

Oct. 16, 1956

N. T. ALMQUIST ET AL

2,766,964

SELF-GOVERNING TURBINE

Filed June 25, 1952

2 Sheets-Sheet 1

Fig. 1.

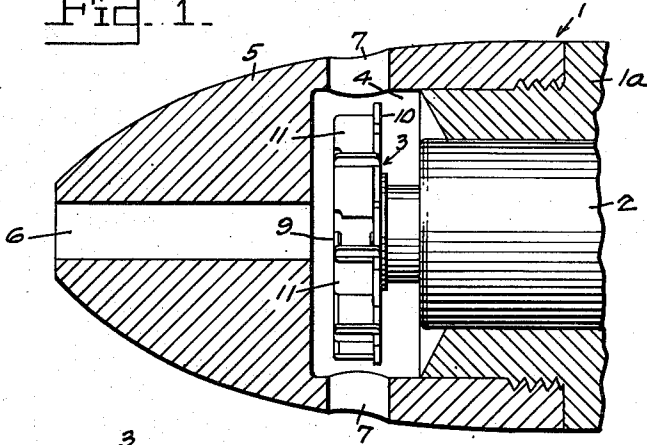


Fig. 2.

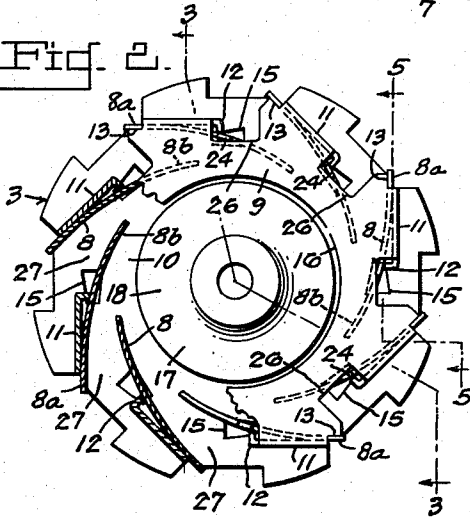


Fig. 4.

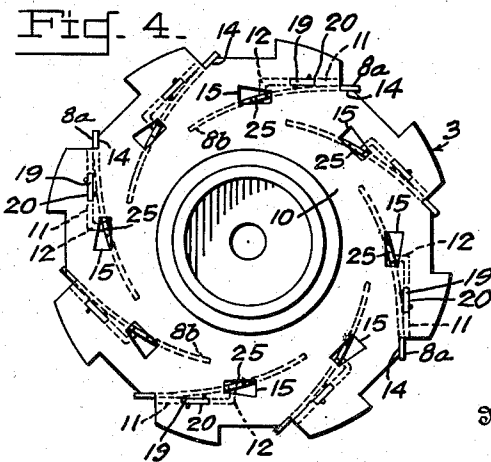


Fig. 3.

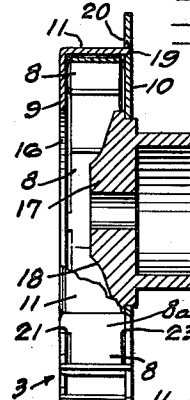
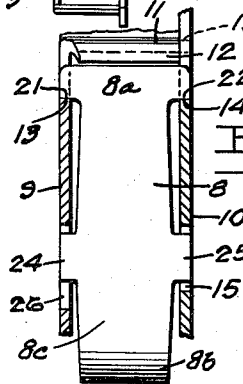


Fig. 5.



Inventors
Nils T. Almquist
Myron G. Domsitz
Max Shufer

By *J. J. Kessenich & A. W. Dew*
ATTORNEYS
and *F. E. McFee*
AGENT

Oct. 16, 1956

N. T. ALMQUIST ET AL

2,766,964

SELF-GOVERNING TURBINE

Filed June 25, 1952

2 Sheets-Sheet 2

Fig. 6.

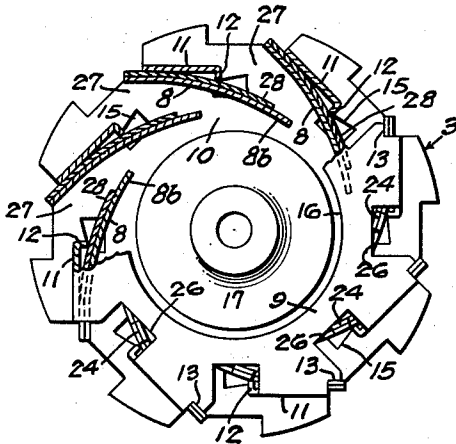


Fig. 7.

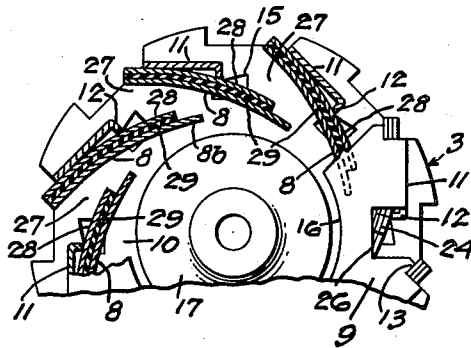


Fig. 8.

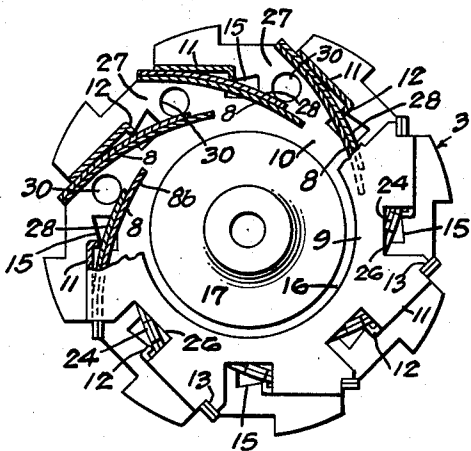
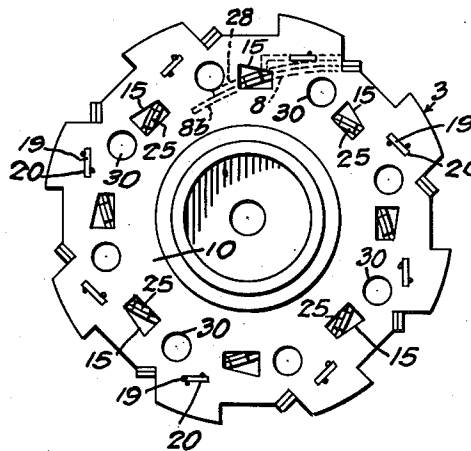


Fig. 9.



Inventors

Nils T. Almquist

Myron G. Domsitz

Max Shufar

By *G. Kessenich + A. W. Dew*
ATTORNEYS
and *F. E. Mc Lee*
AGENT

1

2,766,964

SELF-GOVERNING TURBINE

Nils T. Almquist, New Britain, Conn., Myron G. Domsitz, Bethesda, Md., and Max Shufer, Bellerose, N. Y., assignors to the United States of America as represented by the Secretary of the Army

Application June 25, 1952, Serial No. 295,422

6 Claims. (Cl. 253—79)

In electrically or electronically operated fuses for ordnance missiles, the source of electric power is frequently a generator driven by a wind vane or turbine, rotation of which is caused by the air blast created by the travel of the missile through the air. In such use, it is desirable that electric power be available at the required voltages as rapidly as possible and that these voltages be not exceeded as occurs when the rotational rate of the wind turbine or vane reaches speeds higher than needed to deliver the required voltages. Voltage regulating circuitry has frequently been used to maintain the voltage thus produced within the desired limits. Circuitry of this type is comparatively costly and occupies space which is desired for other components. In order to provide a uniform generator speed and thus a voltage which shall not reach excessive values, we have invented a self-regulating turbine as hereinafter described.

The specific nature of the invention as well as other objects and advantages thereof will clearly appear from the following description and accompanying drawings in which:

Figure 1 is a cross sectional view showing the turbine of the invention incorporated in an ordnance missile.

Figure 2 is a front elevation of a preferred form of the turbine rotor with parts broken away, in which each blade is made of a single resilient member displaceable by air pressure and/or centrifugal force.

Figure 3 is a cross sectional view taken along line 3—3 of Figure 2.

Figure 4 is a rear elevation of the rotor of Figure 2.

Figure 5 is an enlarged sectional view taken generally along line 5—5 of Figure 2 showing a blade of the turbine rotor and the method of mounting the blade.

Figure 6 is a front elevation, with parts broken away, of a modification of the rotor wherein each blade is composed of a plurality of resilient members.

Figure 7 is a fragmentary view, similar to Figure 6, showing the resilient members separated by a frictional material.

Figure 8 is a front elevation, with parts broken away, of the turbine rotor showing the vent ports.

Figure 9 is a rear elevation of the rotor shown in Figure 8.

Referring more specifically to the drawing wherein Figure 1 illustrates an ordnance missile 1 having mounted therein an electric generator 2 driven by the turbine rotor 3 of the invention. The rotor 3 is positioned in a chamber 4 formed by the nose member 5 and body 1a of the missile. The nose member is provided with a duct 6 through which air flows while the missile is in flight to cause rotation of the turbine rotor 3. Reference numeral 7 indicates the exhaust ports through which the air is passed to the outside of the missile.

In Figure 2 there is shown an embodiment of the turbine rotor 3 comprising a plurality of blades 8 mounted between a front plate 9 and a rear plate 10. The blades may be made of a resilient material such as spring steel, phosphor bronze or the like. The front plate is pro-

2

vided with peripherally spaced tab-like members 11 bent at right angle thereto and affixed to rear plate 10 so as to space said plates from each other. Each member 11 has an edge which projects inwardly of the plates and is provided with a transverse lip 12 which bears against one of the blades 8. Spaced notches 13 formed in the peripheral edge of the front plate and corresponding notches 14 in the rear plate adjacent the outwardly directed edge of member 11 supports one end 8a of the blades 8. The front plate has formed centrally therein an orifice 16 for admission of the air stream to the rotor 3. In axial alignment with the orifice 16 and affixed to the rear plate is a tapered hub 17 which serves not only as a means for affixing the rotor to the generator 2 but also to direct the airstream outwardly to the turbine blades 8 through tapered portion 18 of the hub 17 and thence to the exhaust ports 27. The exhaust ports are formed by adjacent spaced peripheral members 11 and adjacent portions of the front and back plates. The means for assembling the front and rear plates is shown in Figure 3 wherein the spaced peripheral members 11 are provided with lips 19 which are positioned in perforations 20 in the rear plate 10 and staked therein.

Figure 5 illustrates the configuration of one of the turbine rotor blades 8 wherein one end 8a of the blade 8 has formed therein shoulders 21 and 22 which rest in notches 13 and 14 respectively. The other end 8b of blade 8 is free to move radially outward. Intermediate the ends 8a and 8b the blade is provided with tabs 24 and 25. The tab 24 is positioned on notch 26 formed in the front plate and tab 25 in slot 15 of the rear plate. The portion 8c of the blade between the tabs 24 and 25 and end 8b is tapered so that this portion may freely flex radially away from the tapered member 18 of the hub 17 under centrifugal force and/or air pressure when the turbine is in operation.

At certain air speeds it has been found that the blades 8 of the turbine rotor vibrate and at extreme speeds they tend to be stressed beyond their elastic limits, thus taking a permanent set. A method of overcoming this is shown in Figure 6 wherein it will be seen that the blade 8 has placed adjacent thereto and reinforcing it, a supplementary blade 28 which is similar in shape to blade 8, except that the free flexible end is somewhat shortened. The supplementary blade 18 is provided with tabs identical to the tabs of blades 8 and is also supported in notches 13 and 26, notch 14 and slot 15 formed in the front and rear plates, respectively. If desired or found necessary, additional supplemental blades similar to blade 28 but further shortened may be used.

A further method of reducing vibration is shown in Figure 7 wherein a strip of frictional material 29 such as rubber, impregnated asbestos etc., is mounted between blade 8 and supplementary blade 28, thus acting as damping means.

In Figures 8 and 9 there is shown a modification of the invention wherein vent ports 30 have been included in the back plate. When the rotor is revolving at high speed the blades 8 flex outwardly, uncovering the vent ports 30, and thereby permitting escape of air to reduce the force exerted on the blades by the air stream passing through the rotor.

From the above description, the construction of the turbine will be apparent to one skilled in the art. It will also be apparent that under moderate pressures of the airstream entering the orifice 16, the airstream will be directed radially by the tapered portion 18 of the hub 17 and will impinge upon blades 8 on its travel to the exhaust ports 27, thus imparting a rotational motion to the entire rotor assembly. As the rate of rotation increases centrifugal force will cause the blades 8 to flex about the lips 12, the degree of motion being limited by

3

the movement of tabs 25 in the perforations 15. Thus the free ends of the blades will move outwardly, partially blocking the exhaust ports 27. Under this condition the portion 8a assumes a less curved shape to decrease the efficiency of the system and maintains a constant rotational velocity.

It will be apparent that the embodiments shown are only exemplary and that various modifications can be made in construction and arrangement within the scope of the invention as defined in the appended claims.

We claim:

1. A self-regulating turbine comprising a housing having exhaust ports in the walls thereof and means for admitting air therein, a rotor assembly mounted in said housing, said assembly comprising a cup-shaped member having a plurality of exhaust ports formed in the lateral walls thereof, a disk closure member, said disk closure member affixed to said cup-shaped member in axial alignment therewith, inwardly directed flexible curved vanes in said rotor assembly, each of said vanes having one end affixed to said lateral walls adjacent each of the exhaust ports formed therein, and an aperture in the bottom wall of the cup-shaped member for admitting an airstream to the flexible vanes, a hub member affixed in said disk closure member having a tapered portion projecting into said assembly opposite said aperture, the air stream admitted through said aperture striking the tapered portion and deflecting radially towards said flexible vanes whereupon said vanes cause rotation of said turbine and flex outwardly of said hub towards said exhaust ports to proportionately close said ports in accordance with the pressure created by said air stream.

2. A turbine of the class described having a self-governing rotor assembly mounted therein, said assembly comprising a front disk member and a rear disk member spaced apart but affixed to each other as to form exhaust ports in the peripheral surface of the assembly, circumferentially spaced flexible vanes positioned between said disks, each of said vanes having one end anchored in the peripheral surface, the opposite end of each vane being free to move radially and normally curved inwardly towards the center of the assembly, oppositely disposed tabs provided on each of said vanes intermediate the ends thereof, substantially rectangular perforations formed in the rear disk in alignment with said tabs and of larger dimensions than said tabs, one tab of each of said vanes positioned in one of said perforations to limit the degree of movement of said blades when yielding under pressure of an airstream passing through said assembly and thereby closing said exhaust ports an amount in proportion to the pressure of said airstream.

3. An air turbine having a self-governing rotor therein, said rotor comprising a front disk provided with a central aperture, a rear disk provided with a hub affixed in an aperture in the center thereof, the disks being affixed to each other in spaced relationship in such a manner as to

4

form a cylindrical member, spaced exhaust ports formed in the peripheral surface of the member, curved flexible air actuated vanes circumferentially spaced along the peripheral surface within the member, each of the vanes having one end anchored in the peripheral surface, the opposite end of each blade directed inwardly of the member towards the hub, the hub having a tapered portion projecting inwardly of the member in alignment with said central aperture, tab means integral with each of said vanes positioned in apertures formed in said rear disk to limit the outward motion of said vanes, and vibration dampening means cooperatively associated with each of said vanes, the air upon entering the central aperture striking the tapered portion of the hub and being thereby directed radially to impinge upon said vanes and cause rotation of said rotor whereupon said vanes are stressed away from said hub to close the exhaust ports an amount proportionate to the force created by said air and thereby limit the angular velocity of said rotor.

4. The invention in accordance with claim 3 wherein said vibration dampening means comprises a flexible member slidably affixed to each of said vanes so as to oppose outward radial motion thereof.

5. The invention in accordance with claim 3 wherein said vibration dampening means comprises a supplementary blade in spaced relation to each of said vanes, and frictional material in contact with said vane and supplementary blade.

6. A self-regulating turbine comprising a housing provided with duct means for admitting air thereto and exhaust means in the longitudinal walls thereof, a rotor assembly mounted in the housing in alignment with said duct, the rotor assembly comprising a front disk, a rear disk, said front disk affixed to said rear disk in spaced relationship, exhaust ports formed in the peripheral surface of the assembly, a hub having a conical surface projecting inwardly of and centrally fixed in said rear disk, spaced flexible vanes, each of said vanes having one end mounted in said peripheral surface intermediate the exhaust ports and having the free end directed inwardly along a curved path towards the conical surface, vent ports in the rear disk surrounding said hub, said duct directing air to the conical surface which subsequently directs said air to impinge upon said blades and rotate the rotor assembly, said blades flexing outwardly under high air stream pressure and exposing portions of said vent ports to said high pressure air stream thereby permitting the escape of air therethrough to reduce the high pressure on said blades.

References Cited in the file of this patent

UNITED STATES PATENTS

38,707	Watson et al. -----	May 26, 1863
1,008,550	Loewenstein -----	Nov. 14, 1911