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[54] PUMP UNIT

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[58] **Field of Search**.....417/367, 368, 367, 424; 310/63, 57, 60, 62, 54; 165/47, 122, 107

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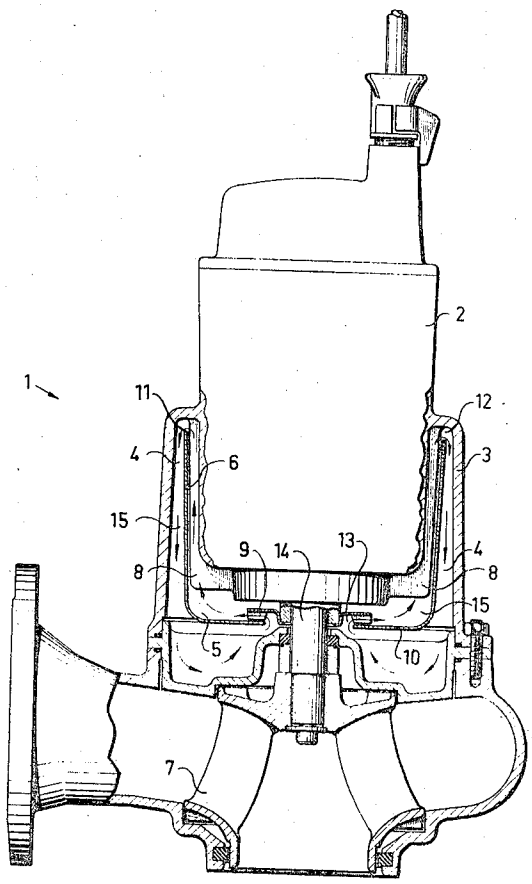
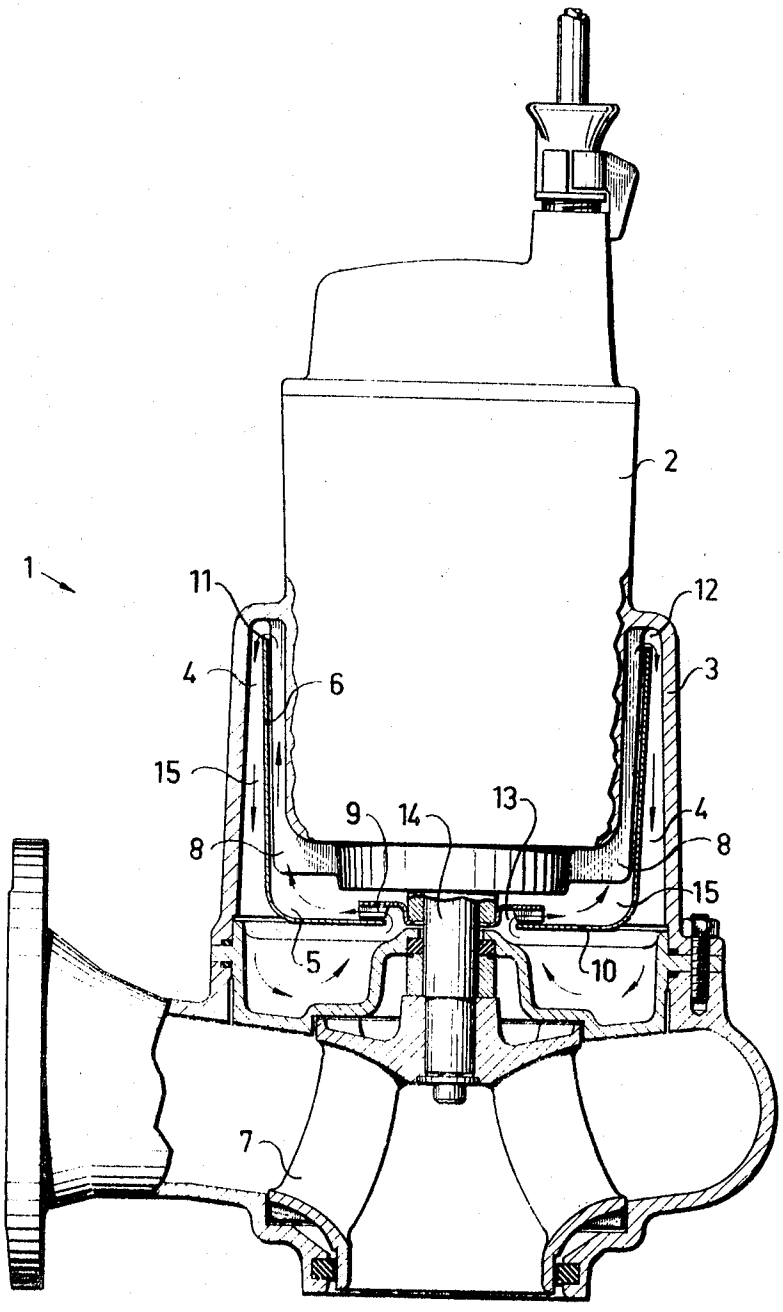
[57] **ABSTRACT**

Pump unit for pumping polluted liquid such as sewage water, comprising a motor housing, which at least partially is surrounded by a cooling jacket forming a cooling liquid compartment, which is closed and, by means of a partition surrounding the motor housing, divided into an outer and an inner part which parts at the ends of the partition, viewed in the axial direction of the motor housing communicate with one another to permit circulation of the cooling liquid, so that inside the partition the cooling liquid flows in one direction and outside the partition in the opposite direction.

5 Claims, 1 Drawing Figure

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PUMP UNIT

The invention relates to a device for cooling of electric motors, especially pump motors.

With several fields of electrical engineering the development has lead to a striving for smaller motor units in order to obtain cheap motors of low weight. But as a reduction of the size of motors must not at the same time lead to a reduction of their power, difficult problems of cooling arise. These can sometimes be solved by entirely immersing the pump units in the pumped medium, through which the pump motor is extremely effectively cooled. In some cases, however, it is desireable to install the motors in dry condition, e.g., for pumping of severely polluted liquid in which case certain difficulties are involved in repair and maintenance of pump immersed in the liquid. Other conditions as well may necessitate installation of the motors in dry state.

Furthermore it is not always possible to arrange the pump unit in such a way that the motor is constantly below the liquid surface, as the level of the liquid may vary considerably under different conditions. The situation thus arises that the motor sometimes works immersed in the liquid and is satisfactorily cooled, but on other occasions works wholly or partially above the liquid surface, in which case the cooling is greatly impaired. This problem cannot be solved through the use of a cooling fan, as the motor periodically works entirely immersed in the liquid. For this reason the principle is known of furnishing the motors with cooling fins, which, however, must be placed fairly close together to ensure the necessary cooling when the motor works wholly or partially above the liquid surface. But this solution is not satisfactory either, as the channels between the cooling fins are liable to become clogged with dirt from the pumped medium.

In the attempt to eliminate these problems it has been proposed that the pump motor should be enclosed in a casing and that the pumped medium should pass between the casing and the motor housing. This solution of the problem as well, however, has proved unsatisfactory, as the space between the casing and the motor housing quickly becomes clogged by the dirt in the liquid. In accordance to a known arrangement this problem has been solved by separating the dirt from the liquid before the liquid is allowed to circulate into the space between casing and motor housing. This arrangement however, exhibits a disadvantage in the pumping of liquid containing sludge, namely the difficulty of preventing the liquid from carrying some sludge into the cooling space between the casing and motor housing, where the sludge sediments.

A method is also known of arranging a cooling chamber in which oil is cooled and then carried into and through the motor housing. The motor winding is thus cooled through direct contact with the oil. In this way it is admittedly possible to obtain effective cooling of the pump motor, but the dirt which can be avoided neither in the motor housing nor in the cooling chamber is carried with the oil into, among other parts, the bearings of the rotor shaft, which are thereby quickly destroyed. Damage also occurs, for example, to the windings if water leaks into the oil which is pumped into the motor housing.

The present invention relates to a pump unit with which effective cooling of the pump motor is obtained irrespective of whether it works immersed in liquid or not. The pump unit according to the invention is intended for pumping of preferentially polluted liquid such as sewage water, pulp or the like, and comprises a cooling jacket, at least partially surrounding the pump motor housing, for formation of a cooling liquid compartment, and the invention is characterized chiefly in that the cooling liquid compartment is closed and, by means of a partition extending around the motor housing, is divided into an outer and an inner cooling liquid compartment, the which compartments, at the ends of the partition, viewed in the axial direction of the motor housing, communicate with one another to permit circulation of cooling liquid, so that in the inner cooling liquid compartment the cooling liquid flows along the motor housing in one direction and in the outer compartment in the opposite direction.

According to a further development of the invention the cooling liquid compartment is built integral with an oil compartment, which usually exists in immersible pumps, preferentially having cooling fins and being arranged between the pump housing and motor housing and serving for separation of the latter from the pump housing and for lubrication of the sealing rings of the driving shaft. The advantage is thus gained that the oil can be used for cooling not only of the sealing rings but also of the motor housing.

The motor housing is preferentially furnished in the known manner, with cooling fins, the partition consisting of a cup-shaped cover passed over these cooling fins, the cover extending into the cooling fluid compartment bounded by the cooling jacket, so that the compartment, as mentioned, is divided into an outer and an inner cooling liquid compartment. The inner compartment consists of a number of channels bounded by the cooling fins and the cover. The bottom of the cup-shaped cover has an opening which is concentric with the motor shaft and does not close tightly against any portion of the motor housing. The axial extension of the cover is also chosen so as not to reach furthest into the cooling liquid compartment bounded by the cooling jacket. In this way the cooling liquid is allowed to flow axially on the inside of the cover along the motor housing and thereafter on the outside of the cover in the space bounded by the cover and the cooling jacket.

In cases when the pump unit is to be installed with the motor shaft vertical, the cooling liquid can circulate by natural circulation, in which case the cooling liquid warmed by the motor flows upwards on the inside of the cover and thereafter, under liberation of heat to the environment, downwards outside the cover. To ensure effective cooling of the motor, however, it is advisable to arrange for forced circulation of the cooling liquid by means of a separate pumping device, e.g., an impeller.

The cooling jacket is preferentially arranged in the manner that at least part of it is in direct contact with the pumped medium, even if the motor housing is not immersed in it, so ensuring effective cooling of the cooling liquid.

With reference to the attached drawing one embodiment of the invention will now be described.

The drawing shows a pump unit **1** consisting of a motor housing **2**, enclosing an electric motor, and a pump **7**. The motor housing **2** is partially surrounded by a cooling jacket **3** and has a number of cooling fins **8**. Over these cooling fins **8** there is a cover **6** concentric with the motor housing **2**, the cover dividing the cooling liquid compartment bounded by the motor housing **2** and the cooling jacket **3** into an outer cooling liquid compartment **4** and an inner cooling liquid compartment **5**. The axial extension of the cover **6** is so chosen that an annular slit **12** is formed at its free end **11** between the cover **6** and the cooling jacket **3**. In the bottom **10** of the cover there is also a hole **13** situated concentric with the motor shaft **14**, the which hole does not close tightly against any part of the motor housing **2** or the motor shaft **14**.

The outer **4** and inner cooling liquid compartments in communication with one another are thus entirely shut off from the environment and are not in direct communication with the pumped medium.

Usually pump units of this kind are intended for installation with the motor shaft **14** vertical. In such case the cooling liquid, which may consist for example of oil, can be made to circulate by natural circulation, as indicated by arrows **15**, i.e., upwards in the inner cooling liquid compartment **5** and downwards in the outer cooling liquid compartment **4**. To increase the rate of circulation, however, and thus obtain more effective cooling, it is advisable to arrange an impeller **9** at a suitable position in one of the cooling liquid compartments. In order still further to ensure effective cooling of the motor, it is advisable to arrange the cooling jacket **3** in such a way that part of it is constantly in contact with the pumped medium, so that the cooling liquid is effectively cooled.

In a pump unit arranged in this way the motor housing is effectively cooled even if not immersed in the pumped medium.

Dirt accompanying the pumped medium is entirely prevented from entering into the cooling liquid compartment, so that clogging of the latter, which would prevent circulation, is avoided.

Although the invention has been described with reference to one of its embodiments, it can nevertheless be arbitrarily varied within the scope of the subsequent claims.

What we claim is:

1. In an apparatus including a submersible pump for contaminated liquid such as sewage water, pulp or the like and having a pump housing, and a submersible electric motor drivingly coupled to the pump and having a sealed housing surrounding the motor, an improved closed liquid recirculation cooling system for the motor, comprising:

a. a cooling jacket at least partially surrounding the motor housing and defining a closed liquid chamber, and

b. a partition surrounding the motor housing and positioned within the liquid chamber to define an inner cooling chamber between the motor housing and the partition and an outer recirculation chamber between the partition and the cooling jacket, the inner and outer chambers communicating with each other at one end of the partition,

c. means for circulating cooling liquid through the inner chamber in a first direction and through the outer chamber in a second, opposite direction.

2. A cooling system according to claim 1, wherein the motor housing has cooling fins and the partition comprises a cup-shaped cover surrounding the cooling fins.

3. A cooling system according to claim 1, wherein said means for circulating cooling liquid comprises an impeller driven by the motor for providing forced circulation of the cooling liquid.

4. A cooling system according to claim 1 wherein the closed liquid chamber lies adjacent the pump housing at one end whereby the cooling liquid is itself cooled by the liquid being pumped.

5. A cooling system according to claim 4, wherein the oil compartment has cooling fins.

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