

The invention concerns a flow meter according to the introductory part of claim 1.

5 A flow meter of the indicated kind is known, for example, from the European Patent Document 0 228 577. In this flow meter, a screw-shaped distributor for producing a spin is arranged ahead of the rotor that is arranged in a passage duct for the medium, so as to act on the blades of the rotor which extend in a direction parallel to the axis and are bent in the circumferential direction, and to cause the rotor to rotate. Each blade of the rotor has a window formed as an axial parallel slot. A beam of a light barrier directed at right angles to the rotor axis, whose light source is arranged on the inner casing on one side and the light sensor on the opposite side of the rotor, passes through the window. To be sure, this principle presupposes that the medium whose rate of flow is to be metered is transparent for the passing of the light beam of the light barrier, and reduces its scope of application. Moreover, for the metering with blade windows to be passed, the number of pulses to be obtained per revolution of the rotor is limited to three because of the overlap of the blades.

While the known flow meter is operating reliably in applications with higher flow rates, it has been shown that it is not capable of delivering accurate metering results in the case of low rates.

From the DE-A-2 047 785, a flow indicator is known, with an optical determination of the rotational speed or rate of flow. In this arrangement, a rotor arranged in a casing and fitted with blades is provided with alternating bright and dark fields by means of annular strips disposed on a surface. The surface is either that of the blades or the outer side of a shell surrounding them at their periphery. The casing has a suitably arranged window.

The present invention is therefore based on the problem of creating a flow meter that can be inexpensively made and which can, because of its accurate metering results, be universally used even with the lowest rates of flow.

For solving this problem, the flow meter has the features in accordance with claim 1.

The use of a ring on the rotor in combination with the action on the curved blades on their concave side produces an enhanced response sensitivity. The cause might in this connection be found in an almost complete utilization of the kinetic energy of the flow whose rate of flow is to be metered. This is obtained by preventing any radial outflow in the zone of the blades. In this arrangement, the ring can, because of the rigid anchoring of the blades at their outer sides too, be used for stiffening them. This makes it possible to reduce the mass of the blades

without reducing the area acted on. Thus the total mass of the rotor is not subject to any increase due to the ring.

Preferably the ring is made in one piece together with the blades and the rotor pin, which promotes both the rigidity and a reduction in mass. An integrally manufactured rotor makes it, moreover, possible to avoid the corresponding costs of assembly.

According to a preferred further development of the flow meter in accordance with the invention, the counting or metering signals are obtained by scanning the outer surface of the rotor ring that is provided with marks.

Since the flow meter thus does not have to clear a beam path for a light barrier, the rotor shape is simplified. The universal scope of application for the flow meter is thereby further enhanced, inter alia, because the medium need not be transparent. Apart from this, it is possible to generate a number of signals per revolution that can be virtually unlimited.

Further details and advantages follow from the description given below, wherein a mode of embodiment of the flow meter is described in greater detail, purely by way of example, with reference to the drawings. There are shown in:

Fig. 1 a longitudinal section through a flow meter on a scale enlarged approximately tenfold,

Fig. 2 a cross-section through the flow meter along line 1 - 1 in Figure 1.

The flow meter has an inner casing 1 which has a tubular shape, is preferably made of a plastic material and can be connected on both sides to hose lines. A liquid medium flows through the inner casing 1 in the direction of arrow 2 from right to left. A distributor 4 designed as a multistart screw or worm is arranged in the cylindrical passage duct 3 of the inner casing 1. An axial core 5 from which the turns 6 are starting, is extended in the direction of the incident flow into a streamlined body 7. This distributor 4 divides the inflowing medium into different part flows which are in this process given a twisting motion and are accelerated.

A rotor 8 is arranged behind the distributor 4 in the direction of flow. The rotor pin 9 is mounted with play on the side of the incident flow in a bore 10 formed in the core of the distributor 4. On the other side, the rotor pin 9 is also mounted with play in a bore 11 which is formed in a narrow cross piece 12 that passes transversely through the passage duct 3.

On the rotor pin 9 there are secured three identical blades 13 in an axially parallel position which are distributed over the circumference and are bent along their radial dimension round one or more exclusively axially parallel axes of curvature.

The thin-walled blades 13 have an unbroken surface and have in the example of the embodiment shown, an axial dimension which remains constant along the radial dimension. The blade ends are secured on a cylindrical ring 14 which is coaxial with the rotor pin 9. The ring 14 shown has the same width as the width of the blades 13, which corresponds to an advantageous design. To be sure, the axial dimension of the ring may be both greater or smaller than that of the blades. Likewise, a symmetrical arrangement of the ring with respect to the blades is not necessary. An arrangement may also be expedient, wherein the ring is arranged with an offset in the axial direction in such a way that it leaves the blades free on one side and projects beyond them on the other side. In any case, the ring has an unbroken surface and has end faces that are disposed in parallel radial planes.

The curvature of the rotor blades 13 is designed in such a way that they are acted on, on their side with a concave curvature by the helical flow formed by the distributor 4.

Expediently the rotor, consisting of the rotor pin 9, the blades 13 and ring 14 is integrally formed in each case. This produces a very high strength or stability of shape with the smallest rotor mass, even with a design of the blades with the thinnest walls. In this arrangement, such an integral rotor, made for example of a plastic material, can be produced with a relatively simple tool in an injection moulding process if the blades are only curved round axes that extend parallel to the axis of the rotor.

However, for the flow meter in accordance with the invention, or its dynamic behaviour, it is essential that the design and/or the arrangement of the ring 14 on the rotor enforces a flow of the medium in an approximately axial direction, and that in particular, it prevents any radial outflow at the radial outer ends of the blades 13. Since gap losses between the rotor and the surrounding passage duct are thereby already largely excluded, the flow energy of the medium is completely preserved for acting on the blades. It has been shown that, together with the ring, the action on the blades on the concave side substantially increases the sensitivity of response and also contributes to increasing the metering accuracy, in particular with low rates of flow.

The gap between the rotor ring 14 and the inner wall of the passage duct that is visible in the drawing has, of course, not been shown to scale in its radial dimension, and is, in reality, very narrow. By means of an inwardly projecting peripheral shoulder in the passage duct which is arranged ahead of, or as shown, behind the ring (as viewed in the direction of flow), it is possible to prevent an outflow of the medium past the rotor to the greatest possible extent.

If the ring 14 extends less far than the blades 13, in particular in the downstream direction, the internal diameter of the passage duct must at that point be approximately equal to the internal diameter of the ring to prevent a radial outflow of the medium.

On the outer peripheral surface 15 of the ring 14, a plurality of marks 16 are formed or arranged on a circular line at equal angular intervals from each other. The marks preferably are recessed portions worked into the surface during the manufacture of the ring; colour marks are also feasible. As the rotor 8 rotates, the marks 16 are detected by a light beam 17. for example a laser beam, directed against the outer surface 15 of the ring 14, which strikes the outer peripheral surface 15 of the ring 14 from the outside through a window 18 in the inner casing 1 in the zone of the marks 16 that are there provided. Thus as the rotor rotates, the light beam alternately strikes a mark 16 and the ring surface between the marks, and the light reflected with a varying intensity, is focused by a lens 19 arranged ahead of the window 18 on the outside, and is passed to a sensor 21 via a fibreglass cable 20. The rate of flow per unit time can be ascertained from the signals received in this way. The fibreglass cable 20 is connected to an outer casing 22 which can be screwed open and wherein the replaceable lens 19 is also arranged.

Devices for transmitting a light beam and for the optical detection of the reflected light pulses are known. For example, the fibreglass cable 20 may have zones separated from each other in the longitudinal direction, one of which guides the light beam directed towards the outer rotor surface 15, and the reflected light pulses are passed through the other zone to the optical sensor 21.

The advantage of this device is that for generating signals, it does not have to rely on the interruption of a light ray path, and thus permits the use of a closed ring without windows which completely covers the blades. Obviously it is not possible with this device to produce a number of signals corresponding to the number of blades each having a window, but a plurality of signals corresponding to the number of marks provided on the circumference of the ring. This substantially increased signal sequence makes it possible to increase the accuracy of the flow meter in certain applications. It is also advantageous that the flow meter described is also suitable for metering the rate of flow of any nontransparent medium.

In conjunction with the high number of signals per revolution, the enhanced sensitivity of response of the low mass rotor produces exceedingly accurate metering results in every field of application.



PATENT CLAIMS

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1. A flowmeter with a substantially cylindrical passage duct (3), a rotor (8) coaxially arranged in the passage duct, mounted for rotation and provided with curved blades (13), and a helical distributor (4) arranged in the passage duct coaxially ahead of the latter in the direction of flow, for dividing the flow medium flowing through the passage duct into part flows and for producing a spin to set the rotor into rotational motion by action on its blades on their concave side, as well as a means (18-21) cooperating with the rotor and arranged outside the passage duct for generating signals, characterized in that the wall of the blades is unbroken and that the rotor has a cylindrical ring (14) arranged coaxially with the rotor shaft (9), which surrounds the blades and whereon the blades are anchored with their outer ends, and that the ring carries on its outer peripheral surface (15), marks (16) for cooperation with the means for generating the signals.

2. A flowmeter according to claim 1, characterized in that the ring (14) has on its outer peripheral surface (15), marks (16) arranged in a distribution over the circumference, and that the means for generating the signals have means (17) for focusing the light beam, as well as an optical sensor (21) for generating signals to ascertain the rate of flow.

3. A flowmeter according to claim 1 or 2, characterized in that the blades (13) of the rotor (8) are designed with an axially parallel curvature and that the ring (14) with its unbroken wall extends over the width of the blades.

4. A flowmeter according to claim 2 or 3, characterized in that the ring (14), the blades (13) and the rotor shaft (9) are made in one piece.

5. A flowmeter according to claim 3, characterized in that the ring (14) is arranged symmetrically in the axial direction with respect to the width of the blade.

6. A flowmeter according to claim 2, characterized in that the outer peripheral surface (15) of the ring (14) has a plurality of colour marks (16) arranged on a circular line at equal angular intervals.



7. A flowmeter according to claim 2, characterized in that the marks (16) are formed as pointed raised portions.

- 5 8. A flowmeter according to one of the preceding claims,
characterized in that the rotor (8) is arranged in an inner
casing (1) which is surrounded by an outer casing (22) with a
lens (19) arranged therein for focusing the light beam, and with
a connector for a light conductor cable (20) which connects the
10 flowmeter to the optical sensor (21).

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