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(12) # EUROPEAN PATENT APPLICATION

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(54) **Fluid contacting surfaces and devices incorporating such surfaces.**

(57) A means for forming a fluid-contacting surface on such as a stationary deflector or a blade (1), of a rotatable impeller or propeller, and any device incorporating or provided with such fluid-contacting surface, wherein said surface comprises at least part of the surface generated by a generating line (OP) extending radially from a point of origin (O), on a axis (Z), and rotated about said axis from said point and radial position so as to sweep through a decreasing

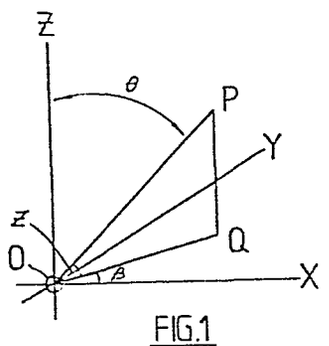
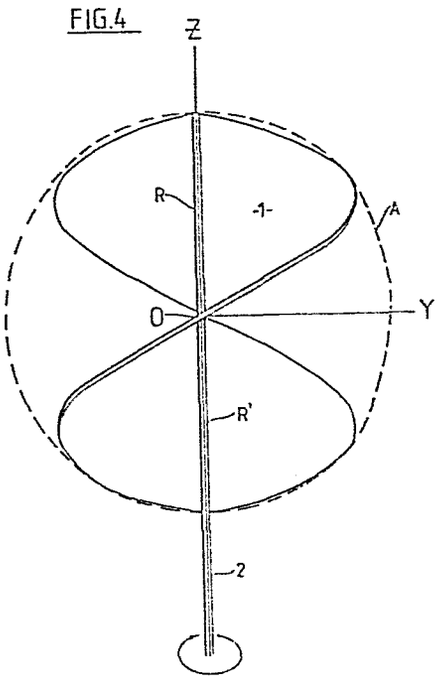


FIG.1

FIG.4



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"Fluid Contacting Surfaces and Devices Incorporating Such Surfaces'

This invention relates to fluid-contacting surfaces and devices incorporating such surfaces, and more particularly relates to fluid-contacting surfaces and devices which are arranged to affect, modify or control the flow of fluids, as for example the fluid-contacting surfaces of stationary deflectors or rotatable devices such as turbines, impellers or propellers and the like which may be used for a variety of purposes and applications e.g. as in pneumatic and hydraulic applications.

Conventional design of the fluid-contacting surfaces of such as impellers, propellers and like devices can be quite complex and involve relatively high design and production costs for such devices. It is accordingly an object of the present invention to provide an alternative means for generating or forming a fluid-contacting surface, and a device incorporating at least one such surface, in a relatively simple but effective and efficient manner.

Another object of this invention is to provide a fluid-contacting surface and/or device incorporating at least one such surface, which may have special purpose applications and provide more effective fluid flow control than at least many conventionally formed fluid-contacting surfaces and devices.

Other and more particular objects and advantages of the present invention will become apparent from the ensuing description.

According to one aspect of this invention therefor, a fluid-contacting surface comprises at least a part of that

surface generated by a generating line extending radially from a point of origin on an axis and rotated about said axis from a said point of origin and radially position so asto sweep through a decreasing angle relative to the axis as rotation takes place.

In another aspect of the invention, there is provided a stationary fluid deflector incorporating the fluid-contacting surface generated according to the preceding claim.

In a further aspect of the invention, there is provided an axial flow fluid impeller or propeller incorporating at least one fluid-contacting surface generated as aforesaid.

The invention further includes the methods of forming the said generating surface and the said stationary deflector and/or axial flow fluid impeller or propeller.

Some preferred aspects of the invention will now be described by way of example and with reference to the accompanying drawings, in which:

FIGURE 1: is a diagram illustrating the principles involved in generating a fluid-contacting surface in accordance with the invention

FIGURE 2: is an axial or end view of a first form of an impeller or propeller blade formed in accordance with the invention

FIGURE 3: is a view in the direction of arrows III-III of figure 2

FIGURE 4: is a view in the direction of arrows IV-IV of figure 2

FIGURE 5: is an axial view of a blade part for forming the impeller or propeller of figures 2, 3 and 4, illustrated

in a flat form prior to shaping

FIGURE 6: is a perspective view of another form of the impeller or propeller form in accordance with the invention

FIGURE 7: is a side view in the direction of arrow VII of figure 6

FIGURE 8: is a side view in the direction of arrow VIII of figure 6

FIGURE 9: is an axial or end view of the arrangement of figure 6 as viewed in the direction of arrow IX

FIGURE 10: is an axial view of one blade part for forming the impeller or propeller of figures 6 to 9 inclusive, illustrated in the flat form prior to shaping

FIGURE 11: is a side view of a further impeller or propeller similar to but including a modification of the impeller of figures 6 through to 9, and

FIGURE 12: is a view in the direction of arrows XII-XII of figure 11.

Referring firstly to figure 1 of the drawings, this diagrammatically illustrates how a fluid-contacting surface in accordance with the present invention may be generated about a point or origin O of an axis of rotation Z. A generatrix point P defines a radius vector OP, transverse axis X extends at right angles to the axis of rotation Z and the angle β is formed between the X axis and the projection OQ of the radius vector OP onto the XY plane, with the angle α being formed between the radius vector OP and the XY plane. The parametric equations defining the curve generated by the point P are:

$X = R.\cos\beta \cos z$

$Y = R. \sin\beta \cos z$, and

$Z = R. \sin z$

Either of the angles β and z may be eliminated from the equations by expressing it as a function of the other.

As seen, in the XYZ co-ordinate system the point of origin O is at the intersection or point of origin of the three co-ordinate axes, and with the angle between the true axis of rotation Z and radius vector OP referred to as θ, the fluid-contacting surfaces generated in accordance with this invention is defined as the locus of the generatrix line OP where $\theta = f(\beta)$ i.e. is some function of the angle β. For example, where

$$\theta = \beta$$

$$\theta = \frac{\beta}{2.6}$$

$$\theta = \frac{1}{16\pi}$$

or any other other function, including tables of discrete values.

Simply put, the fluid-contacting surface in accordance with this invention, is any part of that surface generated by the radius vector or generating line OP rotated about the axis Z from the point of origin and swept between the transverse axis X through a decreasing angle to lie adjacent and parallel the axis Z. The surface may include the full 90° sweep between the transverse axis X and the true axis of rotation Z or a part thereof, or the full 180° sweep from adjacent the axis Z to one side of the point of origin O through the transverse axis X to lie adjacent the axis Z at the opposite side of the point of origin O; and the surface thus formed may be duplicated or otherwise multiplied in providing a plurality of similar fluid-contacting surfaces in continuous or spaced relationship about the axis of rotation Z e.g. as in providing fluid-contacting surfaces on a twin or multi bladed impeller or propeller.

The angle through which the radius vector or generating line OP is swept and the angle of rotation about the axis E may be unrelated or each may be a function of the other such as, for example, directly proportional, according to the use to which the fluid-contacting surface is to be put. Similarly the variance in the angle through which the generating line OP is swept may be unrelated or directly proportional to the speed of rotation of the line OP about the axis E.

Further, it is envisaged that the generating line OP can remain of constant length throughout its rotational and angular sweep relative to the axis E, so that the said surface, and any impeller or propeller blade formed thereby or incorporating such surface, may be swept through an imaginary sphere or spheroidal form,or the length of the generating line OP can be varied as it is swept through its prescribed angle and rotated about the axis E from its point of origin O in forming a fluid-contacting surface or device incorporating such surface arranged to sweep through an alternative required form as hereinafter described.

Referring now to figures 2, 3 and 4, the rotatable impeller or propeller may be constructed with a blade 1 formed from such as a thin sheet of metal or other suitable material in initially flat circular disc form of radius equal to the length of the generating line OP and provided with either a single radial slit S or a small sector R,R' cut out, as illustrated by way of example in figure 5 of the drawings; and the whole or part disc form may then be twisted and bent into shape with the radial slit

(or sector) edges R, R' disposed in opposition 180° apart to lie on or adjacent the axis of rotation Z of the impeller or propeller.

In constructing the impeller or propeller in this manner, the slit S between the radial edges R, R' of the blade 1 may be a width such that is is substantially equal to the diameter of an axial shaft 2 for the impeller or propeller and to which the said radial edges R,R' can be secured such as by welding.

Conventional screw type impellers or propellers are formed with at least the inner parts of their fluid-contacting surfaces as a true helix or substantially a true helix about the axis of rotation, with such helix being maintained perpendicular to the axis as it progresses longitudinally thereof; and many propellers are provided with a further helical twist along their radial axes towards their outer periphery. It will be seen that in the present invention there is a substantial difference in construction in that the blade is simply spirally formed from one point of origin O on the axis of rotation Z so that from the one medial position on the transverse axis X where the fluid-contacting surface generating line OP is disposed perpendicular to the axis of rotation Z, either side of such perpendicular position the angle of inclination θ relative to the axis Z progressively decreases as it approaches the axis of rotation Z until it is positioned parallel and adjacent thereto i.e. adjacent the longitudinal surface of the axially disposed shaft 2.

In this form of the invention, a pitch value of n = 2 has been selected, with the result that the blade 1 curves tightly into the main axis of rotation Z of the impeller or propeller. In

figure 2, radial lines 3 represent equal increments of the angle β of figure 1 and the dashed lines 4 join sample points of equal displacement from the plane of the X and Y axes.

In this arrangement, with rotation of the impeller and shaft about axis E a positive axial thrust on the fluid is exerted by the fluid-contacting surface of the blade 1 for efficient and effective operation either in moving the fluid coaxially or moving such as an aeroplane or boat relative to the respective fluid (air or water) in which it is located.

The arrangement shown in figures 2,3 and 4 illustrate a single blade, but a complementary second blade can be provided and mounted in complementary diametric opposition, as shown in broken outline; and it will be seen also that on rotation the blade 1 or blades 1 will sweep through an imaginary sphere A as indicated in broken outline in figure 4.

Referring now to figures 6 to 10 of the accompanying drawings, a twin bladed impeller or propeller is provided with a different pitch and consequential different shape formed as a result of each blade 1' being constructed from thin sheet metal initially of disc form as before but with a relatively large segment S' cut out between radial edges R and R', as shown in figure 10.

Again and with the two blades 1' and their common shaft 2' rotated about the said axis E, the blades 1' will sweep through an imaginary sphere A. It will be appreciated however that the invention is not confined to impellers or propellers in which the fluid-contacting surface generating line OP is constant, but by varying the length of such line (e.g. by a gradual increase

to a peak followed by a gradual decrease) during formation of the impeller, or by subsequent shaping of the impeller blades once initially formed as before described, impellers or propellers of different shapes and sweeping different shaped volumes can be provided to meet the desired situations. For example, the impeller blades 1' can be shaped so that on rotation a substantially cylindrical volume may be swept as indicated in chain dot outline B in figure 7, or the blades 1' may be shaped so that an ellipsoidal form C is swept by the impeller blades. In other variations the basic spheroidal form may be in the main applicable to the medial part of the impeller or propeller, but segments of the sphere or spheroidal form at the opposite axial ends may be cut off, or the longitudinal axis of the impeller or propeller substantially shortened relative to the true diameter.

Referring now to figures 11 and 12 of the accompanying drawings, a twin bladed impeller or propeller may be provided which is substantially similar to the impeller or propeller previously described with reference to figures 6 to 10 of the drawings, except that in this arrangement whilst the two blades 1'' are similarly formed from a thin flat disc arrangement, on assembly or prior to assembly axial end portions are cut out at T to more particularly separate the blades 1'' at the shaft 2'' each side of the medial portion 1''a

Experiments with impellers and impeller blades formed as aforedescribed in accordance with this invention have shown that in many instances and on rotation in one direction the formed impellers will give a far more concentrated axial thrust than

conventional impellers or similar overall size, similarly powered, and rotated at the same revolutions. The invention thus has particular applications in the construction of small and large air circulation, cooling and ventilating fans and the like; and it is further expected that the invention will have useful applications in marine propulsion for boats and the like, and/or the impelling or pumping of various kinds of fluids, and possibly further have aeronautical applications.

As before indicated, the invention particularly lends itself to simplification of manufacture utilising sheet materials, but it will be appreciated that the invention is not confined in this respect and that the impeller, propeller or other blades or deflectors incorporating the fluid-contacting surface or surfaces in accordance with the invention can be manufactured and formed by other means.

Particular forms of the invention and its applications have been described only by way of example with reference to the accompanying drawings, and it will be appreciated that other variations of and modifications to, and applications of, the invention may take place without departing from the scope of the appended claims.

CLAIMS:

1. A fluid-contacting surface comprising at least a part of the surface which is generated by a generating line extending radially from a point of origin on an axis and rotated about said axis from said point and radial position so as to sweep through a decreasing angle relative to the axis as rotation takes place.

2. A fluid-contacting surface as claimed in claim 1 wherein the variance of said angle is directly proportional to the speed of rotation of the line about said axis.

3. A fluid-contacting surface as claimed in claim 1 or claim 2 wherein the length of the said generating line is constant through said rotational angular sweep.

4. A fluid-contacting surface as claimed in claim 1 or claim 2 wherein the length of the said generating line is varied by gradual increase to a peak and followed by a gradual decrease.

5. A fluid-contacting surface as claimed in claim 1 wherein the generating line is swept through substantially an angle of 90^{o} from perpendicular to the axis to adjacent and parallel therewith.

6. A fluid-contacting surface as claimed in claim 1 wherein the generating line is swept through substantially 180^{o} from a position adjacent and parallel with the axis to one side of said point of origin, through said radially extending position to a position adjacent and parallel with the axis at the other side of said point of origin.

7. A stationary fluid deflector having at least one fluid-contacting surface defined by at least part of the surface which is generated by a generating line extending radially from a point of origin on an axis and rotated about said axis from said point and radial position so as to sweep through a decreasing angle relative to the axis as rotation takes place.

8. An axial flow fluid impeller or propeller having at least one fluid-contacting surface defined by at least part of the surface which is generated by a generating line extending radially from a point of origin on an axis and rotated about said axis from said point and radial position so as to sweep through a decreasing angle relative to the axis as rotation takes place.

9. A fluid impeller as claimed in claim 8 and comprising two similar blade parts secured to and disposed in diametric opposition about a common axis, each of said blades having a fluid-contacting surface and said common axis being said axis about which the generating line is rotated.

10. A fluid impeller or propeller as claimed in claim 8 or claim 9 wherein the blade or blades is or are arranged to sweep through an imaginary co-axial spherical or spheroidal form on rotation of the impeller or propeller.

11. A fluid impeller or propeller as claimed in claim 8 or claim 9 wherein the blade or blades is or are arranged to sweep through all or part of an imaginary ellipsoidal form on rotation of the impeller or propeller.

12. A fluid impeller or propeller as claimed in claim 8 wherein the blade or blades is or are arranged to sweep through an imaginary co-axial cylindrical form on rotation of the impeller or propeller.

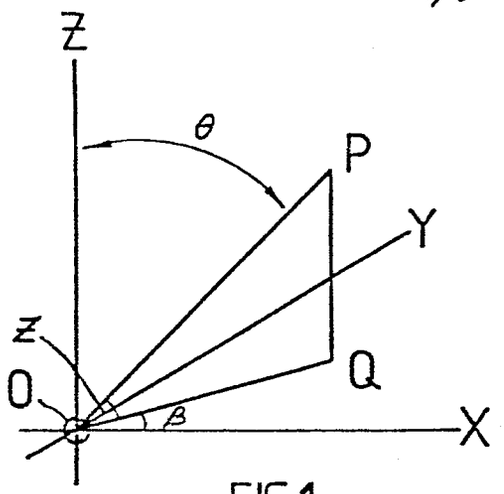


FIG.1

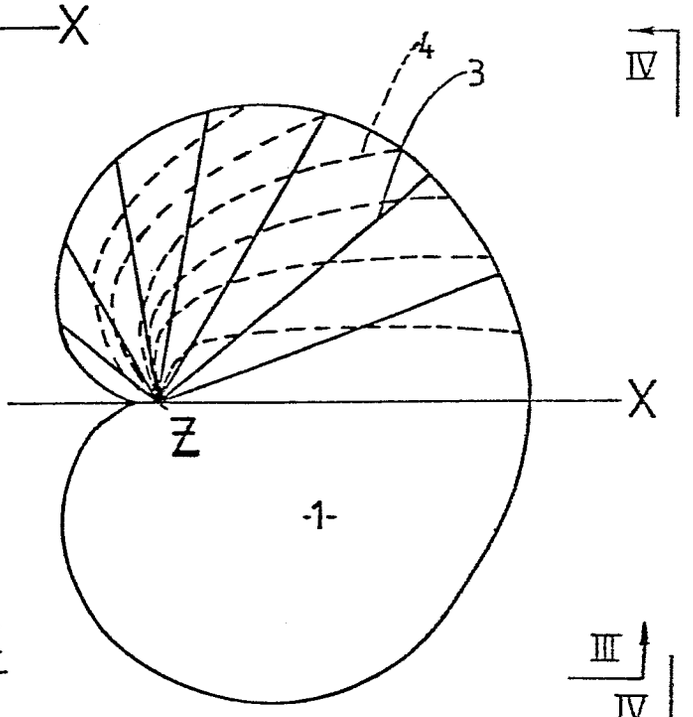


FIG. 2

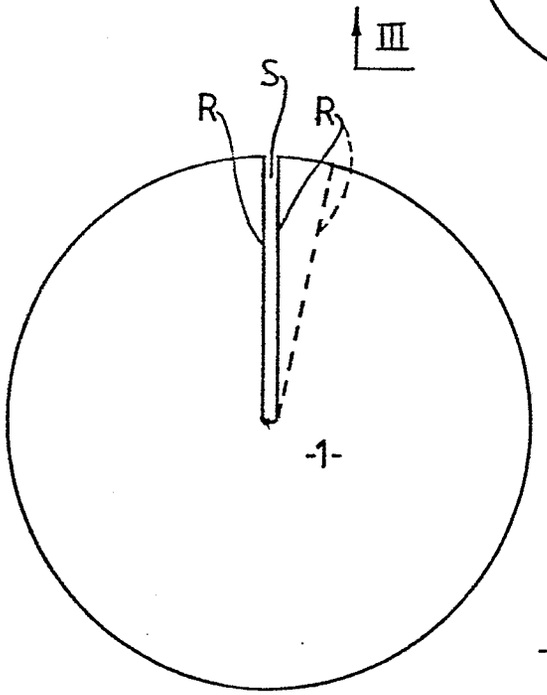


FIG.5

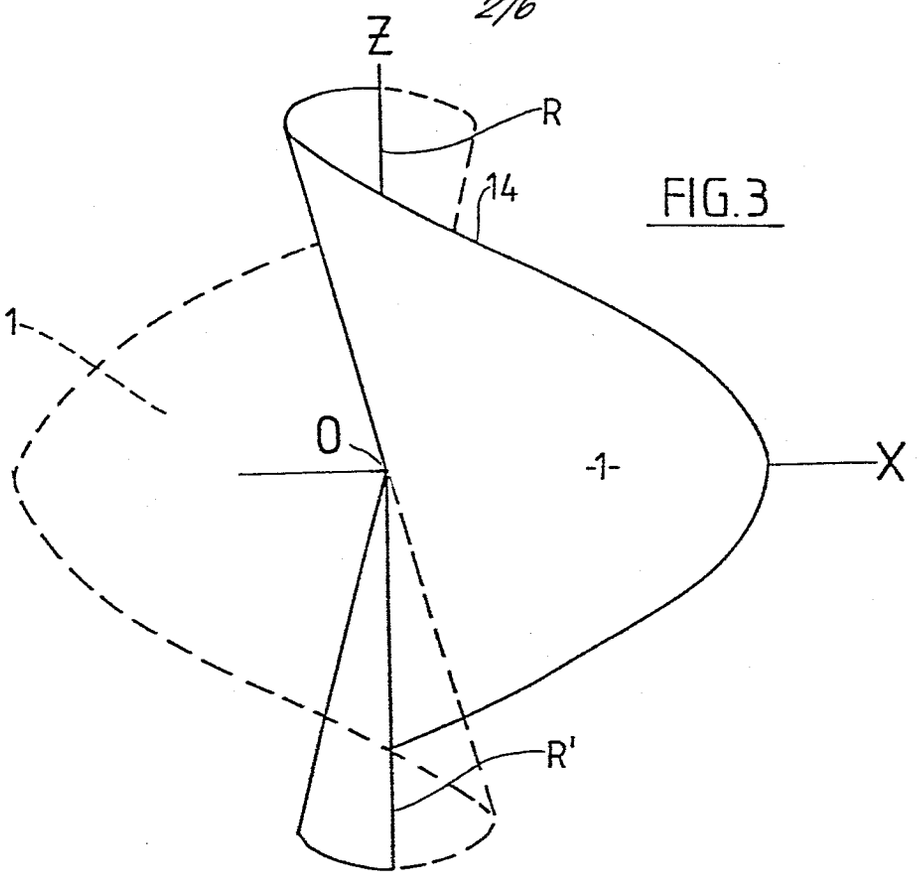


FIG.3

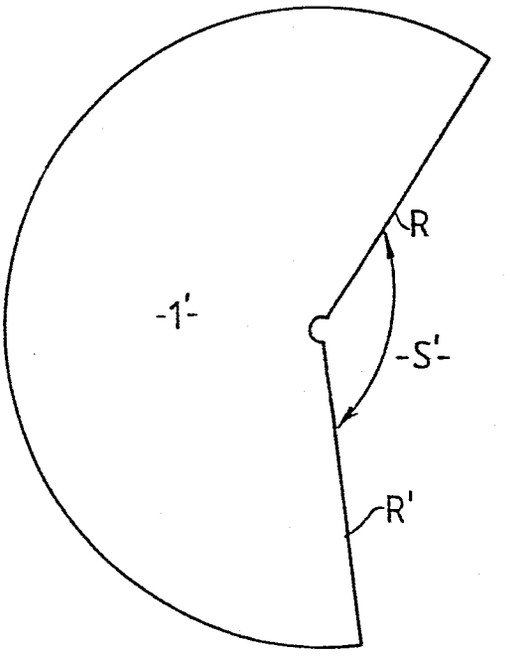
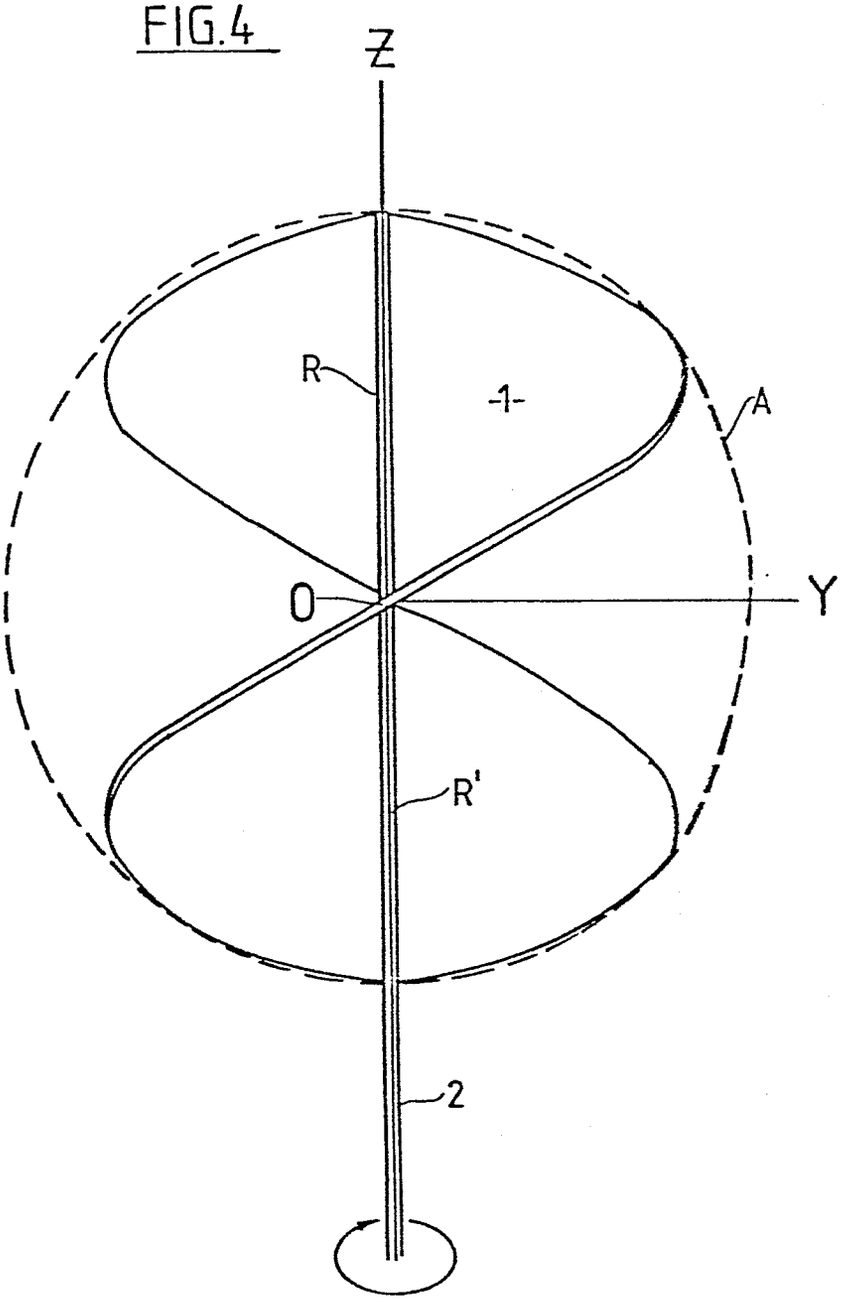


FIG.10

FIG.4



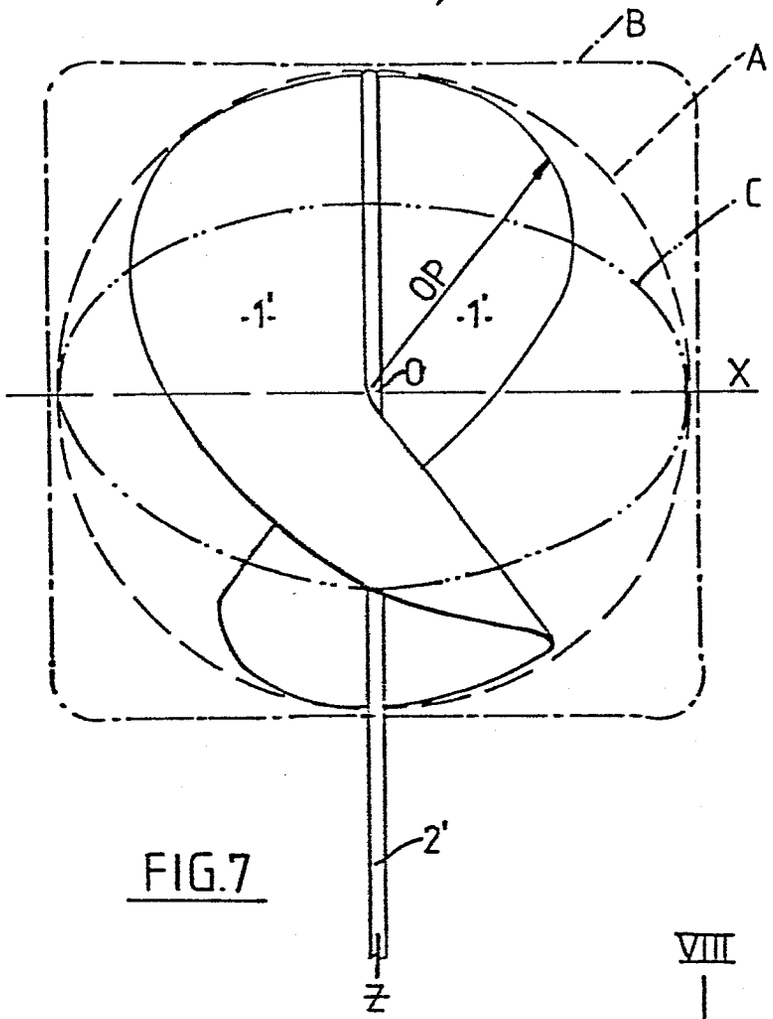


FIG.7

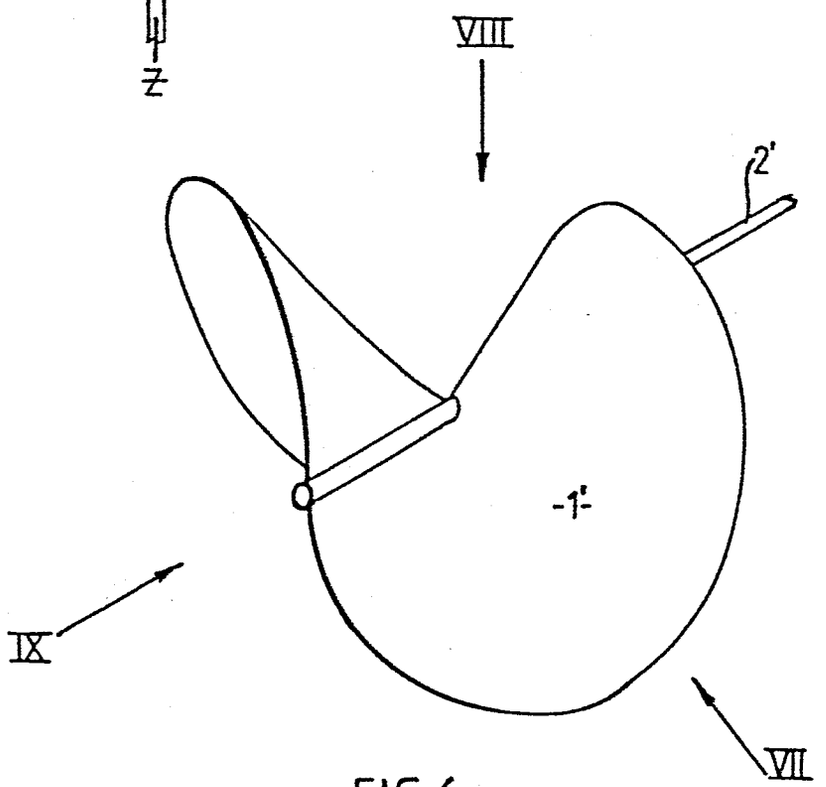


FIG.6

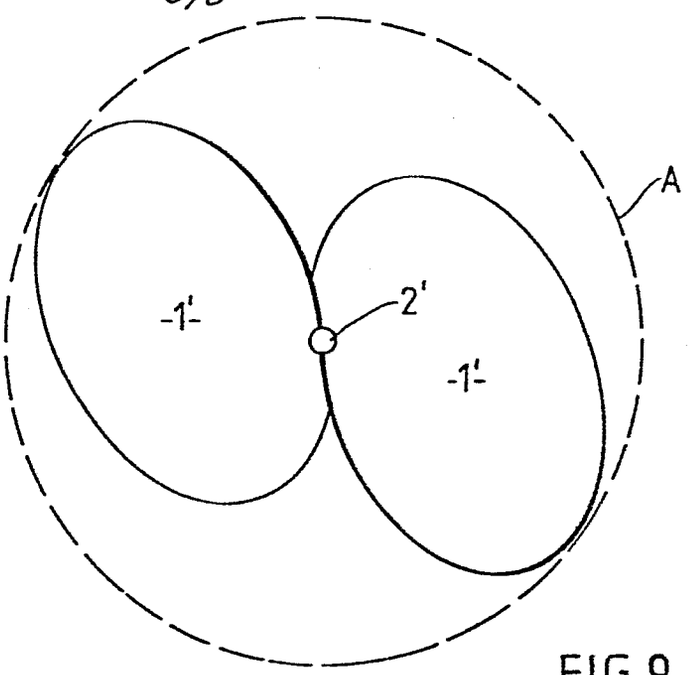


FIG.9

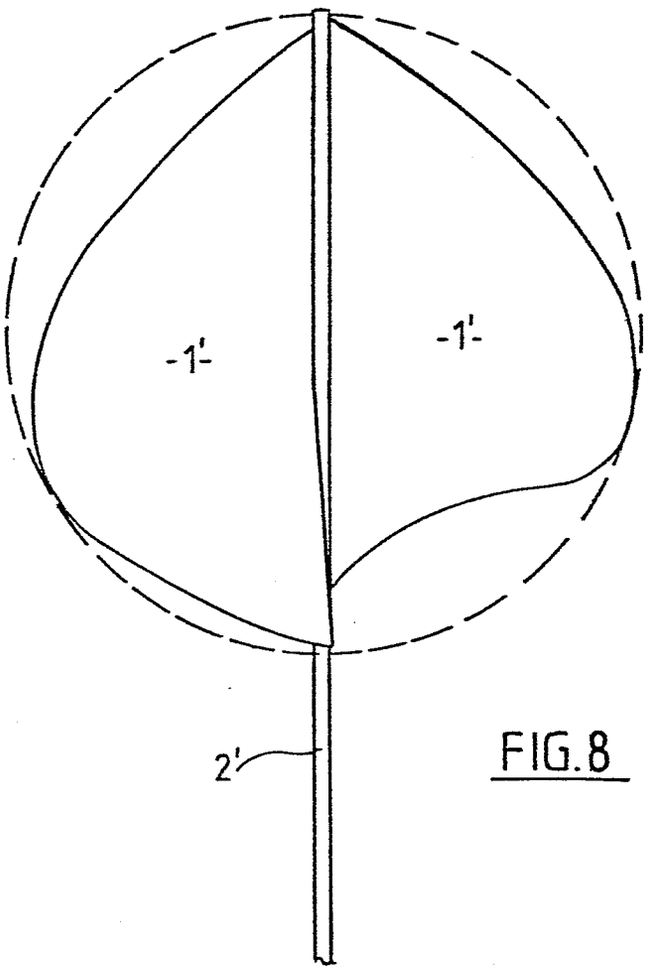


FIG.8

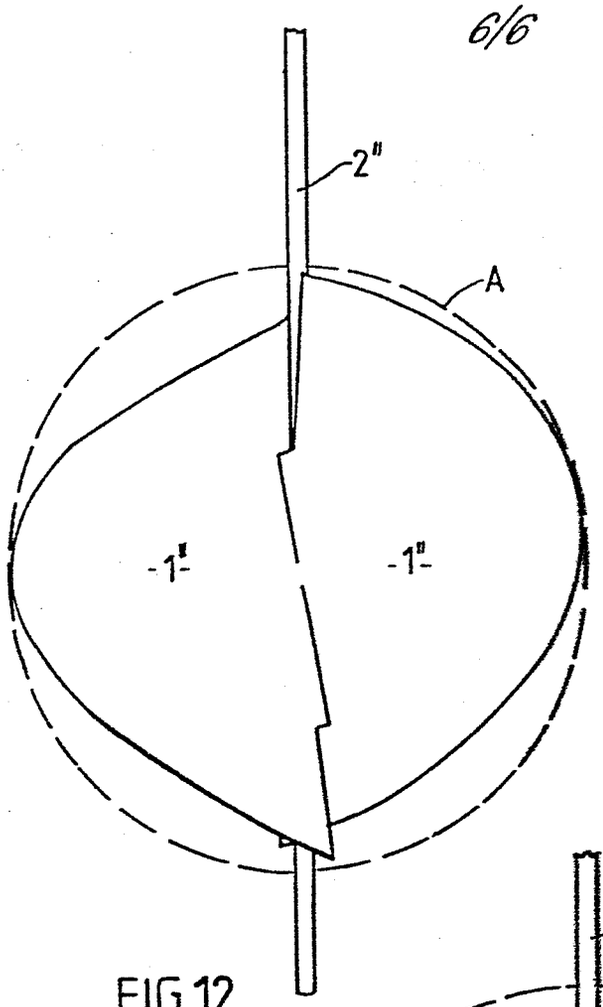


FIG.12

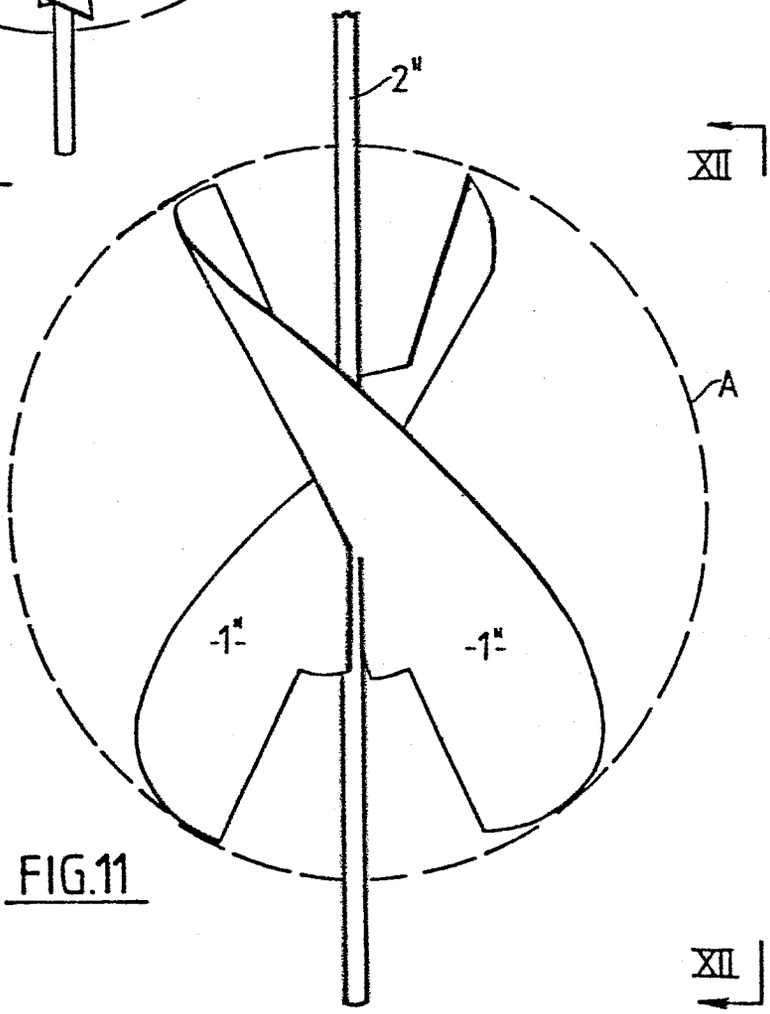


FIG.11

European Patent Office

EUROPEAN SEARCH REPORT

0122726
Application number

EP 84 30 1804

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int Cl ³)
A	FR-A-2 187 030 (CRAMBES) * Figures 1-4; page 1, lines 31-40 *	1	F 04 D 29/18 B 63 H 1/26
A	DE-B-1 017 915 (BERGEDORFER) * Column 2, lines 35-40; figure 2 *	1	

TECHNICAL FIELDS SEARCHED (Int Cl ³)

F 04 D
B 63 H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	09-07-1984	WOOD R.S.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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