A heat exchanger, such as for a refrigeration device, including a pipe for a first heat exchanger fluid and having a turbine located in the pipe and being driven by the flow of the first heat exchanger fluid. A magnet is coupled to the turbine and generates a rotating magnetic field outside the pipe. The rotating magnetic field outside the pipe drives a flow generator which acts on a second heat exchanger fluid in contact with the pipe.
HEAT EXCHANGER-TURBINE ASSEMBLY

[0001] The present invention relates to a heat exchanger-turbine assembly according to the preamble of claim 1.

[0002] Such an assembly is known from FR-A-2 792 063.

[0003] In order to intensify the heat transfer between a first heat carrier fluid circulated in a heat exchanger and a second heat carrier fluid surrounding the heat exchanger, especially air, it is known to use a fan which sets the second heat carrier fluid in motion along the surface of the heat exchanger. Usually in refrigeration devices, such as domestic refrigerators, freezers, etc. having such a fan, the fan is driven by an electric motor. In a refrigeration device such a fan can be used both as an evaporator and as a condenser. Especially in the case of an evaporator, the attachment of such an electric motor involves considerable expenditure and costs since a supply line for its power supply must be laid through the heat-insulating casing wall of the refrigeration device. This casing wall is conventionally constructed from a one-piece plastic inner container and an outer wall which encloses an intermediate space which is filled with insulating foam material in the course of the manufacture of the appliance.

In order to prevent foam from penetrating into the interior of the refrigeration device at the location where a lead passes through, such a lead-in must be carefully sealed.

[0004] In the heat exchanger known from FR-A-2 792 063 a turbine arranged in a pipe through which the circulated heat carrier fluid flows is used to directly drive a fan acting on the respectively other heat carrier fluid. The turbine is arranged on a pipe section before or after the heat exchanger. The turbine housing and its connections to the pipe must be absolutely tight for the coolant. This makes it expensive to incorporate such a turbine in a refrigeration device. In addition, since such a turbine is not a commercial product whereas small electric motors suitable for driving a fan in a refrigeration device are manufactured for a plurality of applications in enormous numbers and are correspondingly cheap, it is difficult to prepare the turbine at economic costs compared with electric motors.

[0005] It is the object of the invention to provide a heat exchanger-turbine arrangement which can be used economically in a refrigeration device, especially a domestic refrigerator.

[0006] The object is solved according to the invention by an arrangement having the features of claim 1.

[0007] Since the turbine is enclosed in a casing of the heat exchanger, the costs for an independent turbine casing and the expenditure for its assembly in the refrigeration device are eliminated. In an extreme case, the turbine can be reduced to a running wheel on the drive shaft for the fan, bearings for the shaft can be formed directly on the casing of the heat exchanger. A magnet is preferably arranged in the casing and coupled to the turbine to produce a rotating magnetic field outside the casing. As a result, it becomes superfluous to guide a drive shaft for the fan out of the casing of the heat exchanger since the fan can be driven by means of magnetic coupling using a second magnet arranged outside the casing rotatably with respect to this first magnet. A particular advantage of the magnetic coupling to the fan is that in the event of a mechanical blockage of the fan, the turbine is not hindered from rotation in the pipe so that the flow of the first heat carrier fluid in the pipe is not simultaneously blocked by such a blockage.

[0008] Furthermore, the casing of the heat exchanger is preferably constructed of a flat plate and a structured plate in which the profile of the coolant pipe is formed by the heat exchanger, and the magnet is arranged on the flat wall. It is thus possible to glue the heat exchanger with its flat plate on the foam side of a refrigeration device inner container and to place the fan opposite to the magnet of the heat exchanger on the inside of the inner container.

[0009] The turbine can be formed simply and cheaply using blades constructed as extruded profiles.

[0010] A heat exchanger of the type described above can be used as a condenser or as an evaporator for a refrigeration device.

[0011] Further features and advantages of the present invention are obtained from the following description of exemplary embodiments with reference to the appended figures. In the figures:

[0012] FIG. 1 is a perspective view of an evaporator for a refrigeration device fitted with a turbine according to the present invention;

[0013] FIG. 2 is a schematic radial cross-section through the turbine from FIG. 1; and

[0014] FIG. 3 is an axial section through the turbine.

[0015] FIG. 1 shows a perspective view of an evaporator for a refrigeration device as an exemplary embodiment of a heat exchanger according to the invention. The evaporator 1 is constructed in an inherently known fashion from two metal sheets 2, 3 soldered together, made of a non-magnetic, good heat-conducting material such as aluminium, one flat sheet 2 provided to be affixed to an inner container of a refrigeration device on the foam side by gluing and one sheet 3 in which a coolant pipe 4 is formed. A suction pipe for the coolant is guided out from the evaporator 1 at a connecting piece 5 and an injection pipe is inserted concentrically to this. A turbine 6 is arranged on the evaporator 1 at a point where the narrow injection pipe goes over into the further coolant pipe 4 of the evaporator.

[0016] The structure of the turbine 6 is shown more accurately in two sections in FIGS. 2 or 3.

[0017] FIG. 2 shows a section through the turbine 6 in a plane parallel to the sheets 2, 3. An impeller 8 is rotatably mounted in a circular chamber 7 so that a coolant jet emerging from the injection pipe 10 at high pressure and high speed flows onto its blades 9. Some of the expansion of the coolant at the beginning of its passage through the evaporator conventionally achieved by capillary injection is thus achieved in the evaporator 1 according to the invention by the coolant flow in the turbine 6 performing work during driving the impeller 8.

[0018] The impeller 8 has a uniform cross-section in the axial direction, perpendicular to the plane of FIG. 2. Such an impeller can be manufactured cheaply by forming an extruded profile, e.g. made of aluminium or a plastic resistant to the coolant, with the cross-section of the impeller, and cutting the extruded profile into disks.
FIG. 3 shows an axial section through the turbine 6 in the state mounted on the container inner wall 16 of a refrigeration device. A shaft 11 of the turbine is held by two ball bearings 12 of which one is held on an outer shell 13 and the other on a support sleeve 14 which are each affixed on the flat sheet 2 of the evaporator. The outer disk 13 can be covered by the sheet 3 in the ready mounted evaporator 1 or it can be formed in one part in the sheet 3.

A magnet 15 is affixed on the end of the shaft 11 facing the flat sheet 2. This rotates jointly with the impeller 8 when coolant flows onto the latter.

A fan 17 is mounted on the inside of the container inner wall 16 so that a shaft 18 of said fan is aligned with the shaft 11 of the turbine 6. The shaft 18 is affixed via ball bearings 12 and a support sleeve 19 on the container inner wall 16. The end of the shaft 18 facing the container inner wall 16 bears a magnet 20 which lies opposite to the magnet 15 of the turbine. As a result of the attraction between the magnets 15, 20, the latter tends to follow a rotation of the magnet 15 driven by the coolant in the turbine 6 and thus rotationally drives the fan 17. Since there is no direct mechanical coupling between the shafts 11, 18 of the turbine 6 and the fan 17, there is no risk of the evaporator leaking on the turbine 6. At the same time, a blockage of the fan 17 cannot result in the impeller itself becoming stuck and thus blocking the flow of coolant in the evaporator 1.

1-7. (canceled)

8. a heat exchanger, comprising:
   - a pipe for a first heat exchanger fluid;
   - a turbine located in said pipe and being rotationally driven by the flow of said first heat exchanger fluid;
   - a magnet coupled to said rotating turbine; and
   - said magnet rotating with said rotating turbine to generate a rotating magnetic field outside said pipe.

9. The heat exchanger according to claim 8, including said turbine having a plurality of extruded profile blades.

10. The heat exchanger according to claim 8, including a flow generator rotationally driven by said rotating magnetic field outside said pipe and a second heat exchanger fluid in thermal contact with said pipe, said second heat exchanger fluid driven by said rotating flow generator.

11. The heat exchanger according to claim 10, including said flow generator is a fan.

12. The heat exchanger according to claim 8, forming a refrigeration device condenser.

13. The heat exchanger according to claim 8, forming a refrigeration device evaporator.

14. A refrigeration device, comprising:
   - a heat exchanger;
   - said heat exchanger including a pipe for a first heat exchanger fluid;
   - a turbine located in said pipe and being rotationally driven by the flow of said first heat exchanger fluid;
   - a magnet coupled to said rotating turbine; and
   - said magnet rotating with said rotating turbine to generate a rotating magnetic field outside said pipe.

15. The refrigeration device according to claim 14, including said turbine having a plurality of extruded profile blades.

16. The refrigeration device according to claim 14, including a flow generator rotationally driven by said rotating magnetic field outside said pipe and a second heat exchanger fluid in thermal contact with said pipe, said second heat exchanger fluid driven by said rotating flow generator.

17. The refrigeration device according to claim 16, including said flow generator is a fan.

18. The refrigeration device according to claim 14, including said heat exchanger forming a refrigeration device condenser.

19. The refrigeration device according to claim 14, including said heat exchanger forming a refrigeration device evaporator.

20. A refrigeration device, comprising:
   - an inner container including a wall;
   - a heat exchanger including a first substantially non-magnetic and substantially flat metal sheet affixed to said inner container wall;
   - said heat exchanger including a pipe formed in a second substantially non-magnetic metal sheet affixed to said first substantially non-magnetic and substantially flat metal sheet, said pipe including a first heat exchanger fluid;
   - a turbine located in said pipe and being rotationally driven by the flow of said first heat exchanger fluid;
   - a magnet coupled to said rotating turbine;
   - said magnet rotating with said rotating turbine to generate a rotating magnetic field outside said pipe; and
   - a flow generator rotationally driven by said rotating magnetic field outside said pipe and a second heat exchanger fluid in thermal contact with said pipe, said second heat exchanger fluid driven by said rotating flow generator.

21. The refrigeration device according to claim 20, including said turbine having a plurality of extruded profile blades.

22. The refrigeration device according to claim 20, including said flow generator is a fan.

23. The refrigeration device according to claim 20, including said heat exchanger forming a refrigeration device condenser.

24. The refrigeration device according to claim 20, including said heat exchanger forming a refrigeration device evaporator.