June 1, 1965 A. J. BAGGS 3,187,191

TURBINE DEVICE HAVING A PERMANENT MAGNET ROTOR

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Fig. 1

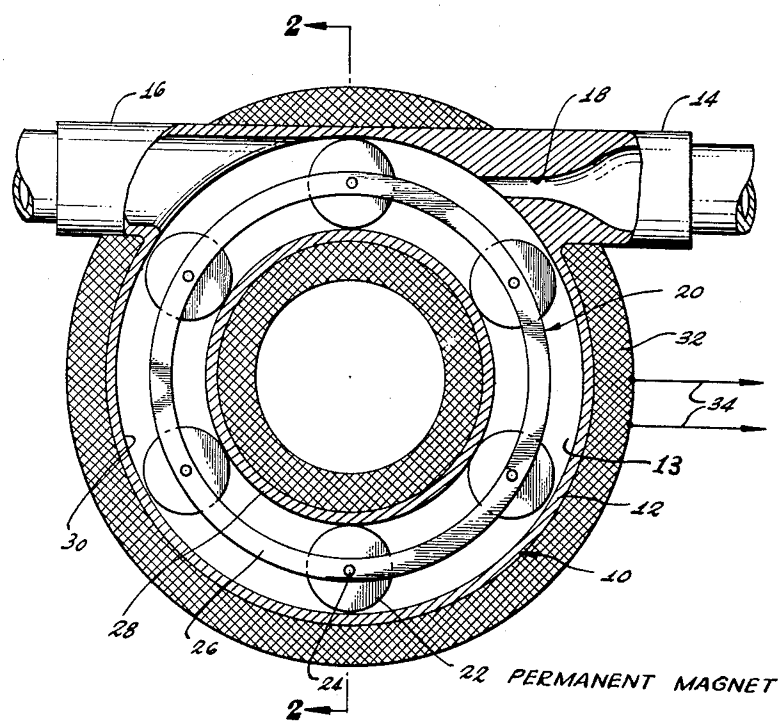

Fig. 2

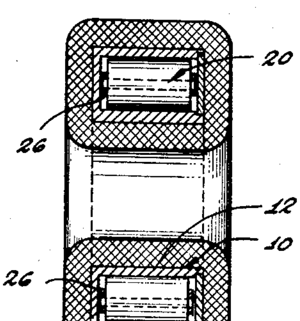

Fig. 3

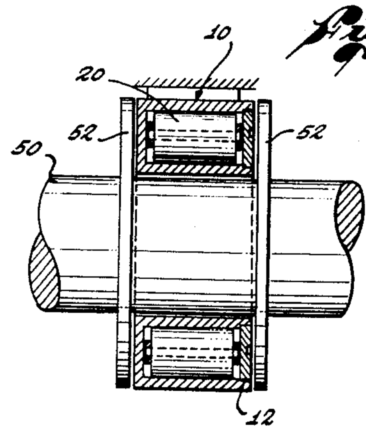

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Fig. 4

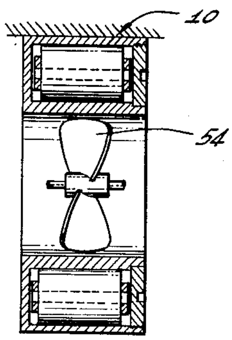


Fig. 5

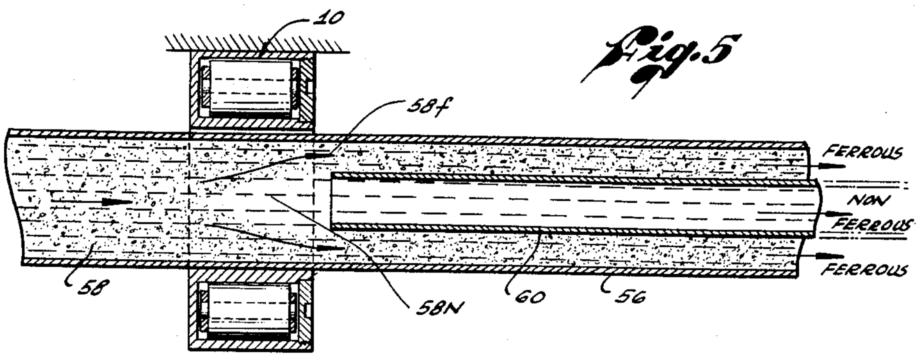
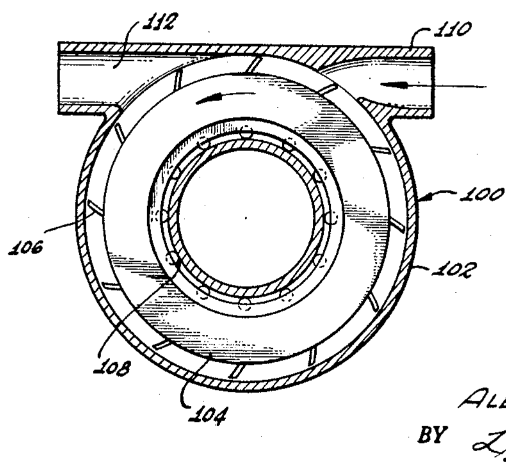


Fig. 6



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TURBINE DEVICE HAVING A PERMANENT MAGNET ROTOR

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10 Claims. (Cl. 290—52)

This invention deals generally with fluid pressure operated devices and particularly with a unique turbine device.

A general object of the invention is to provide a turbine device which is devoid of shaft seals or other points of fluid leakage and which has an unusual toroidal shape that adapts the turbine device to a wide variety of unique uses and applications.

Another object of the invention is to provide several different fluid pressure operated devices, each embodying the present turbine device, namely, a generator to produce a rotating magnetic field, an electrical generator, a rotary magnetic drive, a magnetic separator, and a gyroscopic device.

Other objects of the invention are concerned with providing a turbine device which is relatively simple, inexpensive, easy to manufacture, and ideally suited to use in nuclear power systems and other fluid systems which must be completely closed and leakproof.

Briefly, these objects are attained by providing a turbine device equipped with a hermetic casing of annular or toroidal configuration. The rotor of the turbine also has a generally annular configuration and is rotatably mounted within the annular interior of the turbine casing. Driving of the rotor is accomplished in the usual way by the action of pressure fluid on surfaces or vanes of the rotor.

In certain illustrative forms of the invention, the rotor carries magnetic field producing means, such as permanent magnets, so that a rotating magnetic field is thereby generated during operation of the turbine. In one illustrative application, this rotating field is used to generate electrical power by placing a coil or winding on the turbine casing. In other illustrative applications, the rotating magnetic field acts on a magnetically permeable, rotary driven member, concentrically arranged in the center opening of the toroidal shaped turbine casing, whereby the driven member is magnetically coupled to and driven from the turbine rotor. In yet another illustrative application, the rotating magnetic field is employed as a means to separate ferrous ore from nonferrous ore.

According to a further illustrative form of the invention, the turbine rotor provides simply a rotating mass for stabilizing purposes.

A better understanding of the invention may be had from the following detailed description thereof taken in connection with the annexed drawings, wherein:

FIG. 1 is a section through the electrical generator of the invention which embodies the present toroidal turbine device;

FIG. 2 is a section, on reduced scale, taken on line 2—2 of FIG. 1;

FIG. 3 is a section, on reduced scale, through one form of magnetic drive according to the invention;

FIG. 4 is a section through another magnetic drive according to the invention;

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FIG. 5 is a section through the magnetic separator of the invention; and

FIG. 6 is a section through the rotary stabilizer of the invention.

In FIGS. 1 and 2 of these drawings, the turbine device of the invention is designated by the numeral 10. This device comprises a hollow, hermetic casing 12 of generally annular or toroidal shape having an interior space 13 in the form of a closed loop. The housing has a fluid inlet 14 and a fluid outlet 16. Extending through the inlet 14 is a fluid passage terminating in a tangentially directed nozzle 18.

Rotatably mounted within the turbine casing 12 is the rotor or impeller 20. This impeller illustratively comprises a plurality of rollers 22 which are rotatably mounted on axles 24. Opposite ends of these axles are fixed in a pair of flat rings 26 in such locations that the rollers are uniformly spaced around the rings, as shown. The rollers 22 roll on the inner cylindric surface 28 of the turbine casing and are spaced slightly from the outer cylindric surface 30 of the casing, as shown.

The turbine device is operated by connecting the fluid inlet of the turbine casing to a source, not shown, of fluid under pressure. This fluid discharges as a high velocity jet through the nozzle 18 and impinges the rollers 22 on the impeller which serve as impeller vanes or blades. The impeller is thereby driven in rotation.

It is obvious that the impeller 20 can be made in ways other than that illustrated. For example, the impeller might comprise a ring which is formed with conventional impeller blades and is rotatably mounted in the casing by means of ball bearings. Also, while the illustrated turbine device is of the impulse type, it is evident that the invention could be embodied in a reaction type turbine as well.

In FIGS. 1 and 2, as well as in FIGS. 3–5 to be presently discussed, the turbine device is utilized to generate a rotating magnetic field. For this purpose, the impeller carries magnetic elements which produce a magnetic field that rotates as the impeller turns. Various types of magnetic field producing means may be used for this purpose.

In the drawings, for instance, the impeller vanes or rollers 22 comprise permanent magnets. The turbine casing 10, on the other hand, comprises some non-magnetically permeable material. During operation of the turbine, therefore, the magnetic impeller 20 is driven in rotation and produces a rotating magnetic field.

In FIGS. 1 and 2, this rotating magnetic field is used to generate an electrical voltage. This is accomplished by placing an electrical winding 32 about the turbine casing 12 in such a way that during rotation of the impeller, the lines of magnetic force in the rotating magnetic field created by the rotating impeller cut through the turns of the coil 32 to generate a voltage across the output leads 34 of the winding.

An obvious advantage of this unique magnetic turbine generator is the absence of any shaft seals or other points of fluid leakage. This permits a completely closed fluid system which is highly desirable or essential in many installations, such as nuclear power installations. Also, of course, the absence of shaft seals simplifies and reduces the cost of the generator.

In the magnetic drive of FIG. 3, the coil 32 of FIG. 1

is omitted. A shaft 50 to be driven is inserted through the center of the turbine casing 12 and is rotatably supported in any convenient way, not shown. The turbine casing 12 itself is fixed.

Fixedly mounted on the driven shaft 50 at opposite sides of the turbine casing 12 are a pair of magnetically permeable plates 52. When the impeller 20 of the turbine device 10 is driven in rotation, as described in connection with the generator of FIG. 1, the action of the rotating magnetic field on the plates 52 creates a torque which drives the shaft 50. It is evident that the magnetically permeable driven means 52 may assume configurations other than plates and may, in some cases, even comprise the shaft itself.

In the magnetic drive of FIG. 4, the driven member comprises a propeller or fan 54 rotatably mounted concentrically within the turbine device 10. The blades of the propeller are magnetically permeable or carry magnetically permeable means so that the rotating magnetic field produced during operation of turbine 10 creates a torque for driving the propeller in rotation. The propeller drive of FIG. 4 might be advantageous in wind tunnels, for example, because of the absence of a motor on the axis of the propeller which would disturb the air flow pattern through the propeller as well as restrict air flow.

In the magnetic separator of FIG. 5, a pipe or conduit 56, for conveying ferrous and non-ferrous material 58 to be separated, extends through the center of the turbine 10. The material 58 might comprise, for example, a pulp made up of ferrous and non-ferrous ores which is forced to flow, in some way, through the pipe 56 in the direction indicated. During movement of this pulp through the rotating magnetic field produced by the turbine 10, the ferrous materials tend to be formed by the field into a rotating annular mass 58*f* adjacent the wall of the pipe 56 while the non-ferrous materials tend to be formed into a cylindrical mass 58*n* at the center of the pipe.

Extending concentrically through pipe 56 is an inner pipe 60. The left end of this inner pipe is open and arranged to receive the non-ferrous materials 58*n* while the latter are still retained in a concentrated mass by the action of the rotating magnetic field. The outer annular mass 58*f* of ferrous materials flows into the annular space between the inner and outer pipes. The ferrous and non-ferrous materials are thereby separated and may be conveyed to separate receivers.

In FIG. 6, the numeral 100 denotes a turbine device having a toroidal-shaped casing 102 similar to the casing of turbine 10. Within this casing is an impeller 104 comprising an annular flywheel having peripheral blades or vanes 106. The impeller is rotatably mounted in the casing in some convenient way, such as by ball bearings 108.

The turbine casing has a fluid inlet 110 and a fluid outlet 112 like those of turbine 10 so that the impeller is driven in rotation by the action of pressure fluid, entering through inlet 110, on the impeller blades 106. This rotating impeller provides a rotating mass which can be used for stabilizing purposes, for example. Such a stabilizing device might be used to advantage in a rocket, for example, in which case parts of the rocket propulsion system might conveniently extend through the center opening through the turbine casing.

It should be understood that the several applications of the present turbine device which have been disclosed are meant to be purely illustrative in nature and not to constitute an exhaustive list of all of the possible uses to which the turbine can be put.

What is claimed is:

1. A magnetic turbine device comprising a hollow, generally toroidal turbine casing defining an annular space within the casing and an axial opening at the center of the casing, a rotary annular impeller in the casing, means to direct a fluid against the impeller to drive the latter in rotation, and magnetic means mounted on the impeller so as to produce a rotating magnetic field as the impeller turns.

2. A turbine device comprising a hollow, generally toroidal turbine casing defining an annular space within the casing and an axial opening at the center of the casing, a rotary annular impeller in said casing including a plurality of circumferentially spaced, axially extending rollers which roll on an inner cylindric surface of the casing, and means to direct a fluid against said rollers to drive the impeller in rotation.

3. The subject matter of claim 2 wherein said rollers comprise magnetic means to produce a rotating magnetic field as the impeller turns.

4. The subject matter of claim 1 including a coil means on said casing in which said rotating magnetic field generates a voltage.

5. The subject matter of claim 1 including a magnetically permeable driven member rotatably mounted concentrically within said opening through the casing and driven in rotation by said rotating magnetic field.

6. The subject matter of claim 1 including a conduit extending through said opening in the turbine casing, and a second conduit extending concentrically through the first conduit and having an open end located within the zone of said rotating magnetic field.

7. A turbine device comprising a hollow, generally toroidal turbine casing having a central axial opening and an internal annular space surrounding said opening, said casing including an internal coaxial surface forming an axial wall of said space, an annular impeller in said space including rollers engaging said surface to support said impeller for rotation in said casing, and means for directing a fluid against said impeller to drive the latter in rotation.

8. A turbine device comprising a hollow, generally toroidal turbine casing having a central axial opening therethrough and a toroidal interior space encircling said axial opening, said interior space being bounded at its radially inner side by an inner, generally cylindrical wall of said casing extending about and defining the wall of said axial opening, at its radially outer side by an outer, generally cylindrical wall of said casing, and at its two remaining sides by generally annular side walls of said casing which are joined about their inner circumference to said inner wall and about their outer circumference to said outer wall, whereby said toroidal interior space is completely enclosed on all sides by the turbine casing, impeller means within said interior space and supported by said casing for rotation around said space and about said axial opening, said impeller means having impeller surfaces, means on said casing defining a fluid inlet terminating in a nozzle opening generally tangentially to said space for directing a high velocity fluid stream against said impeller surfaces for driving said impeller means in rotation around said interior space, means on said casing defining a fluid outlet from said interior space, driven means rotatably mounted within said axial opening, and one of said means comprising a magnetically permeable metal and the other means comprising magnetic means for forming a magnetic drive coupling between said impeller means and said driven means, whereby said driven means is driven in rotation by rotation of said impeller means.

9. The subject matter of claim 8, wherein said driven means comprises a rotary fluid impeller.

10. A turbine device comprising a hollow, generally toroidal turbine casing having a central axial opening therethrough and a toroidal interior space encircling said axial opening, said interior space being bounded at its radially inner side by an inner, generally cylindrical wall of said casing extending about and defining the wall of said axial opening, at its radially outer side by an outer, generally cylindrical wall of said casing, and at its two remaining sides by generally annular side walls of said casing which are joined about their inner circumference to said inner wall and about their outer circumference

to said outer wall, whereby said toroidal interior space is completely enclosed on all sides by the turbine casing, an annular impeller within said interior space and rotatably mounted on said casing for rotation around said space and about said axial opening, said impeller having impeller surfaces circumferentially spaced therearound, means on said casing defining a fluid inlet terminating in a nozzle opening generally tangentially to said interior space, and means on said casing defining a fluid outlet from said space.

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