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ELECTROMOTOR-DRIVEN CENTRIFUGAL PUMP

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Fig. 1

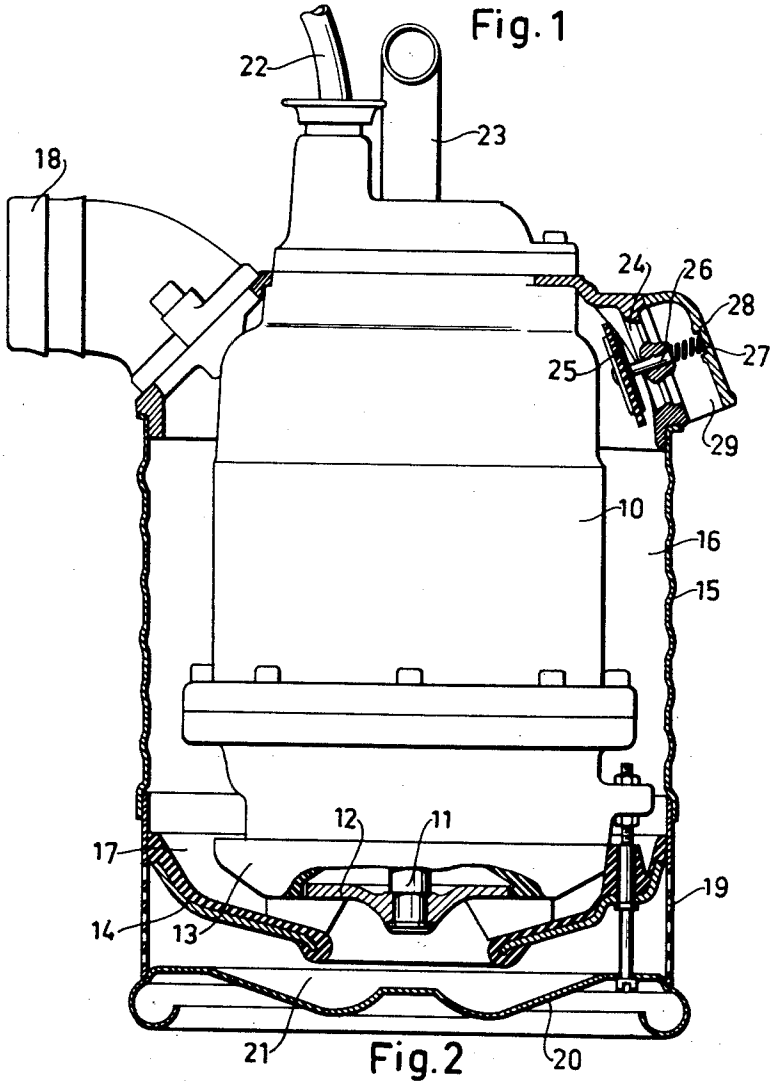
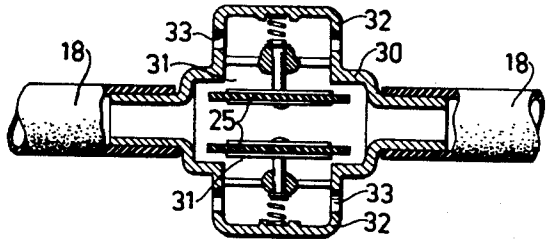


Fig. 2



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ELECTROMOTOR-DRIVEN CENTRIFUGAL PUMP

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The invention relates to electromotor-driven centrifugal pumps, particularly bilge pumps, of the kind in which the drive motor is cooled by the liquid being pumped, said liquid being allowed to pass through a duct system in heat-transferring relation to the motor and comprising, most commonly, one single cooling duct which is annular in cross section and is confined between the motor and an outer casing surrounding the latter.

If for some reason or other the pumping unit of such electromotor-driven centrifugal pumps should cease to force liquid through the cooling duct system, due, for instance, to the pump having drained off the body of water in which it is immersed, this will interrupt the cooling of the motor. Even though the latter will now be idling, thus reducing the development of heat therein, nevertheless the remaining generation of heat due to the idle-state losses in the motor, consisting essentially of the core losses of the motor, will be of a magnitude such that breakdown of the motor due to overheating would take place if it were allowed to go on running without being cooled. In addition, even in its idling state the frictional losses in motor and pump may be considerable because extraneous objects will frequently be wedged between the impeller and pump casing thus giving rise to a very great frictional resistance.

Various measures have been proposed with a view to prevent the drive motor from attaining excessive temperatures on failure of the liquid cooling. Thus it has been proposed to make provision for automatically switching off the current supply to the drive motor whenever its temperature exceeds a predetermined value. However, such safety arrangements are inherently complicated and expensive and are liable to failure as a result of the rough handling to which bilge pumps and similar pumps are often subjected in service.

In accordance with this invention the problem of preventing excessive heating of the drive motor on failure of the liquid cooling has been solved in a different and simpler way. According to the invention the cooling duct system is provided with one or more passageways leading directly into the ambient atmosphere and controlled by valves adapted to remain closed as long as liquid is being pumped through the cooling duct system and to open automatically whenever the liquid flow ceases. After the valve or valves are opened, the centrifugal pump will force a flow of air through the cooling duct system and directly back to the ambient atmosphere through the opened passageways, and this airflow, owing to the comparatively low resistance to flow, will be sufficiently forceful to be capable of dissipating the heat generated due to the idle-state losses and thus to prevent the motor from reaching an impermissibly high temperature.

The valves controlling the outlet passageways to the ambient atmosphere may be in the form of spring-loaded valves which are maintained in their closed position by the liquid pressure against their spring load as long as liquid is flowing through the cooling duct system, and are automatically urged to their open position by their springs as soon as the liquid flow ceases.

The invention is applicable with particular advantage to portable bilge pumps having vertical impeller shafts, although it is applicable also to other kinds of liquid pumps in which the liquid pumped is utilized as a coolant for the drive motor.

The invention will now be described more closely in conjunction with the accompanying drawing, in which:

FIG. 1 is a cross-sectional elevation of a portable bilge pump embodying the invention; and

FIG. 2 is a fragmentary view showing a modified form of the valve mechanism.

Referring to the drawing, numeral **10** designates the liquid-sealingly enclosed electromotor, being, as a rule, an alternating-current motor, and **11** denotes the extended motor shaft having the impeller **12** keyed thereto. The pump housing, which is composed of an upper cup-shaped member **13** lined with rubber or similar material and a lower cup-shaped member **14** also lined with rubber, is bolted to the stator casing of the drive motor. Designated by **15** is a cylindrical sheet-metal outer casing coaxially surrounding the enclosed drive motor **10** so as to form between the latter and the outer casing a cooling duct **16** which is annular in cross section. Opening into the bottom portion of this duct are the discharge passages **17** from the centrifugal pump, whereas the outlet hose **18** for carrying away the liquid being pumped is connected to the upper end portion of the cooling duct. A downward extension of the outer casing **15** constitutes an annular strainer **19**. An end plate **20** confining a suction chamber **21** between the strainer **19** and the intake opening of the pump, constitutes a foot for supporting the pump assembly with its shaft extending vertically on the bottom of the vessel containing the body of water to be drained. Numeral **22** designates the electric connecting cable of the drive motor, and numeral **23** denotes a carrying handle.

The water sucked in through strainer **19** is forced by the impeller **12** upward through the annular duct **16** and out through the hose **18**. On its passage through duct **16**, the water being pumped cools the electric motor **10** whereby the latter is prevented from attaining an impermissibly high temperature.

In order to ensure continued cooling of the motor **10** in the case of failure of the water flow through the cooling duct **16**, there is provided in the wall of the cooling duct, according to the invention, at least one outlet passageway **24** adapted, during pumping, to remain closed by a valve. As shown in the drawing, the valve comprises a poppet head **25** secured, as usual, to a valve stem **26** which is guided for endwise movement and urged by a spring **27** towards the position shown corresponding to the open state of the valve. The spring **27** at its outer end abuts a cover **28** having a downwardly facing outlet **29**. Upon starting the pump, the water being pumped will initially be forced out through the open passageway **24, 29**, but the pressure of the liquid being pumped will immediately cause closing of the valve **25** while compressing the spring **27** so that thereafter the whole amount of water being pumped will be discharged through the hose **18**. The water thus flowing through the annular duct **16** causes effective cooling of the drive motor **10**. If later on the liquid flow will cease due, for example, to the pump having drained off the water in which it is immersed, then the valve **25** is automatically returned by the spring **27** into its open position, after which a flow of air will be forced by the impeller **12** through the cooling duct **16** and the open passageway **24, 29** directly to the ambient atmosphere. The resistance to flow of the cooling duct **16** is now so low that the airflow will be sufficiently forceful to be able to cause effective cooling of the now idling drive motor **10** and of the remainder of the pump assembly.

It is suitable, in order to cause the cooling air to sweep the electric motor **10** as thoroughly as possible all round, to provide at least two valve-controlled outlet passageways

uniformly spaced about the circumference. In this way it will be ensured also that at least one air outlet will provide an unobstructed passage to the atmosphere in case the pump assembly should happen to fall over in such a way that the other outlet is obstructed by the bottom of the sump or the like to be drained.

The valve-controlled air outlet passageways need not necessarily be provided in direct connection with the cooling duct, as shown in FIG. 1, it being possible instead to provide the same in the wall of the hose conduit 18 at a locality not too distant from the connection of the hose to the cooling duct system. A suitable construction is shown in FIG. 2. Herein numeral 30 designates a tubular housing integrally formed with hose connecting nipples and assumed to be inserted in the hose 18 rather close to its connection to the pump assembly. Formed in the walls of the tubular housing are two diametrically opposite openings 31 controlled by individual spring-loaded poppet valves 25. The outer end of each air outlet passageway is closed by a cup-shaped member 32 provided circumferentially with a large number of apertures 33. Whenever the pump is idling and thus not discharging any liquid through the hose, the valves 25 occupy their open position as shown in the drawing. Then the impeller 12 will pump air through the cooling duct 16 and the inlet portion of the hose and through the passageways 31 directly to the ambient atmosphere while cooling the drive motor. If the pump should again begin to discharge liquid, the valves 25 will be closed automatically by the action of the liquid pressure, after which the cooling of the motor will take place in the normal way utilizing the liquid being pumped as a coolant.

Obviously, the invention is applicable not only to water-cooled drain or bilge pumps having vertical impeller shafts, but also to other kinds of electromtor-driven liquid pumps in which the liquid displaced is utilized as a coolant for the pump assembly.

What is claimed is:

1. A pump unit comprising, in combination, a centrifugal pump, an electric driving motor for said pump, a cooling duct system in heat exchange relationship with said electric motor, said cooling duct system having an inlet and an outlet, the inlet of said cooling duct system being connected to the delivering end of said centrifugal pump and the outlet thereof being connectible to a discharge conduit, one or more passageways leading to the ambient atmosphere provided adjacent the outlet end of said cooling duct system, a valve located in each passageway, each valve having means to maintain its associated passageway closed as long as liquid is being pumped through the cooling duct and to open the passageway automatically whenever the liquid flow ceases.

2. A pump assembly according to claim 1 characterized in that the respective valves are arranged to be acted on by springs which urge the valves towards their open position but allow the valves to be closed under the action of the liquid pressure upon liquid being pumped through the cooling duct system.

3. A pump assembly according to claim 1 in which the cooling duct system comprises an annularly cross-sectioned cooling duct surrounding the motor and formed between the motor and an outer casing surrounding the same, characterized in that the valve controlled outlet passageways are provided in the wall of the outer casing, suitably at the end thereof remote from the inlet to the cooling duct.

4. A pump assembly according to claim 1, characterized in that the valve controlled outlet passageways are provided in the wall of the discharge conduit leading from the pump, or cooling duct, and at a slight distance from the connection of the hose to the cooling duct.

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