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(71) Applicant
Nuovopignone Industrie Meccaniche E Fonderia S p A

(Incorporated in Italy)

Via F Matteucci 2, Florence, Italy

(72) Inventors
Pietro Lacitignola
Umberto Corradini

(74) Agent and/or Address for Service
Haseltine Lake & Co
Hazlitt House, 28 Southampton Buildings,
Chancery Lane, London, WC2A 1AT, United Kingdom

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(54) Compressor of regenerative toroidal chamber type

(57) In the compressor the rotor blades (5) have an aerodynamic profile, with their curvature in the direction of rotor motion and their thickness variable such that the distances between the facing surfaces of two adjacent blades (5) when measured perpendicular to the central line (17, Fig. 4) of the outflow channel defined by said surfaces are constant, the stripper (18) being provided on the suction side with an inlet slot (23) of increasing section, and on the compressor delivery side with bevelled edges (25, 26) and flares (27) on the walls of its circumferential channel (19).

Fig.1

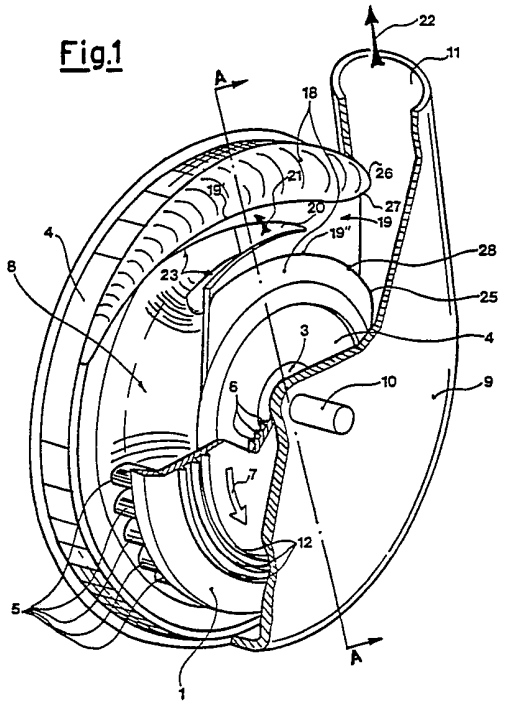

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Fig.1

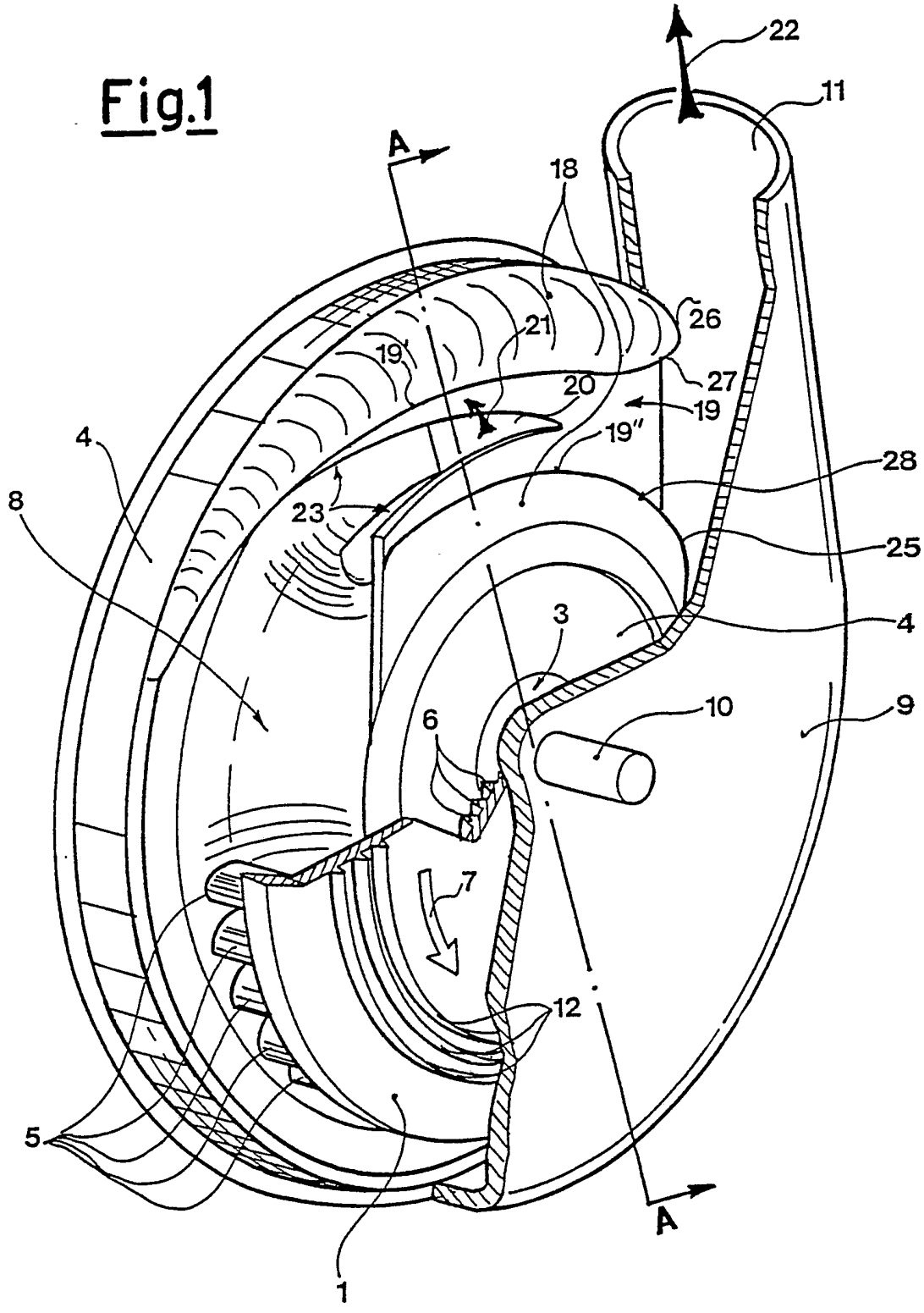


Fig.2

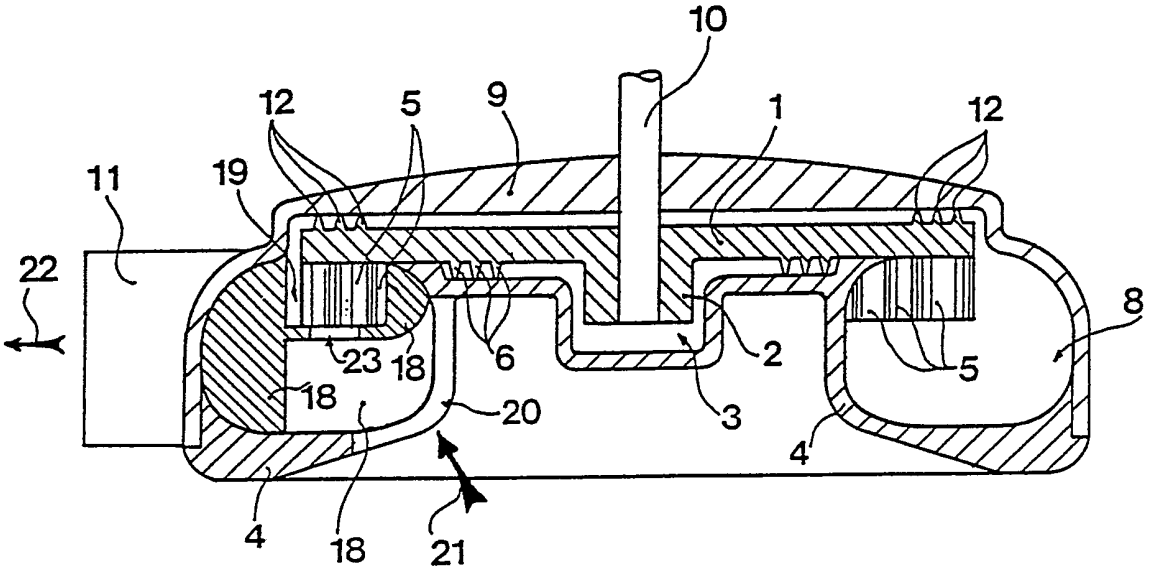
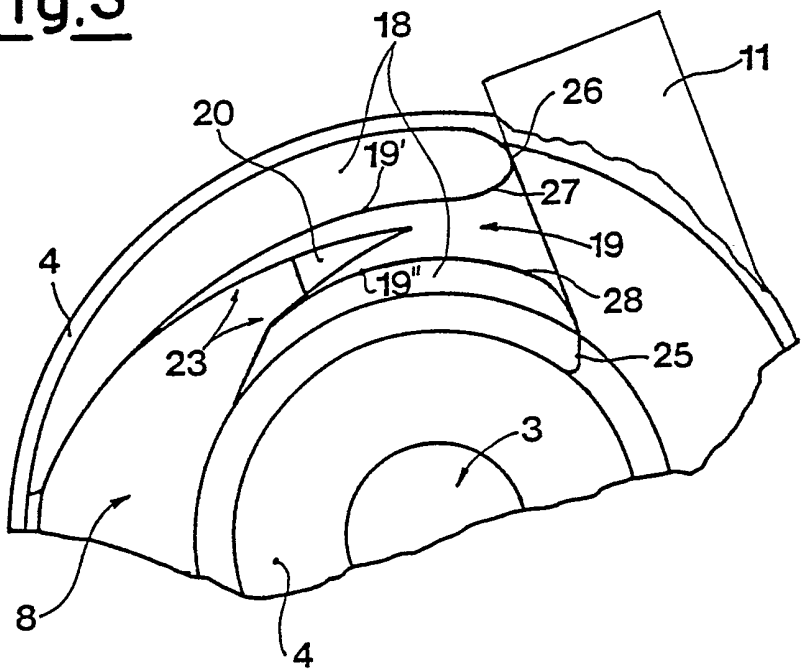


Fig. 2

Fig.3



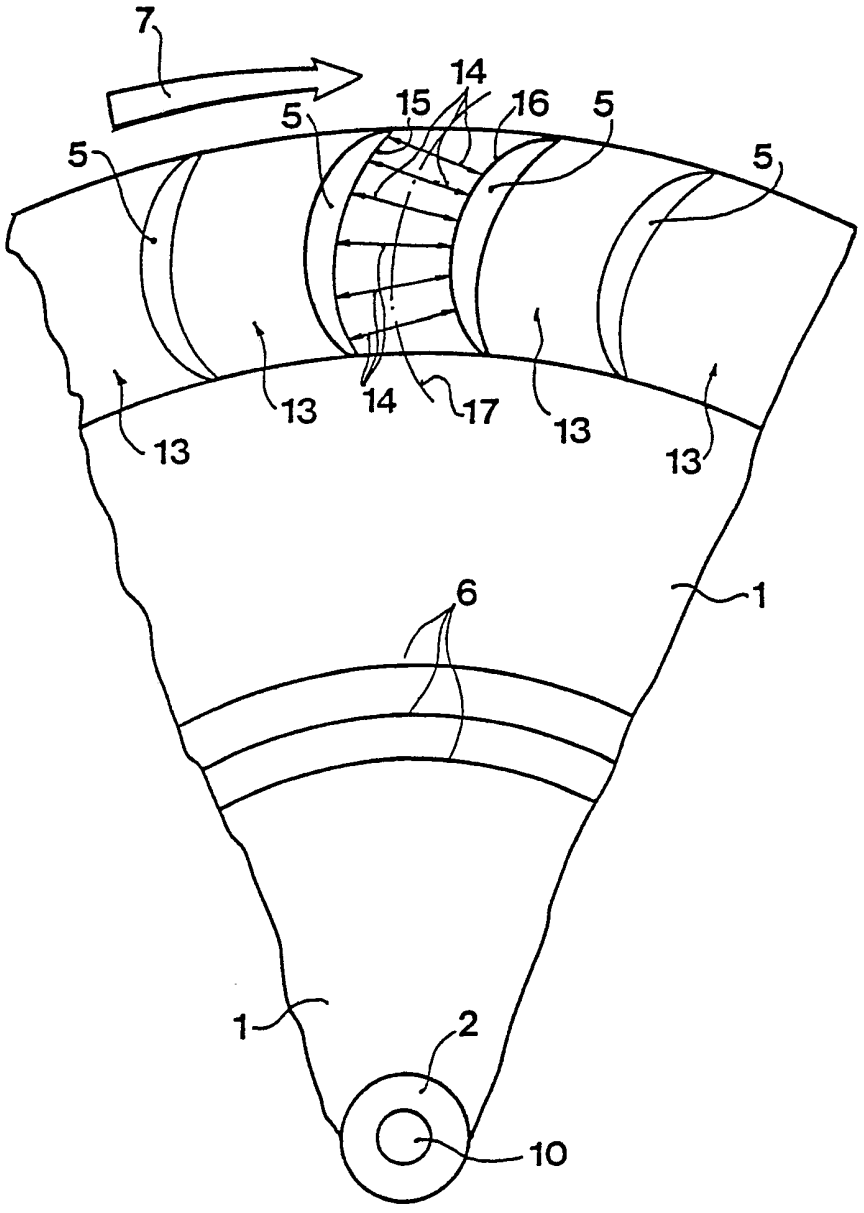


Fig.4

IMPROVEMENTS IN A COMPRESSOR OF REGENERATIVE TOROIDAL CHAMBER TYPE

This invention relates to improvements in a compressor of regenerative toroidal chamber type which, by drastically reducing turbulence and optimizing the fluid path between the blades, enables the compressor noise to be reduced and a very high pressure head to be obtained, while maintaining small compressor dimensions.

Compressors of regenerative toroidal chamber type are known to be used where a large head is required for a small throughput. These compressors consist of a rotor provided on its circumferential periphery with blades which rotate within a toroidal chamber having a cross-section greater than that of the blades, and in which a separation block with a circumferential channel for blade passage, known as a stripper, interrupts the continuity of said chamber by separating the suction side from the delivery side of the compressor, suitable seal members being interposed between said elements. In this manner the indrawn fluid not only follows the rotation of the rotor but also undergoes a helical path through said toroidal chamber by passing several times through the rotor blades during its travel from the inlet to the outlet of the compressor. Each passage through the

blades can thus be regarded as a conventional compression stage, with the result that with such a compressor several compressions are obtained in which the fluid is accelerated several times, hence the name "regenerative" given to the compressor, by which pressure increases are obtained such as could otherwise be obtained only by high-speed or multi-stage compressors.

As these known regenerative toroidal chamber compressors of the state of the art do not provide uniform guiding of the fluid during its helical motion within the toroidal chamber, they are unable to attain high efficiency, so falling short of the theoretically obtainable pressure head. In addition said lack of suitable fluid guiding induces in known compressors a turbulence which is the cause of annoying and undesirable noise.

In some known constructions an attempt has been made to reduce said problems by providing larger-dimension compressors to obtain a greater head, and using complicated and costly silencer arrangements to reduce noise.

The object of the present invention is to overcome said drawbacks by providing a compressor of regenerative toroidal chamber type which besides being economical is highly efficient and in particular of very small dimensions, and in addition is of minimum noise while providing a very large pressure head, so as to make it particularly suitable for domestic use.

This is substantially attained by providing the rotor with blades of aerodynamic profile, with their curvature in the direction of motion and their thickness variable such that the distances between the two facing surfaces of two adjacent blades defining an out-

flow channel are constant when measured perpendicular to the central line of said outflow channel.

In this manner correct and turbulence-free fluid entry into said outflow channels defined by the blades is obtained by virtue of their curvature, the fluid then moving with uniform motion within said channels by virtue of the specific manner in which they are constructed, and the fluid finally emerging with maximum possible velocity because of the forward curvature of the blades, with the final result that a very high pressure head is obtained.

According to the invention, on the compressor suction side said separation block or stripper is provided, for introduction of the fluid into the channels defined by the blades, with an inlet slot of increasing section so that the entering fluid can gradually flow into said channels without any violent impact against the rotor blades and hence without turbulence.

On the compressor delivery side said stripper is provided with bevelled edges and flares on the walls of its channel, to form a gradual lead-in for blade entry into said stripper channel. This not only prevents the generation of vortex phenomena but also prevents the sudden constriction caused by the stripper from producing loud noise by obstructing fluid flow.

Thus the compressor of regenerative toroidal chamber type, comprising a rotor provided on its circumferential periphery with blades which define between them flow channels for the fluid to be compressed, and which rotate within a toroidal chamber having a cross-section greater than that of the blades, and in which a separation block with a circumferential channel for blade passage,

known as a stripper, interrupts the continuity of said chamber by separating the suction side from the delivery side of the compressor, suitable seal members being interposed between said elements, is characterised according to the present invention in that said blades are formed with an aerodynamic profile, with their curvature in the direction of motion and their thickness variable such that the distances between the two facing surfaces of two adjacent blades defining an outflow channel, are constant when measured perpendicular to the central line of said outflow channel, said stripper being provided on the compressor suction side with an inlet slot of increasing section for fluid introduction into the said outflow channels defined by the blades, and on the compressor delivery side with bevelled edges and flares on the walls of its said channel, to form a gradual lead-in for blade entry into said stripper channel.

According to a preferred embodiment of the present invention said seal members consist of a number of concentric threads provided on both sides of the rotor, to form labyrinth seals.

According to a further preferred embodiment of the present invention, said rotor is constructed in one piece, for example by casting, by moulding etc., including its variable thickness blades and its labyrinth seals.

According to a further preferred embodiment of the present invention, said compressor is entirely of plastics construction.

The invention is described in greater detail hereinafter with reference to the accompanying drawings, which show a preferred embodiment thereof by way of non-limiting example in that

technical and constructional modifications can be made thereto but without leaving the scope of the present invention.

In said drawings:

Figure 1 is a partly sectional perspective view of a regenerative toroidal chamber compressor constructed in accordance with the invention;

Figure 2 is a front sectional view of the compressor of the invention to a reduced scale, taken on the line AA of Figure 1;

Figure 3 is a partial view from above of a portion of the compressor without the rotor to better illustrate the characteristics of its stripper;

Figure 4 is a partial view of the bladed face of the regenerative compressor rotor according to the invention.

In the figures, the reference numeral 1 indicates the compressor rotor which is pivoted with its hub 2 in a suitable cavity 3 provided in the inner casing 4 of the compressor, and comprises on the circumferential periphery of its lower face a series of blades 5 plus three concentric threads 6 to form a labyrinth seal against said inner casing 4. Said rotor 1 and consequently its blades 5 rotate in the direction of the arrow 7 within a toroidal chamber 8 having a cross-section larger than that of the blades, and is delimited by said inner casing 4 and the outer compressor casing 9, which comprises a delivery duct 11 and a hole for passage of the shaft 10 which connects the rotor to a drive motor. On the upper face of the rotor 1 there are also provided three concentric threads 12 for forming a labyrinth seal against said outer casing 9. Said blades 5, which between them define outflow channels 13 (see

Figure 4), have an aerodynamic profile with their curvature in the direction of movement 7 of the rotor and their thickness variable such that the distances 14 between the two facing surfaces 15 and 16 of two adjacent blades are constant when measured perpendicular to the central line 17 of the outflow channel defined by said surfaces. Said toroidal chamber 8 is interrupted by a separation block (see Figures 1 to 3) or stripper 18 comprising a circumferential channel 19 for passage of the blades 5, this separating the compressor suction side consisting of a hole 20 in the inner casing 4 through which the fluid enters in the direction of the arrow 21, from the compressor delivery side consisting of said duct 11 through which the fluid is expelled in the direction of the arrow 22. Said stripper 18 comprises in a position corresponding with said hole 20, and hence on its suction side, an inlet slot 23 having a section which increases in the direction of the arrow 7 (see Figures 1 and 3) for guidedly conveying the fluid into the outflow channels 13 defined by the blades 5, and also comprises on its delivery side, ie at the duct 11, bevelled edges 25 and 26 (see Figures 1 and 3) and flares 27 and 28 of the walls 19' and 19" of said channel 19 to form a gradual lead-in for the entry of the gas dragged by the rotating blades 5 within said channel 19 of the stripper 18.

CLAIMS

1. A compressor of regenerative toroidal chamber type, comprising a rotor provided on its circumferential periphery with blades which define between them outflow channels for the fluid to be compressed, and which in use rotate within a toroidal chamber having a cross-section greater than that of the blades, and in which a separation means with a circumferential channel for blade passage interrupts the continuity of said chamber by separating the suction side from the delivery side of the compressor, seal means being interposed between said elements; wherein said blades are formed with an aerodynamic profile in that their curvature in the direction of motion and their thickness vary such that the distances between the two facing surfaces of two adjacent blades, defining an outflow channel, are constant when measured perpendicular to the central line of said flow channel, said separation means being provided on the compressor suction side with an inlet of increasing section for fluid introduction into the outflow channels defined by the blades, and on the compressor delivery side with bevelled edges and flares on the walls of its channel to form a gradual lead-in for blade entry into said channel.

2. A compressor as claimed in claim 1, wherein said seal means comprises a plurality of concentric threads provided on both sides of the rotor to form labyrinth seals.

3. A compressor as claimed in claim 1 or 2, wherein said rotor, including its variable section blades and its labyrinth seals, is constructed in one piece.

4. A compressor as claimed in claim 1, 2 or 3, being entirely of plastics construction.

5. A compressor as claimed in claim 1,

substantially as hereinbefore described with reference to, and as shown in, the drawings.

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