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(54) ELECTRICITY GENERATOR AND STAND-ALONE MEASURING SYSTEM

(57) The invention relates to an electric current generator that uses the fluid movement in a pipe to generate an electric current, that includes an axial rotor having the form of a movable inner ring, which has a bearing and is equipped with short vanes, placed on the inside at an angle of >0° to the rotor plane of rotation, and permanent magnets placed on the outside, wherein the magnets are arranged alternately with the N and S poles on the outside, a stationary outer ring equipped on the outside with ferromagnetic elements with wound coils, which are electrically connected to each other, so that the axial rotor, rotating due to the flow of liquid or gas, generates an alternating magnetic field in the ferromagnetic elements, wherein the generator is seated in a pipe section terminated with connectors on both sides. The invention further relates to a stand-alone measuring system, characterized in that it contains at least one electric current generator, at least one measuring device; and a DC/AC or DC/DC converter.

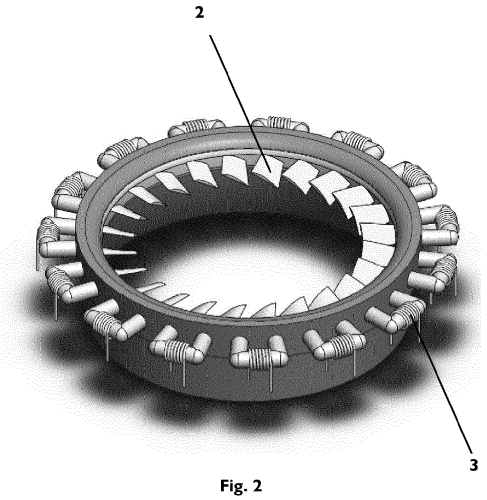

Fig. 2

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Description

[0001] The subject matter of the present invention is an electricity generator and a stand-alone measuring or telemetry system that generates electricity for itself to supply power to the measuring electronics.

[0002] WO2016048128A1 describes a small water generator comprising permanent magnets which is driven in rotation by a rotor via a coupling member to generate a constant electric current due to the rotation of the rotor caused by the flow of fluid. The device may include a water stagnation unit configured to supply water continuously through a conduit to the impeller. The impeller includes at least two L-shaped blades with an airfoil member and discharge nozzles attached thereto, spaced apart by a duct adapter assembly. The outlet nozzle ejects water at an increased speed in a first direction to create a repulsive force tending to move the corresponding L-shaped blade in a second direction opposite to the first direction.

[0003] US2010308591A1 discloses a water-in-tube generator that includes a housing on which a multi-bladed rotating impeller is mounted. The housing is attached to the water pipe so that water flows from the water pipe into the housing, then initiates the mechanical rotation of the impeller. The impeller is designed so that only one impeller blade is submerged in the water when the impeller is mechanically rotated. The electric generator is axially connected to the rotor so that when the rotor rotates, the electric generator generates electricity. The water then flows out of the casing and returns to the water pipe.

[0004] CN204239141U discloses a solution for using waste water to generate electricity. The utility model shows a domestic wastewater generator which consists of three parts: a power supply device, a power generating device and a battery. The feeding device consists of a housing, a fixed sleeve, a sealing sleeve, an impeller and a driving wheel; at the upper end and at the lower end of the cover there are water pipe connectors for connecting the domestic sewage discharge pipe; the vane part of the impeller is placed inside the housing; one end of the rotor shaft is inserted into a hole in the side housing, and the other end of the rotor shaft extends through the housing and is connected to the drive wheel. The impeller is driven into rotation by the kinetic energy generated by the discharge of waste water.

[0005] JP2000125578A discloses a thermoelectric generator charging a local battery with a different structure than the generator of the present invention.

[0006] The documents found describe systems employing various generators, including thermoelectric generators, also for measuring systems, however, no document solves the problem of supplying power to measuring devices in pipes, e.g. water pipes, in building installations or pipelines.

[0007] So, the object of the present invention was to develop a design of an electric current generator that could be used in measuring systems for stand-alone power supply, and to develop such a measuring system for use in building installations or pipelines.

[0008] This object was achieved by an electric current generator and a stand-alone measuring or telemetry system according to the present invention, which generates electricity for itself to supply power to the measurement electronics. As a result, the measuring or telemetry system is not dependent on the power grid. It will also work if the power grid is damaged.

[0009] The subject matter of the present invention is the electric current generator that uses the fluid movement in a pipe to generate an electric current, that includes an axial rotor having the form of a movable inner ring, which has a bearing and is equipped with short vanes, placed on the inside at an angle of >0° to the rotor plane of rotation, and permanent magnets placed on the outside, wherein the magnets are arranged alternately with the N and S poles on the outside, a stationary outer ring equipped on the outside with ferromagnetic elements with wound coils, which are electrically connected to each other, so that the axial rotor, rotating due to the flow of liquid or gas, generates an alternating magnetic field in the ferromagnetic elements, wherein the generator is seated in a pipe section terminated with connectors on both sides. The invention further relates to a stand-alone measuring system, characterized in that it contains at least one electric current generator, at least one measuring device; and a DC/AC or DC/DC converter.

[0010] The subject matter of the invention is shown in embodiments in drawings, where:

Fig. 1 shows the local power supply system for the measuring/telemetry system;

Fig. 2 shows the construction of the rotor with vanes and coils;

Fig. 3 shows the generator cross-section for insertion as part of the flow pipe;

Fig. 4 shows the generator bearing;

Fig. 5 shows the rotor with vanes and magnets; and

Fig. 6 shows the construction of the rotor with vanes, coils, and magnets.

[0011] The main application of such a system is metering of buildings including (cold, hot and central heating) water installations. The measured parameters are: room air temperature, cold water temperature, hot water temperature and central heating water temperature. In addition, the flow of water through the pipe on which the energy generator is built can be measured. Cold and hot water are used occasionally, while the water in the central heating installation is in constant motion, but only during the heating season.

[0012] To become independent of the heating season, it is preferable to place the generators on more than one pipe and to use a battery that is recharged when water flows through the generator. Such a design allows the measuring system to operate continuously without drawing electricity from the power grid.

[0013] If the energy obtained from the water movement in the pipes is insufficient, an alternative way of obtaining energy from the water pipes using the temperature difference can be used simultaneously. It is proposed to use the temperature difference between hot water (about 55 °C) and cold water (about 15 °C), or between water in the central heating installation (about 75 °C) and cold water (about 15 °C). This difference can be used to generate electricity by either a Stirling engine or thermoelectric cells (Peltier cells - Seebeck effect). Additional electricity will be obtained this way. The temperature difference is fairly constant.

[0014] Own power supply, independent of the power grid, guarantees continuity of measurements and control as long as the amount of energy obtained from the working medium flowing through the generator is greater than the amount of energy consumed by the measuring and communication system. Separation from the power grid makes it possible to build modular, independent from one another installations in buildings.

[0015] Another use of the electricity generator according to the present invention is to supply power to the telemetry systems in gas, water and oil pipelines. This is a much more convenient solution for pipeline operators than using an external, vulnerable electric grid.

[0016] In this way, it is possible to supply electricity to devices that cannot be connected to the power grid for various reasons. The advantage is 100% galvanic isolation between the circuits powered in this way.

[0017] The generator is placed instead of a pipe section through which the liquid or gas flows. The axial rotor (1) is in the form of a movable inner ring. The inner ring has a bearing (is movable) and is equipped with short vanes (2) placed on the inside at an angle of >0° to the plane of rotation of the movable ring, and permanent magnets (6) on the outside. The rotor (1) is pressed by the flowing liquid or gas against the ceramic balls (5) bearing the rotor. The balls (5) must not be metal. Therefore, the rotor (1) puts up little resistance and does not significantly affect the measurement results.

[0018] Magnets (6) are placed on the rotor (1) (with alternating N and S poles on the outside). The axial rotor (1) is placed in a stationary outer ring (4), which is equipped on the outside with ferromagnetic elements with wound coils (3). Permanent magnets (6) are seated in holes in the inner ring of the rotor (1). The poles of the magnets (6) are arranged alternately. The rotor (1) rotating due to the flow of liquid or gas generates an alternating magnetic field in the ferromagnetic elements. This alternating magnetic field in turn generates a sinusoidal electric voltage in the coils (3). The coils (3) can be connected in series and parallel and an electrical load (current receiver) can be connected.

[0019] The receiver can rectify the AC voltage and convert the resulting DC voltage into an AC voltage of the same frequency and amplitude as that of the power grid. This will allow connecting any current receivers to the generator. DC voltage also can be used to supply power to electronics.

[0020] The proposed solution does not require the rotor axis to be brought outside, so there is no problem with the tightness of the installation.

[0021] The ferromagnetic elements (e.g. sintered) are placed as close to the magnets as possible.

[0022] The generator is seated in a pipe section terminated with connectors on both sides for ease of installation.

Key advantages and features of the present invention

[0023] The generator according to the invention generates electricity using the kinetic energy of the fluid in the pipe. The generator has an axial rotor with magnets built into the outer ring. The ferromagnetic elements with wound coils are placed close to the magnets in the rotor. A generator of this construction allows galvanic separation of the electrical system from other installations.

[0024] The measuring system can include a DC/AC converter that converts the electricity downstream of the rectifier to the country's standard (e.g. 240V, 50Hz).

[0025] The system can also contain a DC/DC converter that converts electricity to an automation standard, e.g. 24V DC.

[0026] The measuring system according to the invention can be used in building water installations (central heating, cold water and hot service water), but also in pipelines (water, oil, gas).

[0027] Such a design does not require the rotor axis to be brought outside guaranteeing the separation of the working medium and the tightness of the installation.

Claims

1. An electric current generator that uses the fluid movement in a pipe to generate an electric current, that includes:

   - an axial rotor (1) having the form of a movable inner ring, which has a bearing and is equipped with short vanes (2), placed on the inside at an angle of >0° to the rotor (1) plane of rotation, and permanent magnets (6) placed on the outside, wherein the magnets are arranged alternately with the N and S poles on the outside,
   - a stationary outer ring (4) equipped on the outside with ferromagnetic elements with wound coils (3), which are electrically connected to each other, so that the axial rotor (1), rotating

due to the flow of liquid or gas, generates an alternating magnetic field in the ferromagnetic elements, wherein
- the generator is seated in a pipe section terminated with connectors on both sides.

2. The generator according to claim 1, in which the coils (3) are connected to each other in series and/or parallel.

3. The generator according to claim 1 or 2 or 3, which is connected to at least one current receiver.

4. The generator according to claim 3, in which the current receiver is a measuring device.

5. The generator according to claim 3, in which the generated electricity is stored in a battery.

6. A stand-alone measuring system, **characterized in that** it contains:

- at least one electric current generator as defined in claim 1 or 2;
- at least one measuring device; and
- a DC/AC or DC/DC converter.

7. The stand-alone measuring system according to claim 6, **characterized in that** it additionally contains a battery.

8. The stand-alone measuring system according to claims 6 or 7, **characterized in that** it additionally includes a thermoelectric generator or a Stirling engine, which employs the temperature difference of fluids flowing in the pipes.

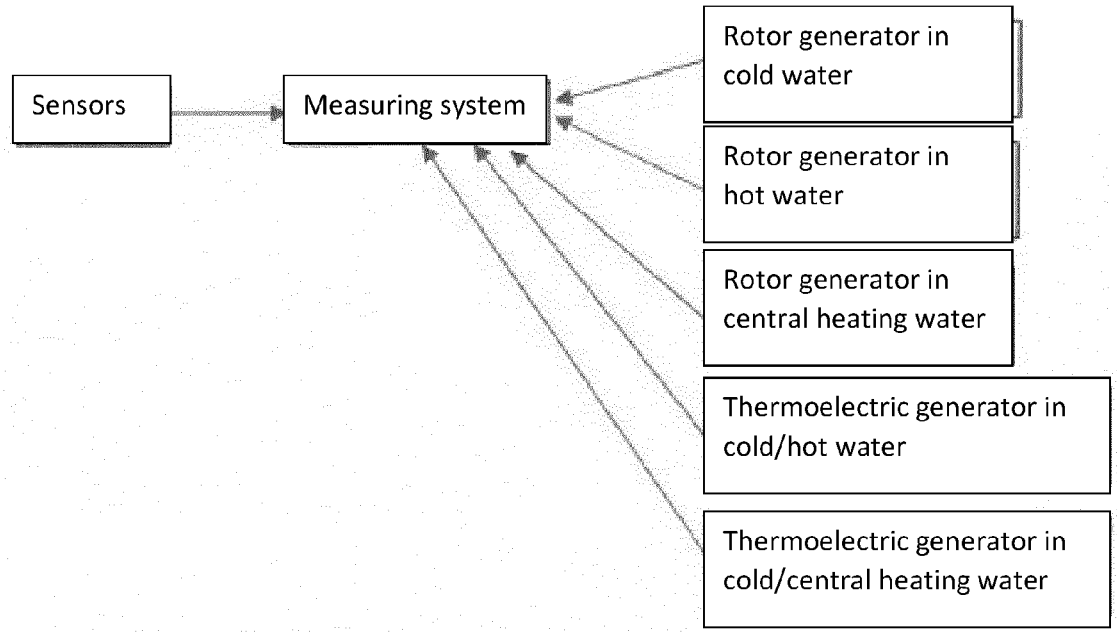
Sensors
Measuring system
Rotor generator in cold water
Rotor generator in hot water
Rotor generator in central heating water
Thermoelectric generator in cold/hot water
Thermoelectric generator in cold/central heating water

Fig. 1

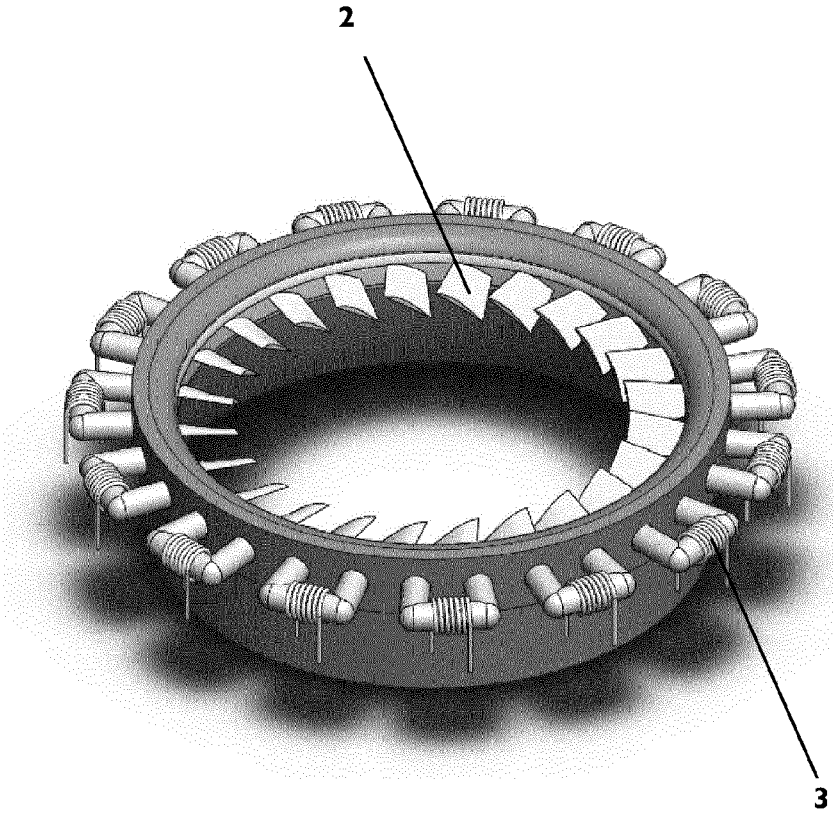
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Fig. 2

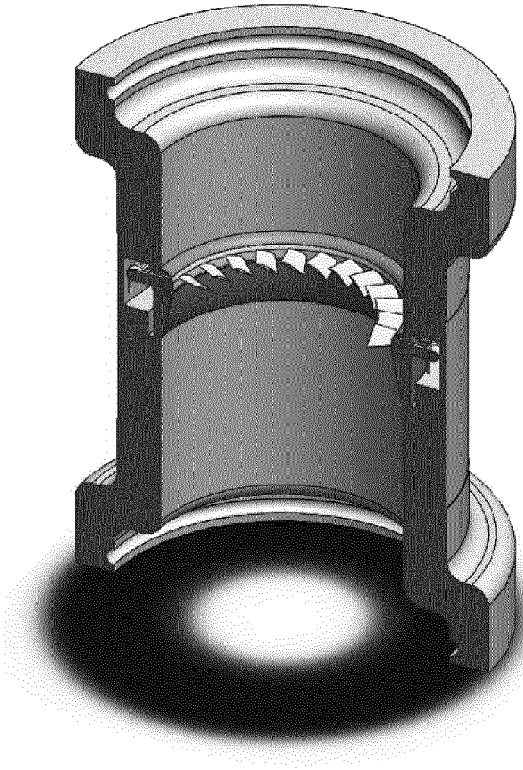

Fig. 3

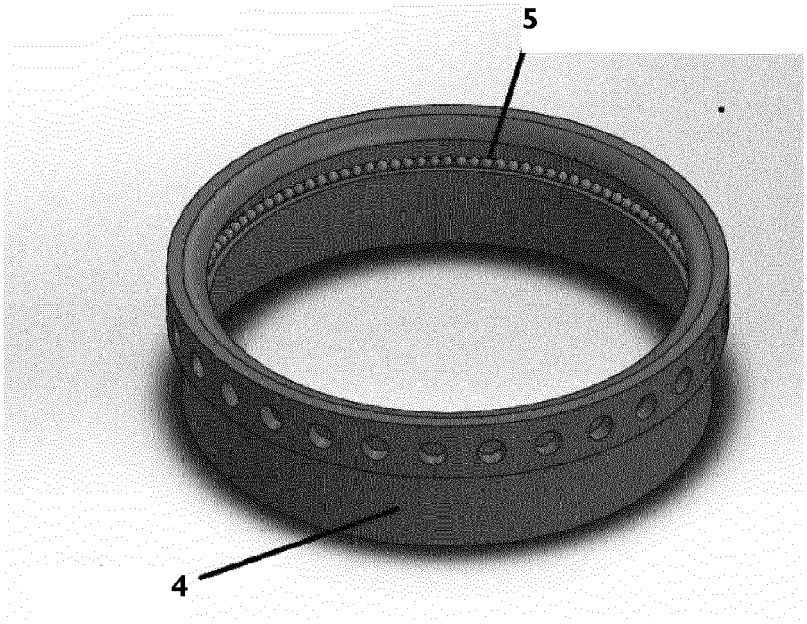

Fig. 4

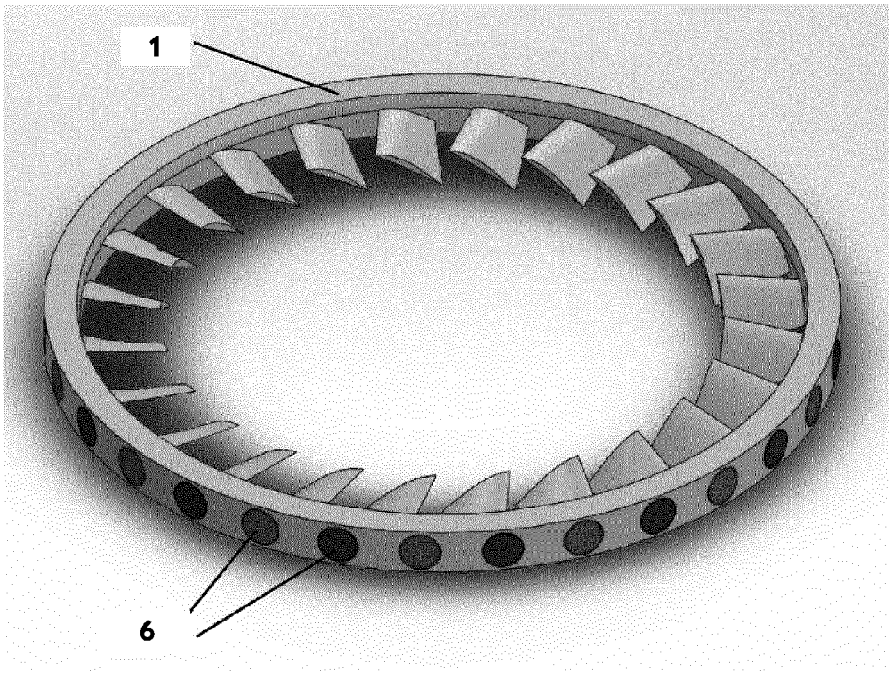

Fig. 5

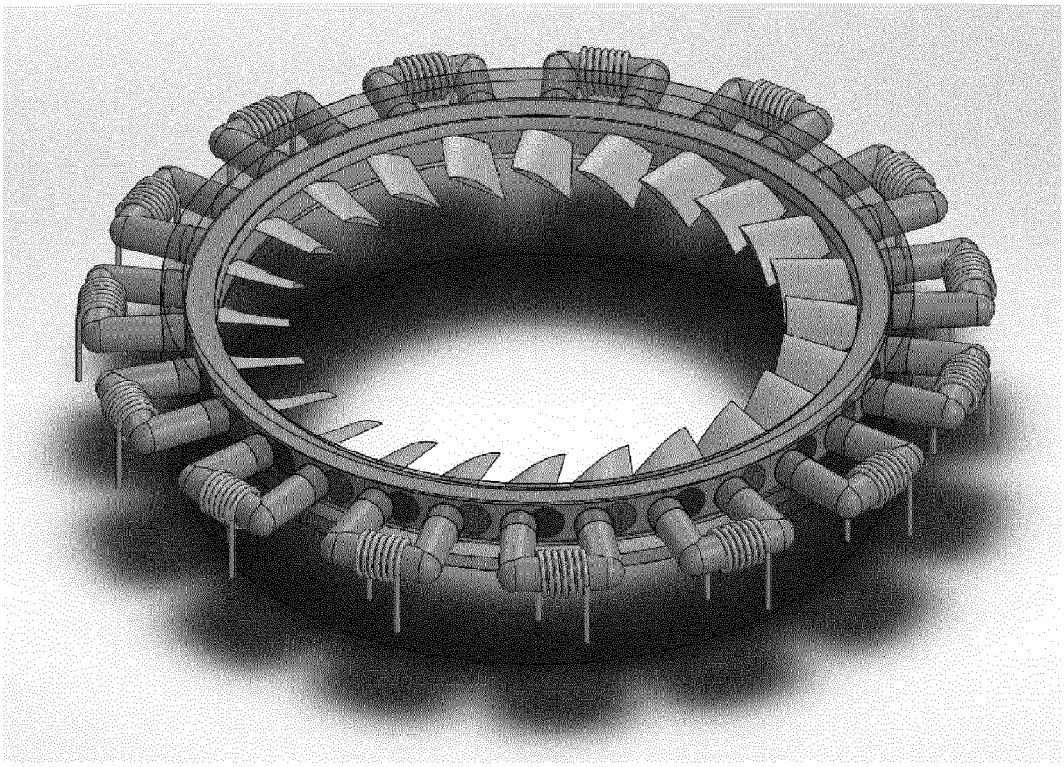

Fig. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 23 46 1546

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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X	WO 2016/022679 A1 (HANNON MARWAN [US]) 11 February 2016 (2016-02-11) * paragraph [0026] - paragraph [0033] * * paragraph [0043]; figures 1-3,7,8 *	1-8	TECHNICAL FIELDS SEARCHED (IPC) F03B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	4 September 2023	Di Renzo, Raffaele

CATEGORY OF CITED DOCUMENTS

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04-09-2023

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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- US 2010308591 A1 **[0003]**
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