Aug. 15, 1961 J. L. McGREGOR 2,996,120

FLUID FLOW TRANSDUCER

Filed Dec. 5, 1958

FIG. 2

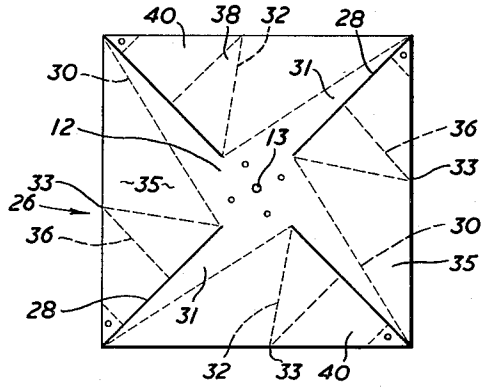
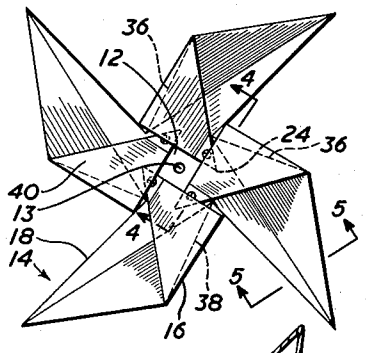


FIG. 3



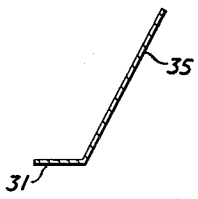


FIG. 5

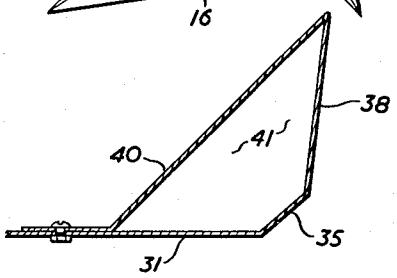
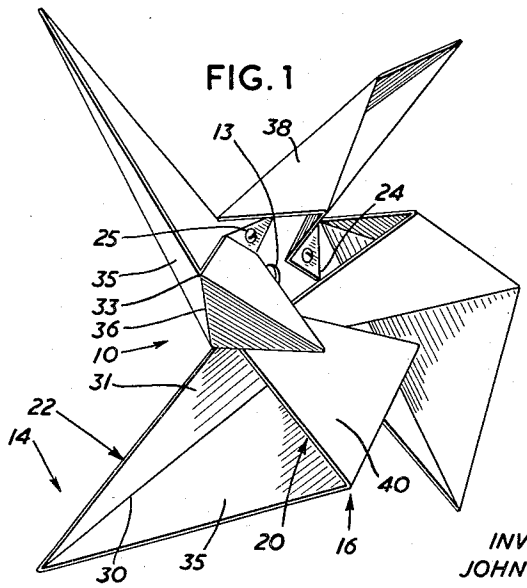


FIG. 4

FIG. 1



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FLUID FLOW TRANSDUCER

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This invention relates to a mechanical-fluid flow transducer.

By mechanical-fluid flow transducer I mean a wheel of the form of a turbine, fan wheel or propeller or the like, suitable for converting rotary mechanical energy to axial fluid flow and vice versa.

By "fluid" I include gases and liquids.

It is an object of this invention to provide a mechanical-fluid flow transducer with large effective area and normally coarse pitch.

It is an object of this invention to provide a mechanical-fluid flow transducer usable as a fan, axial flow pump or turbine wherein there is no dead space for fluid adjacent the axis of rotation.

It is an object of this invention to provide a mechanical-fluid flow transducer having rotatable blades wherein each blade has the approximate contour of an airfoil and wherein means are provided for causing radial flow along the blade surfaces thereby reducing the boundary layer effect and inherent bend loss.

It is an object of this invention to provide a mechanical-fluid flow transducer having rotatable blades wherein each blade has the approximate contour of an airfoil and wherein the blade camber and thickness increases radially inwardly.

It is an object of this invention to provide a mechanical-fluid flow transducer having rotatable blades wherein the contour of the blades channels radially flowing air therealong and either funnels the fluid into a narrow stream or uses part of it for lubrication.

The invention provides a wheel operable as a fan or turbine with central element and a number of blades extending radially therefrom the blades being provided with the necessary pitch to act under rotation as a rotary mechanical-fluid flow transducer. Each of the blades defines in relation to the desired direction of rotation, a leading edge and trailing edge comprising a front portion and a rear portion, relative to the source of fluid flow, said front portion joining said rear portion to define at the junction, the leading edge of said blade and tapering away from said junction in the opposite direction to that of rotation to join said rear portion adjacent the centre of the central element and defining between said front and rear portion a channel whereby said front portion occludes the radially inner portion only of said rear portion.

The invention also provides a mechanical-fluid flow transducer constructed from a blank symmetrical about a point, said blank being defined by a peripheral edge, by providing cuts symmetrical about said point extending inwardly from said edge to provide blades corresponding to the said cuts, made by taking the material on the same side of said cut in each case and folding to attach the material on said side adjacent the intersection of the cut forming the other boundary of the blade being formed with the edge on said side and attaching it adjacent but radially spaced from said point in such a manner that said points of attachment are also symmetrical about said point.

In drawings which illustrate an embodiment of the invention:

FIGURE 1 is a perspective view thereof;

FIGURE 2 is a view of a blank for construction of the device of FIGURE 1 and

FIGURE 3 is a front view of the invention;

FIGURES 4 and 5 are cross sections along the lines 4—4 and 5—5 of FIGURE 3.

In FIGURES 1 and 3 to 5 is shown a turbine or fan wheel **10** comprising a central portion **12** having an aperture **13** therethrough for mounting on a shaft with a number, preferably four, blades **14**, extending radially therefrom. Each of the blades **14** defines in relation to the desired direction of rotation a turbine leading edge **16** and a trailing edge **18** and a front portion **20** and rear portion **22**. It will be understood that the device, when used as a fan or axial flow pump, the leading edge defined above will become the trailing edge and vice versa. The front portion **20** joins the rear portion **22** to define at the junction the inner part of the leading edge **16** of the blade. The front portion **20** tapers in the opposite direction to that of rotation as a turbine to an apex **24** and is joined at **25** near the apex to central portion **12** adjacent the aperture **13**.

The front portion **20** thus occludes, to a viewer at the front of the wheel, a small portion of the rear portion **22**.

The blades **14** and central portion **12** are preferably symmetrical about the rotation axis corresponding to aperture **13**.

Preferably the wheel **10** is four bladed and is made from a single square blank **26** divided by the diagonals thereof into four sections. The blanks cut along lines **28** extending inwardly along the diagonals from the outside of the blank. A crease line **30** extending from the root of each cut from a corner to the adjacent corner (in the same sense in all cases) define between the crease line **30** and the adjacent cut **28**, each first planar extent **31**. A crease line **32** from the root of each cut to the edge at **33** bisecting the angle between a cut and a crease line **30** defines with crease line **30** each second planar extent **35**. A crease line **36** from **33** to the cut remote from the second defines between the line **36** and the crease line **32** the third planar extent **38** and also defines the fourth planar extent **40**. To construct the wheel, the blank is bent about the crease lines and the apex **24** of fourth planar extent **40** is fastened to the centre member at adjacent to but spaced from the centre. It will be seen therefore, that rear portion **22** is comprised of planar extents **31**, **35** and **38** and front portion **20** is comprised of the fourth planar extent **40**. Thus is formed a wheel wherein all surfaces and laminar extents are planar and all fold lines are linear whereby an easily manufactured product is provided.

The geometry of the crease lines is so selected that all inclined planar extents slope rearwardly in the direction of rotation as a turbine, that is to say, the forward boundary of each inclined planar extent lies further upstream in the actuating fluid than does the respective rear boundary.

The geometry is also selected so that radial channel indicated at **41** is defined between planar extents **31—35—38—40** for radially flowing fluid.

It will be noted that the fourth planar extents **40** are displaced from said point radially outward toward the next following blade considering the direction of rotation as a turbine. This arrangement causes the fourth planar extent **40** to slope rearwardly toward the radially inward opening of the channel **41** to assume an angle somewhere between the directions of radial and axial flow just in front of the central portion **12** of the central member and acts like a deflector between such axially and radially flowing fluid.

The geometry is also selected so that the inner apices of planar extent **40** terminate at a position spaced from the middle and are in fact symmetrically arranged thereabout and deflect air flowing into or out of the channel of the adjacent blade located rearwardly in the direction of rotation as a turbine.

It is thus seen that there is produced a fan, pump or turbine wheel with a large effective area and a normally coarse pitch.

It will also be noted that the blades are preferably designed so that the blades are not radial but slope rearwardly outwardly in the direction of rotation as a turbine.

It will be seen that for each channel 41 the fourth planar extent or front portion of the adjacent blade will, when used as a fan or pump deflect radially air to become axially flowing fluid. Similarly, when the wheel is used as a turbine the axially flowing fluid impinging on the central element is deflected by the front portion through the channels 41. Thus there is no dead area in front of the central element and in addition the flow of radial air along the surface of planar extents 31 and 35 prevents a boundary layer effect on the blade surfaces and improves the operation of the blade as a cambered air foil. In addition, the contour of the blade spirals outwardly relative to the radii and thus no further channelling is required whether the blade is used as a fan or as a turbine.

It will be seen that the effective cross section of the blade is an approximation of the highly cambered wing section and that the effective pitch angle becomes steeper towards the centre where the linear speed of the blade is least.

The wheel may be made from self rigid material or from a more flexible material combined with a rigidifying support framework.

What I claim as my invention is:

1. Means for converting translatory fluid flow energy to rotary mechanical energy and vice versa comprising: a bladed body made from a single metal laminar blank including a central element, a plurality of blades extending therefrom symmetrically disposed with respect to a point forming the centre of said central element, each of said blades including a rear portion having a first planar extent, a second planar extent leading said first in the direction of rotation as a turbine and sloping forwardly in such direction of rotation at a greater degree than said first planar extent, a third planar extent joined to said second extent and therefrom sloping forwardly in the direction of rotation at a greater degree than said second planar extent and a fourth planar extent joined to said third planar extent at the leading edge of both surfaces of the blade as a turbine and extending therefrom and tapering in the opposite direction to that of rotation to join said first planar extent adjacent said point, said third planar extent being triangular, said fourth extent sloping forwardly in the direction of rotation at an angle intermediate the corresponding angles for said first planar extent and said third planar extent, the radial extent of said first, third and fourth planar extent being limited by a common radially outward edge progressively sloping radially inwardly across said first third and fourth planar extents.

2. Means as in claim 1 where said fourth planar extents are joined to said central element adjacent to but spaced from said point being radially displaced from said point radially outward toward the next following blade considering the direction of rotation as a turbine.

3. Means as claimed in claim 1 where the boundaries between said first and said second planar extents and between said second and third planar extents and between said third and fourth planar extents are straight lines.

4. A mechanical-fluid flow transducer constructed from a blank symmetrical about a point, said blank being defined by a peripheral edge, and having cuts symmetrical about said point extending inwardly from said edge, to provide blades corresponding to the said cuts, said blades being formed of the material on the same sides of said cut in each case, said material being folded and attached on said side adjacent the intersection of said cut with the edge on said side and attached adjacent but radially spaced from said point in such a manner that said points of attachment are also symmetrical about said points, and all sloping surfaces being sloped in the same sense relative to the direction of rotation, said surfaces being substantially planar and separted by straight fold lines.

References Cited in the file of this patent

UNITED STATES PATENTS

749,638	Steiner	Jan. 12, 1904
2,235,461	Miller	Mar. 18, 1941

FOREIGN PATENTS

128,518	Great Britain	June 26, 1919