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FLUID DRIVEN GYROSCOPE

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FLUID DRIVEN GYROSCOPE

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This invention relates to fluid driven gyroscopes and is directed towards increasing the efficiency thereof.

Normally, the periphery of the gyroscope rotor is provided with a surround, usually a part of the rotor casing, and the driving fluid circulates in an annular space between the surround and the periphery of the rotor. The width of this space between the surround and periphery in a plane containing the rotor axis, is usually uniform across the peripheral surface; that is to say, the surround is uniformly spaced from the rotor periphery across the axial width thereof.

The working fluid enters the central part of the surround, engages the rotor buckets and then spreads out laterally in an axial direction over the rotor periphery. In order to increase the driving torque it is desirable to increase the viscous resistance of the fluid at the centre where the fluid is rotating at a greater speed than the rotor. This can be done by making the separation between the surround and the rotor periphery small. This, however, results in an increase of viscous resistance in the region of the lateral flow over the rotor periphery, where the fluid is circulating at a lesser speed than the rotor and therefore causing drag on the rotor. Consequently, in determining the separation between the surround and the rotor periphery a compromise has previously been made between increased torque and increased drag. The object of the present invention is to overcome this difficulty.

According to the present invention, a fluid driven gyroscope having a surround encircling the periphery of the gyroscope rotor is so constructed as to provide a space between these parts which is less at the centre of the periphery than at its sides, which surround is provided with a number of air passages directed in an inclined manner on to said periphery. The separation increases gradually towards the sides to ensure streamline flow and the avoidance of turbulence. This gradual increase may be obtained by providing the surround and/or periphery with a curved surface.

According to another feature of the invention the usual buckets are dispensed with and the periphery of the rotor is roughened over its central portion, for example by knurling.

In one construction in accordance with the invention the periphery of the rotor is curved so that the maximum radius of the rotor is at the centre and the minimum at the sides. A band running round the central part of the periphery,

or the part of maximum radius is knurled in the same way as the edge of a knob is knurled to enable a finger grip to be obtained, but the knurling is made rather finer and is of a criss-cross character.

The surround is provided with a cylindrical inner surface and a number of jet passages are arranged to extend through the surround with their axes lying in a central transverse plane and each inclined to a radius of the gyroscope whereby a ring of driving jets is formed, each preferably directed on to the periphery of the rotor. These jets communicate with an annular air chamber formed between an outer wall of a casing and the surround, which annular chamber communicates with an air supply.

The following is a description of two alternative forms of construction according to this invention, reference being made to the accompanying drawing, in which:

Figure 1 is a section through an air-driven gyroscope in a plane at right-angles to the axis of spin;

Figure 2 is a section in a plane containing the axis of spin showing one form of casing, and

Figure 3 is a similar view to Figure 2 showing another form of the casing.

Referring to Figure 1, the numeral 10 represents the gyroscope rotor which is encircled by a surround 11 having a number of jet passages 12 inclined to the radius of the rotor. An outer casing 13 is spaced away from the surround so as to provide an annular air chamber 14. The annular air chamber is provided with a suitable air inlet passage 15 in the wall of the casing. As will be seen from Figure 2, the casing is formed in two parts 16 and 17, the former part having the surround 11 formed integrally with it, and the peripheral portions of the two parts of the casing being spaced apart to provide the annular chamber 14. The two parts of the casing are clamped together by suitable bolts 18, shown in Figure 1, and are rendered fluid-tight by a spigot joint 19 and packing ring 20 formed between these parts. The spindle 21 of the rotor is supported by ball bearings 22, the outer race 23 of which is carried by the casing. The races 23 are provided with axial passages 24 through which the spent air from the driving jets may escape from the casing. It may, however, be preferable to plug these passages 24 and provide alternative passages in the casing which operate as anti-topple or precession modifying jets in known manner. It will be noted that the inner surface 25 of the surround is cylindri-

cal in shape, whereas the periphery 26 of the rotor is curved, thereby providing a space between the periphery and said inner surface which gradually increases from the central portion of the rotor to its sides. A central peripheral band 27 of the rotor is provided with a fine criss-cross knurling which is reacted upon by the air which issues from the passages 12. The flow of air through the passages 12 is obtained by means which maintain the pressure in the annulus 14 higher than in the casing. The arrangement shown in Figure 3 differs from that of Figure 2 in that the surround 11 is formed separately from the casing part 16 and is channel-shaped in cross-section having its flanges 23 clamped between the two casing parts.

In both of the illustrated constructions, the distance between the surround and the central knurled band of the rotor and thus between the mouths of the passages 12 and the knurled band, is about eight-thousandths of an inch. Consequently, the high speed of the air issuing from the passages around the periphery and the resultant high viscous resistance gives a large driving torque to the knurled band. The distance of the surface of the surround from the rotor periphery increases to fifty-thousands of an inch at the sides of the rotor, which results in a reduction in the viscous drag. In order to improve the streamlined flow towards the sides of the rotor it will be noted that the sides of the casing part are conical in shape.

In the above constructions, the efficiency is found to be high and at the same time the construction is very simple as the necessity for cutting buckets in the periphery of the rotor is avoided. Owing to the increased efficiency, greater rotor speed may be obtained with a consequent reduction in rotor size.

I claim:

1. A fluid driven gyroscope comprising a rotor, a surround encircling the periphery of the rotor, said surround containing passages adapted to direct fluid on to said periphery in an appropriate direction to drive the rotor, means for causing flow of fluid in said passages toward said rotor, said periphery and surround being shaped to provide an annular space between them which is of less depth around a central radial plane of said rotor than at parallel radial planes spaced from said central plane, the depth of said annular space being uniform in any given radial plane throughout its full circular extent.

2. A fluid driven gyroscope comprising a rotor, a surround encircling the periphery of the rotor, said surround containing passages adapted to direct fluid on to said periphery in an appropriate direction to drive the rotor, means for causing flow of fluid in said passages toward said rotor, said periphery and surround being shaped to provide an annular space between them which increases gradually from a central radial plane of said rotor to its sides, the depth of said annular space being uniform in any given radial plane throughout its full circular extent.

3. A fluid driven gyroscope comprising a rotor, a surround encircling the periphery of the rotor said surround containing passages adapted to direct fluid on to said periphery in an appropriate direction to drive the rotor, means for causing flow of fluid in said passages toward said rotor, one of which above recited members of the gyroscope has a cylindrical surface and the other a curved surface across the width of the

rotor so as to provide an annular space between them which is of less depth around the central circumference of the periphery than at the sides thereof, the depth of said annular space being uniform in any given radial plane throughout its full circular extent.

4. A fluid driven gyroscope comprising a rotor, a surround encircling the periphery of the rotor and having a cylindrical inner surface, which surround is provided with passages adapted to direct pressure fluid on to said periphery in an appropriate direction to drive the rotor, the periphery of which rotor is curved across its width so as to provide an annular space between it and the surround which is of less depth around the central circumference of the periphery than at the sides, the depth of said annular space being uniform in any given radial plane throughout its full circular extent.

5. A fluid driven gyroscope comprising a rotor the periphery of which is provided with a central circumferential band roughened as by knurling, a surround encircling the periphery of the rotor and containing passages adapted to direct fluid under pressure on to said periphery in an appropriate direction to drive the rotor, said periphery and surround being shaped to provide between them a space which is less around the central circumference of the periphery than its sides.

6. An air driven gyroscope comprising a rotor, a surround encircling the periphery of the rotor and formed with a number of pressure air passages each directed in an inclined manner to the adjacent radius of the gyroscope, which periphery and surround are shaped to provide between them an annular space which is of less depth around a certain central radial plane of said rotor than at parallel radial planes spaced from said central plane, the depth of said annular space being uniform in any given radial plane throughout its full circular extent.

7. An air driven gyroscope comprising a rotor, a surround encircling the periphery of the rotor and having a number of air passages formed therein and each inclined to the adjacent radius of the rotor, a casing encircling said surround and spaced away from it to provide an annular chamber, an air conduit communicating with said chamber, said periphery and surround being shaped to provide an annular space between them which is of less depth around a central circumference of the periphery than at the sides thereof, the depth of said annular space being uniform in any given radial plane throughout its full circular extent, and means for the eduction of air from said latter space.

8. A fluid driven gyroscope comprising a rotor, an outer casing encircling said rotor, a surround formed integrally with said casing as to provide an annular air chamber, an air conduit communicating with said chamber, said surround being provided with a number of air passages, each inclined to the adjacent radius of the rotor, the periphery of the rotor and the surround being shaped to provide between them an annular space which is of less depth around the central circumference of the periphery than at the sides thereof, the depth of said annular space being uniform in any given radial plane throughout its full circular extent, and means for the eduction of air from said latter space.

9. An air driven gyroscope comprising a rotor, a surround encircling the periphery of the rotor

and containing air passages adapted to direct air in an appropriate direction on to said periphery, an outer casing supporting said surround, which surround and casing are shaped to provide between them an annular air chamber, an air conduit communicating with said chamber, said periphery and surround being shaped to provide between them an annular space which is of less depth around a central circumference of the periphery than at the sides thereof, the depth of said annular space being uniform in any given radial plane throughout its full circular extent, and means communicating with said space for the eduction of air therefrom.

10. A fluid driven gyroscope comprising a rotor, a two-part casing around the rotor, a surround formed integrally with one of the parts of the casing so as to provide an annular chamber encircling the periphery of the rotor, which surround contains air passages adapted to direct air in an appropriate direction on to said periphery to drive the rotor, an air conduit communicating with said annular chamber, said periphery and surround being so shaped as to provide an annular space between them which is of less depth around the central circumference

of the periphery than at the sides thereof, the depth of said annular space being uniform in any given radial plane throughout its full circular extent, and another air conduit communicating with this latter space for the eduction of air therefrom.

11. A fluid driven gyroscope comprising a rotor, a two-part casing around the rotor, a surround encircling a periphery of the rotor and clamped between the two parts of the casing so as to provide an annular space between it and the casing, said surround being provided with a number of air passages, each inclined to the adjacent radius of the rotor, an air conduit communicating with said annular space, said periphery of the rotor and the surround being so shaped as to provide an annular space between them which is of less depth around the central circumference of the periphery than at the sides thereof, the depth of said annular space being uniform in any given radial plane throughout its full circular extent, and another air conduit communicating with this latter space for the eduction of air therefrom.

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