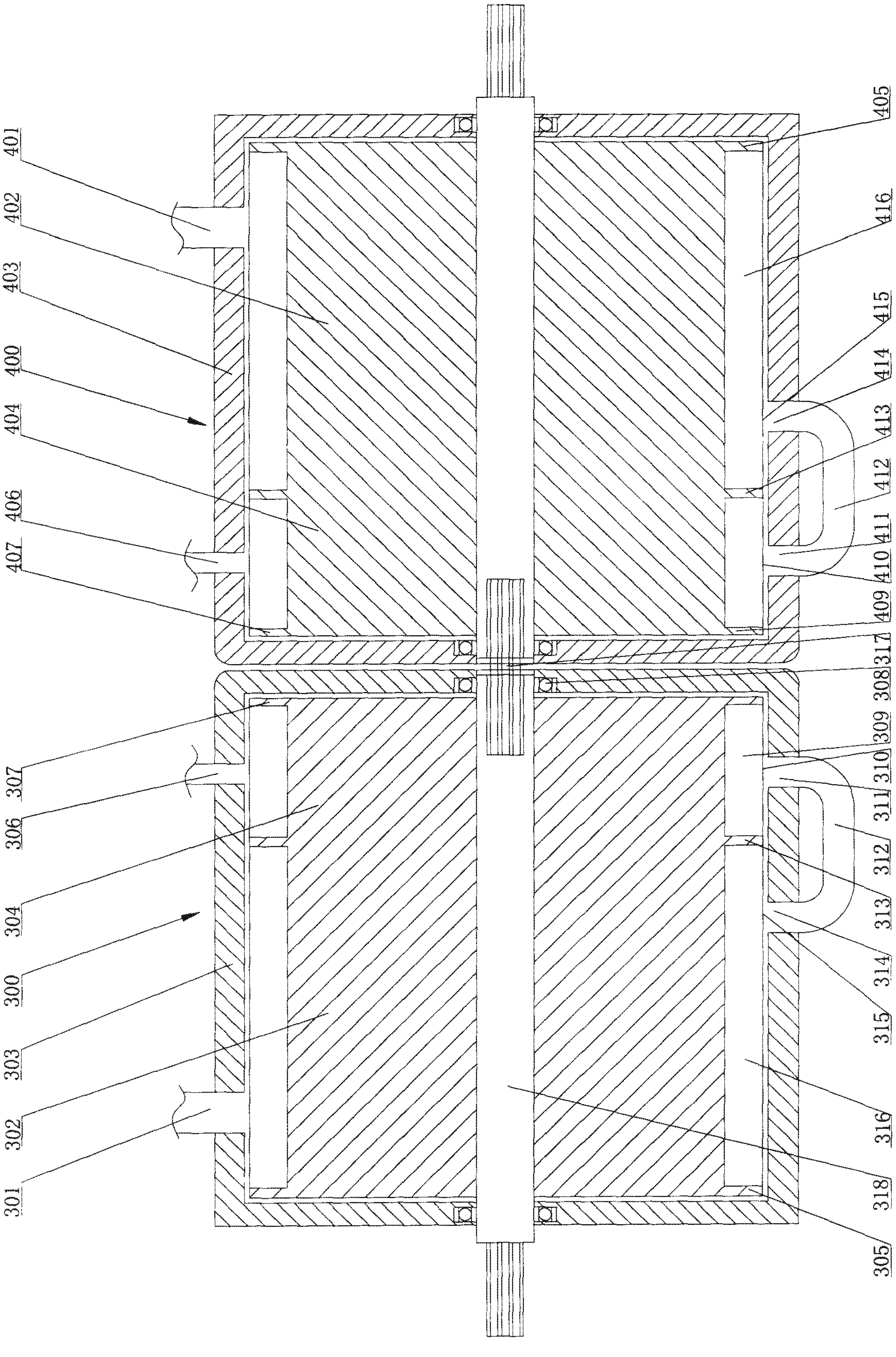
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Fig. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2011/076345

A. CLASSIFICATION OF SUBJECT MATTER

See extra sheet

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:F01D

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)

WPI,EPODOC,CNPAT,CNKI: blade, impeller, multi-, stage, compress, communicate

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	CN201874623U(CONG Yang)22 Jun. 2011(22.06.2011)pages 2-3 of the description, figs.1-3	1-20
E	CN201934144U(CONG Yang)17 Aug. 2011(17.08.2011) pages 3-5 of the description, figs.1-5	1-20
A	GB999459A(ERICH MARTIN)28 Jul. 1965(28.07.1965) pages 2-6 of the description, figs.1-8	1-20
A	US2631428A(ARTHUR H NELSON et al.)17 Mar. 1953(17.03.1953)the whole document	1-20
A	CN2702088Y(ZHU Miaorui)25 May 2005(25.05.2005) the whole document	1-20

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

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

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Date of the actual completion of the international search	Date of mailing of the international search report
16 Sep. 2011(16.09.2011)	**13 Oct. 2011 (13.10.2011)**

Name and mailing address of the ISA/CN
The State Intellectual Property Office, the P.R.China
6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China
100088
Facsimile No. 86-10-62019451

Authorized officer
LIU,Wei
Telephone No. (86-10)62085288

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2011/076345

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN201874623U	22.06.2011	CN201934144U	17.08.2011
CN201934144U	17.08.2011	CN201874623U	22.06.2011
GB999459A	28.07.1965	BE616664A1	16.08.1962
		US3214907A	02.11.1965
US2631428A	17.03.1953	NONE	
CN2702088Y	25.05.2005	NONE	

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

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2011/076345

A. CLASSIFICATION OF SUBJECT MATTER

F01D13/02(2006.01)i
F01D1/02(2006.01)i
F01D9/02(2006.01)i

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 1828046 **[0003]**
- WO 200780030483 A **[0004]**