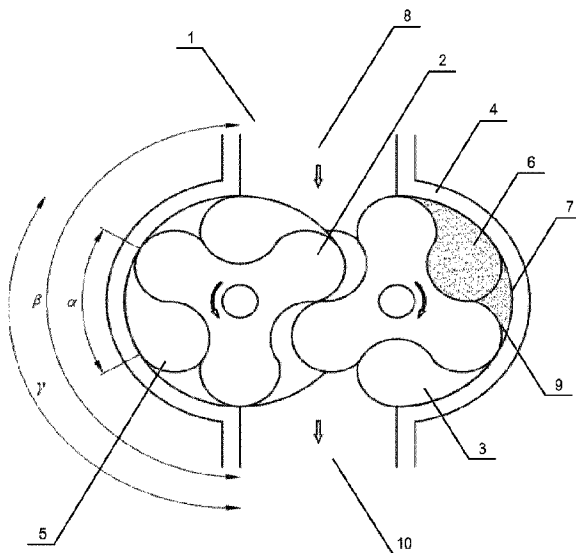




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(54) Titre : DEBITMETRE ROTATIF POUR MESURER UN ECOULEMENT DE GAZ
(54) Title: ROTARY FLOW METER FOR MEASURING GAS FLOW



(57) **Abrégé/Abstract:**

The invention relates to a rotary flow meter for measuring gas flow, comprising a pair of three-toothed rotors, each of which has the shape of a double helical gear, wherein the first rotor is a mirror reflection of the second rotor, and the rotors are adapted to rotate in opposite directions; moreover, the flow meter comprises a body sealing the rotors adapted to form temporary measurement chambers having a strictly defined volume, formed between the outer surfaces of the rotors and the inner surface of the body. The rotary flow meter according to the invention is characterised by the rotors adapted not to contact each other and which are synchronised via an external module synchronising the rotation of the rotors.

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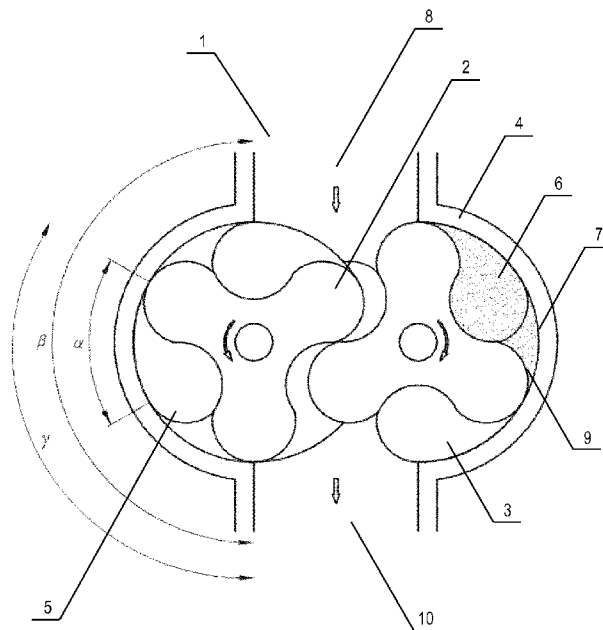


Fig.1

(57) Abstract: The invention relates to a rotary flow meter for measuring gas flow, comprising a pair of three-toothed rotors, each of which has the shape of a double helical gear, wherein the first rotor is a mirror reflection of the second rotor, and the rotors are adapted to rotate in opposite directions; moreover, the flow meter comprises a body sealing the rotors adapted to form temporary measurement chambers having a strictly defined volume, formed between the outer surfaces of the rotors and the inner surface of the body. The rotary flow meter according to the invention is characterised by the rotors adapted not to contact each other and which are synchronised via an external module synchronising the rotation of the rotors.

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Rotary flow meter for measuring gas flow

The present invention relates to a rotary flow meter for measuring gas flow.

5 The application relates to the field of measuring instruments that register the volume of flowing gas.

Rotary flow meters are characterised by pulsed gas flow. Pulsation is transferred in the form of vibrations to other elements of the unit and may interfere with their operation. There are two main reasons why pulsation is generated. The first is related to the closing and opening of measurement chambers, whereby gas with a higher pressure at the inlet to the inside of the body of the flow meter is transported towards the lower pressure at the outlet from the inside of the body of the flow meter and a pressure surge occurs at the outlet side. The second type of pulsation is produced by uneven increment of volume and pressure in the spaces between the teeth of the rotors, depending on the angle of their rotation. The nature of volume changes depends for example on the shape and profile of the rotors used.

15 Document US4329130A discloses a rotary flow meter in which three-toothed rotors have a single curved profile, wherein both rotors have the same profile, the same size and the same twist ratio. In the solution disclosed in the American application, the profiles of the rotors are contacted during rotation, and the phenomenon of pulsation is slightly limited by reducing the mutual pressure of the rotor surfaces and the energy transfer between the rotors.

20 Document US5415041A discloses a device for flow measurement, with two dual helically curved rotors. The four-toothed rotors described in the American patent application rotate in mutual contact, thereby providing a high contact factor. The solution allows for limiting the generation of axial, lateral and distal loads between the rotors and as a result of changes of pressure in the measurement device.

25 One potential advantage of an embodiment is to overcome the drawbacks of the prior art solutions and to reduce pulsation in the flow meter due to an uneven increment of volume between the teeth of the rotors.

- In one aspect, the present application provides a rotary gas flow meter that includes a pair of three-toothed rotors, each of which has the shape of a double helical gear, wherein the first rotor is a mirror reflection of the second rotor, and the rotors are adapted to rotate in opposite directions. The flow meter may include a body sealing the rotors forming measurement chambers, formed between the outer surfaces of the rotors and the inner surface of the body. The measurement chambers may have strictly defined volume, and a geometry of rotors may be adapted to provide an internal balance of axial forces. The rotary gas flow meter may be characterized in that the rotors are adapted not to contact each other, and the rotors are synchronised via an external module synchronising the rotation of the rotors.
- 10 In some implementations, the teeth of the rotors in the shape of a double helical have one extremity of a tooth of the rotor along its height and the location of the same at the meeting location of the two helices of the same tooth along the height of the rotor displaced along the height of the rotor by an angle α

$$\alpha = \frac{360^\circ}{2z}$$

- 15 where z is the number of teeth of the rotor.

In some implementations, the rotors in the shape of a double helical gear are three-toothed and interact with the inner surface of the body over a section with an angular length expressed by the wrap angle β

$$\beta = \frac{540^\circ}{z}$$

- 20 where ' z ' is the number of teeth of the rotor.

In some implementations, the adjacent teeth of the three-toothed rotors in the shape of of a double helical gear have their tops displaced from each other by an angle γ of 120° .

- In some implementations, the displacement angle α of the tops of the tooth of the rotor along the height of the rotor corresponds to half the displacement angle γ of the tops of adjacent teeth of the rotor with respect to each other.
- 25

In some implementations, the rotors and the body of the flow meter are made of plastic in 3D printing technology.

In some implementations, the rotors and the body of the flow meter are made of an electrically conductive plastic.

- 30 The solution of the invention is advantageous in some implementations because of the complete elimination of pulsation resulting from uneven increments of volume and pressure between the teeth of the rotors achieved through the use of an external synchronising module that prevents the rotors from contacting each other. Additionally, the use of three-toothed rotors in the shape of a double helical gear with a specific displacement angle of the rotors' tops with respect to each

other and a specific wrap angle, an internal balance of axial forces between the rotors has been achieved.

The subject matter of the invention is presented in greater detail with example embodiments shown in the drawings, in which:

5 Fig. 1 is a schematic view of the rotary flow meter in a top view;

Fig. 2 is a view of two rotors coupled with an external synchronising module, in an isometric view; and

Fig. 3 is a detailed view of the rotor of the rotary flow meter.

10 Fig. 1 is a schematic view of the rotary flow meter 1 in an embodiment, in a top view. The rotary flow meter 1 has a pair of three-toothed rotors 2, 3, adapted by an external synchronising module 11 (not shown in Fig. 1) to rotate in opposite directions. The rotors 2, 3 are arranged in the body 4 sealing the rotors 2, 3 adapted to form temporary measurement chambers 5, 6 such that the inner surface of the body 7 cooperates with the individual rotors 2, 3 over a section having an angular length expressed by the wrap angle (β). The wrap angle (β) depends directly on the number of
15 teeth of the rotor (z) and can be calculated from the following formula:

$$\beta = \frac{540^\circ}{z}$$

According to this embodiment of the rotary flow meter 1 with three-toothed rotors 2, 3, the wrap angle (β) is 180° , and the adjacent teeth of the three-toothed rotors 2, 3 in the shape of a double helical gear have their tops displaced from each other by an angle (γ) of 120° . The advantage achieved by using the strictly defined geometry of the rotors 2, 3 is the balance of the internal
20 axial forces that interact between them. Moreover, according to this embodiment of the invention, body 4 is adapted to form temporary measurement chambers 5, 6 having a strictly defined volume, such that gas flowing to the inside of the body 4 through the inlet 8 fills the measurement chambers 5, 6 formed between the external surfaces of the rotors 9 and the internal surface of the body 7, and the overpressure at the inlet 8 of the gas causes the rotors 2, 3 to rotate and a
25 portion of gas to be transported to the outlet from the inside of the body 4. The rotors (2, 3) and the body (4) of the flow meter can be made of plastic in 3D printing technology, and preferably, in particular of an electrically conductive plastic. The advantage achieved by using the 3D printing technology when making the flow meters is the ability to precisely and accurately reproduce the shape of the rotors. The use of an electrically conductive plastic is important as it regards safety
30 and it allows for discharging the electrostatic charge accumulating in the flowing gas.

Fig. 2 is a view of two rotors 2, 3 in the shape of a double helical gear coupled with an external synchronising module 11 in an isometric view. According to this embodiment of the invention, the first rotor 2 is a mirror reflection of the second rotor 3, and, in addition, the rotors 2, 3 are adapted by an external synchronising module 11 to rotate in the opposite direction, without contacting
35 each other, and, preferably, the second rotor 3 is adapted to rotate clockwise, and the first rotor 2 is adapted to rotate counter-clockwise. Moreover, the synchronising module 11 synchronises the rotations of the rotors 2, 3 so that the surfaces of the rotors 2, 3 do not contact each other. As shown in fig. 2 the synchronising module preferably has the form of a gear transmission with two interlocking toothed wheels 12.

- Fig. 3 is a detailed view of the rotor 3 of the rotary flow meter 1. An advantageous technical result of balancing the axial forces between the rotors 2, 3 has been achieved by using an appropriate profile and shape thereof, in particular by selecting an appropriate displacement angle (α) of the tops of the individual teeth of the rotors 2, 3. By the top of the individual tooth we shall understand the extremity of a tooth of the rotor along its height and the location of the same at the meeting location of the two helices of the same tooth along the height of the rotor displaced along the height of the rotor. So the shape of a double helical gear have one extremity (top) of a tooth of the rotor along its height and the location of the same at the meeting location of the two helices of the same tooth along the height of the rotor displaced along the height of the rotor.
- 10 In particular, the advantageous result of balancing the axial forces is achieved when the displacement angle (α) of the tops of the tooth of the rotor 3 in relation to the height of the rotor 3 corresponds to half the angle (γ) between adjacent tops of the rotor 3. Moreover, angle (α) depends directly on the number of teeth of the rotor (z) and can be calculated based on the following ratio

$$\alpha = \frac{360^\circ}{2z}$$

- 15 According to this embodiment of the three-toothed rotor, angle (α) has 60°.

Claims

1. A rotary gas flow meter, comprising:
 - a pair of three-toothed rotors each of which has the shape of a double helical gear, wherein the first rotor is a mirror reflection of the second rotor, and the rotors are adapted to rotate in opposite directions;
 - a body sealing the rotors forming measurement chambers formed between the outer surfaces of the rotors and the inner surface of the body, wherein the measurement chambers have strictly defined volume, and a geometry of rotors is adapted to provide an internal balance of axial forces,
 - and wherein the rotors are adapted not to contact each other, and the rotors are synchronised via an external module synchronising the rotation of the rotors.
2. The flow meter according to claim 1, wherein the teeth of the rotors in the shape of a double helical gear have one extremity of a tooth of the rotor along its height and the location of the same at the meeting location of the two helices of the same tooth along the height of the rotor displaced along the height of the rotor by an angle (α)

$$\alpha = \frac{360^\circ}{2z}$$

where z is the number of teeth of the rotor.
3. The flow meter according to claim 1 or 2, wherein the rotors in the shape of a double helical gear are three-toothed and interact with the inner surface of the body over a section with an angular length expressed by the wrap angle (β)

$$\beta = \frac{540^\circ}{z}$$

where z is the number of teeth of the rotor.
4. The flow meter according to any one of claims 1 to 3, wherein the adjacent teeth of the three-toothed rotors in the shape of a double helical gear have their tops displaced from each other by an angle (γ) of 120° .

5. The flow meter according to claim 2 or claim 4, wherein the displacement angle (α) of the tops of the teeth of the rotor along the height of the rotor corresponds to half the displacement angle (γ) of the tops of adjacent teeth of the rotor with respect to each other.
6. The flow meter according to any one of claims 1 to 5, wherein the rotors and the body of the flow meter are made of plastic in 3D printing technology.
7. The flow meter according to any one of claims 1 to 6, wherein the rotors and the body of the flow meter are made of an electrically conductive plastic.

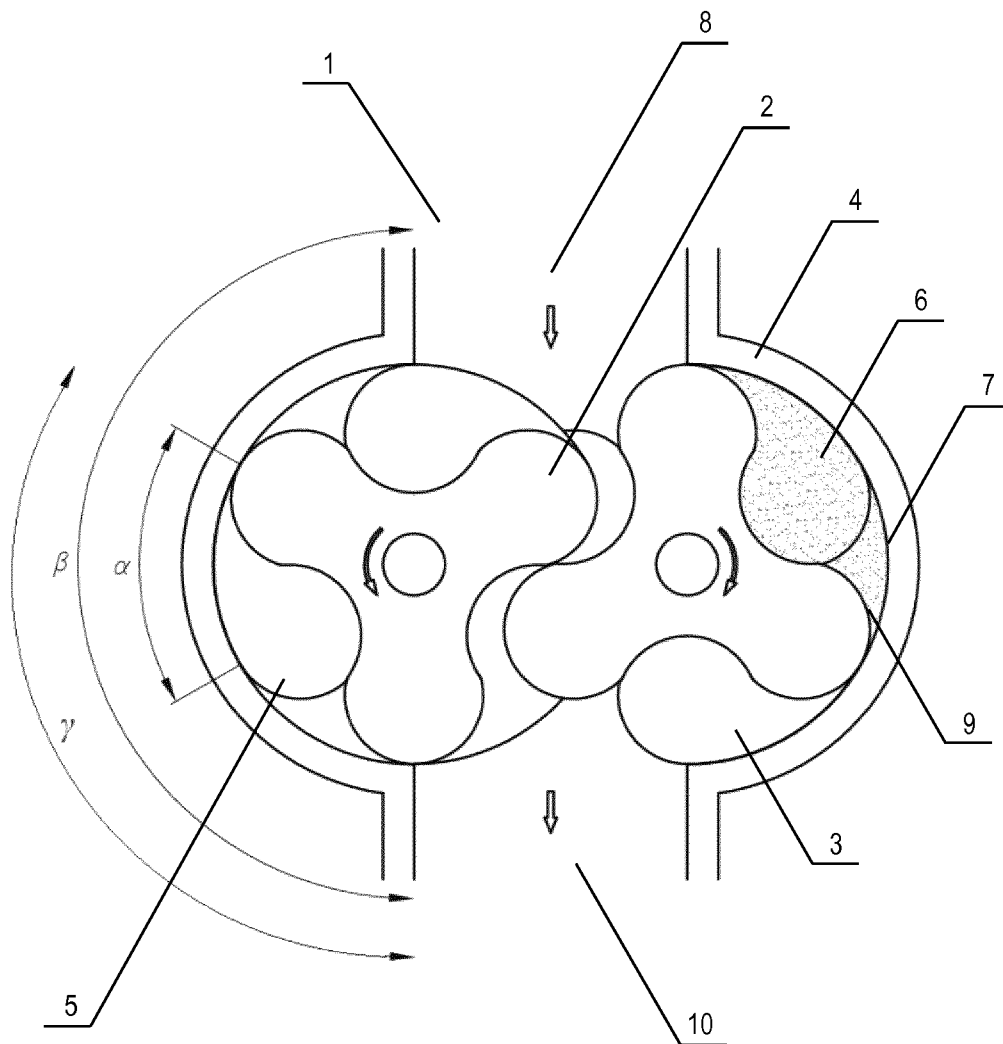


Fig.1

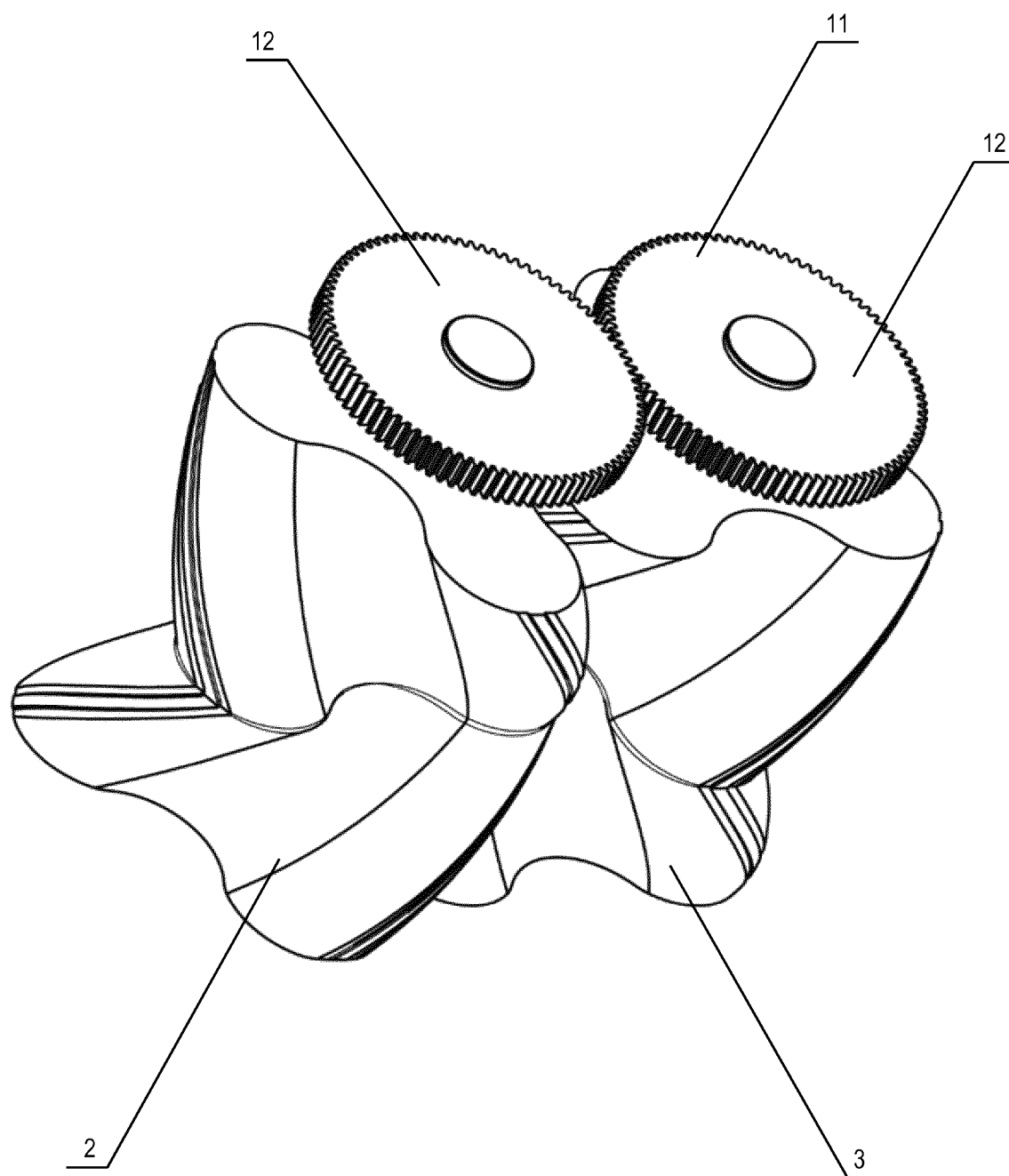


Fig.2

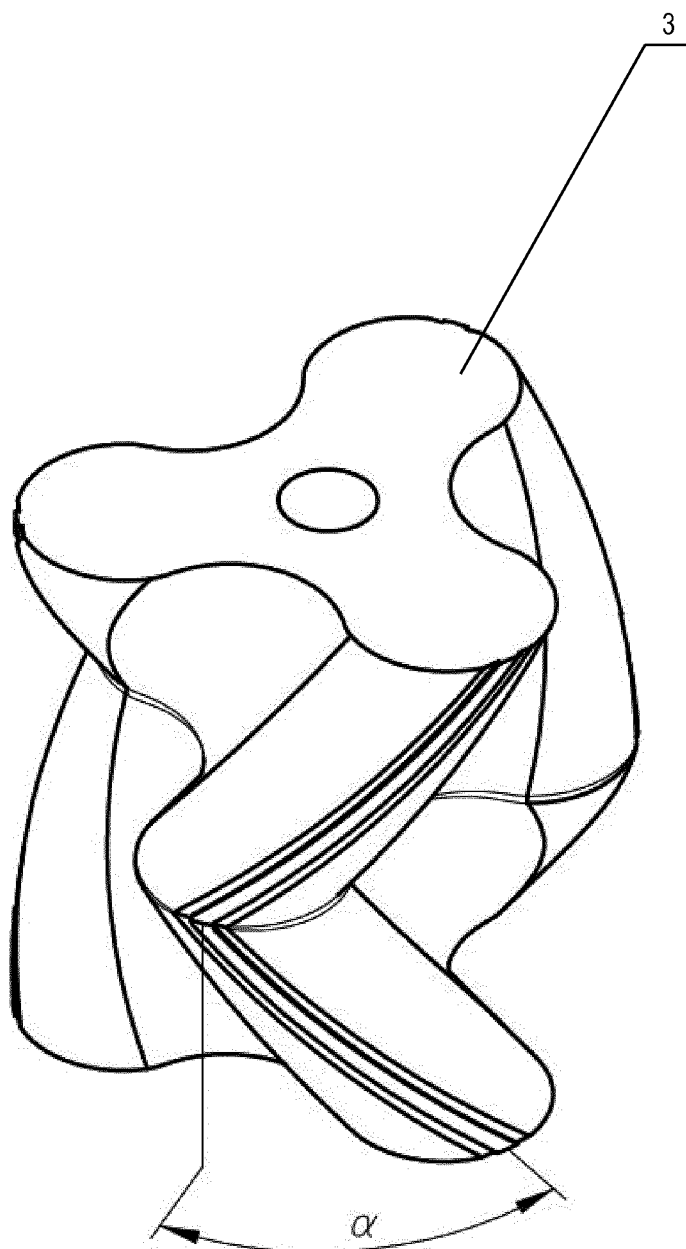


Fig.3

