J. F. BREEZE.

ELECTRIC MOTOR AND PUMP CONNECTED THERETO.

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1,114,727. Patented Oct. 27, 1914.

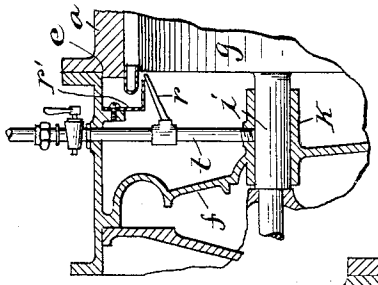

Fig. 2.

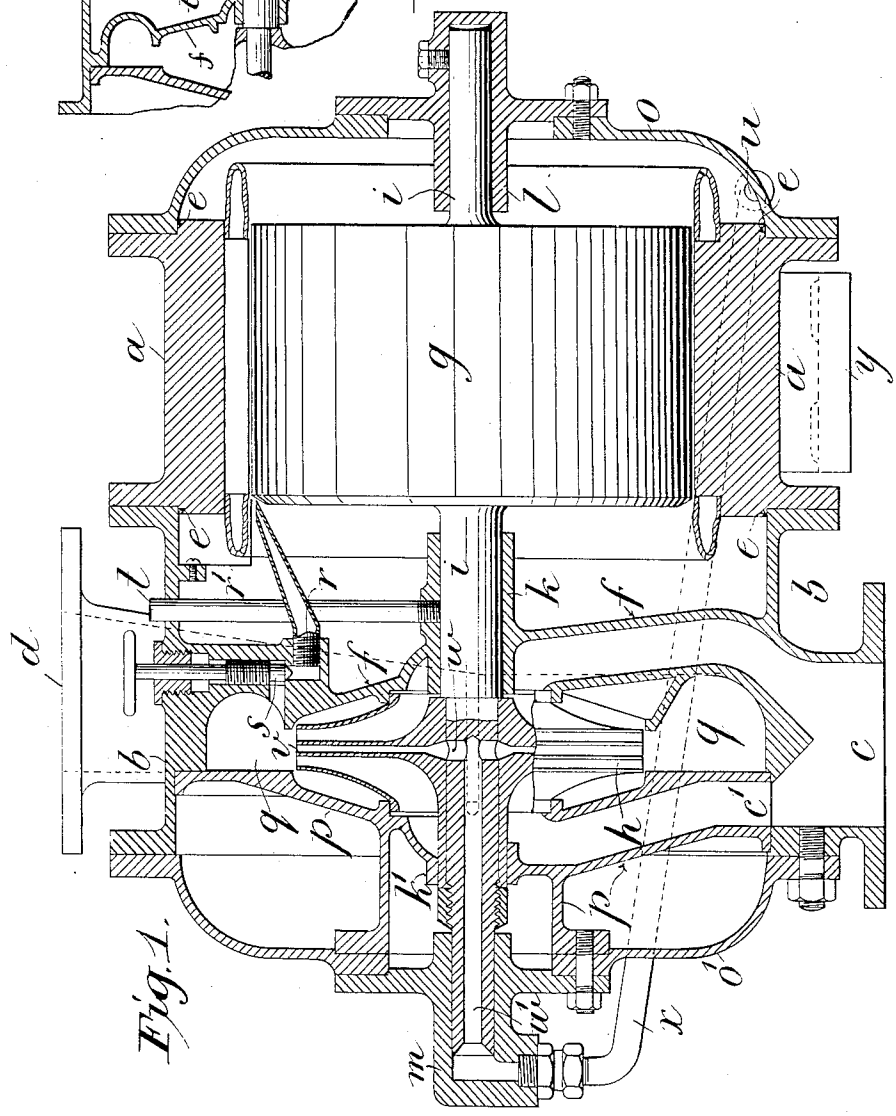

Fig. 1.

Witnesses:

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ELECTRIC MOTOR AND PUMP CONNECTED THERETO.

1,114,727. Specification of Letters Patent. Patented Oct. 27, 1914.

Application filed July 28, 1911. Serial No. 641,129.

To all whom it may concern:

Be it known that I, JOHN FREDERICK BREEZE, a subject of the King of Great Britain and Ireland, residing at Hammersmith, in the county of Middlesex, England, have invented Improvements Relating to Electric Motors and to Pumps Connected Thereto, of which the following is a specification.

It has heretofore been proposed to pump water over the windings of an electric motor intended to be submerged and operated in water without the use of any inclosing casing, the water, in some cases, being delivered thereto by a pump permanently connected to the motor; the water thus supplied is sufficient to prevent the overheating of a motor that is economically designed for efficient working under water in the event of it being run for some time unsubmerged. It has also been proposed to totally inclose such a submersible motor and to circulate sufficiently pure cooling water through the casing. In such cases, the rotor runs in a body of liquid which offers great resistance to its rotation. Another proposal has been to drive a current of air through the motor casing and to inject with the air finely divided water spray which will evaporate and absorb heat, but with this arrangement the pressure in the casing exceeds atmospheric pressure and there is corresponding frictional resistance. Now according to this invention water is delivered into the inclosing casing of an electric motor in any convenient manner and the casing is connected to an exhausting device so constructed and arranged as to prevent the accumulation of water within the casing, the pressure therein preferably being reduced to below that of the atmosphere.

A further feature of this invention is the combination of an electric motor and a centrifugal pump directly connected thereto, the construction and arrangement being such that the pump serves to exhaust the cooling water from the motor and, it may be, also to discharge the cooling water thereto.

The invention also includes features of construction and arrangement whereby manufacture is simplified and cheapened and the apparatus rendered readily adaptable to various conditions of working.

In the accompanying drawings, Figure 1 illustrates in longitudinal vertical section one arrangement embodying the present improvements. Fig. 2 is a part section illustrating a modification in which water is delivered into the motor casing from an external source.

As will be seen the inclosing casing comprises a section *a* usually a circular casting having flanges at each end, which constitutes an induction motor yoke carrying internally the stator laminæ and windings, and a section *b* which constitutes the body of a centrifugal pump and is preferably of similar external shape to the motor section except that it is provided with the necessary suction and delivery branches *c* and *d*. The two sections are adapted to be secured together by bolting the flanges, annular flanges *e* being preferably provided on the motor section *a* to facilitate swiveling of the pump section *b* so that the angular position of branches *c* and *d* may be readily adjusted to suit the peculiarities of varying pipe connections. The pump body forms a partition *f* between the pump impeller chamber and the rotor chamber. The rotor *g* of the motor and the impeller *h* of the pump are fixed upon the same shaft *i* which is mounted in bearings *k*, *l* and *m* in the partition *f* and carried by end covers *o*, o^1 which are preferably similar, the bearings *l* and *m* being closed in as shown to avoid stuffing boxes and glands. To the end cover o^1 is bolted a casting *p* which is fitted into the section *b* as shown and constitutes the one end wall of the pump, being formed with an inlet passage o^1 to one side of the impeller and with a shaft bearing k^1.

The pump is balanced as regards axial thrust and may have a single impeller with inlets to the vanes from both sides as shown, or the pump may be of the multistage type as shown in Fig. 3. The water required for cooling the motor passes under pressure from the pump discharge passage *q* through a passage pipe *r* extending from the partition *f* and terminating preferably in a nozzle or jet opposite the air gap between the stator and rotor. A suitable shield r^1 is provided, which may be attached in any convenient manner to the casing *b* in the neighborhood of the nozzle in order to prevent damage to the windings by reason of the playing on them of water from the jet. The supply of cooling water may be regu-

lated by a valve *s* operated from the exterior and the passage or pipe may be fitted with a small filter (not shown) to stop the passage of grit which might damage the motor. This supply of water under pressure may also be led to the bearings which may be lubricated in this or any other convenient way, supplementary grease cups being provided if desired. Should the pump be dealing with fluid of such a nature as would cause damage to the motor, the supply of water is taken from any auxiliary pressure service as may be found convenient; *t* indicates a pipe supplying water from an external source to the bearing *k*. The pipe *t* may also supply water to the nozzle or jet pipe *r* as shown in Fig. 2. To keep the rotor chamber practically empty in spite of the incoming jet of water, a drain connection *u* is provided in the motor casing and this may be connected in any suitable manner to supplementary vane passages *v* provided in the impeller; the impeller may be divided transversely at its center into halves formed with the main vaned passages the adjacent faces of which halves have narrow vane strips cast on them so that, when the two halves are placed on the spindle and secured thereto between a shoulder and a lock nut by a feather key, supplementary vane passages are formed between them; these vane passages *v* are in communication with the drain connection through radial and longitudinal passages *w*, *w*¹ in the spindle, and the pipe *x*. The supplementary vanes are designed to work against a greater pressure than the head against which the main pump is to work and they and the connecting passages are of ample dimensions for dealing with the cooling water jet and any water leaking through the bearing *k*. The supplementary vane passages discharge the water pumped by them into the main pump delivery passage *q* with the liquid being pumped. Thus the rotor *g*, instead of running in a flooded chamber, will be in a reduced pressure; the diminution of frictional resistances obtained in this way will reduce power consumption and increase efficiency without loss of the beneficial results of water cooled motor windings. If the pressure in the motor section is reduced below atmospheric pressure, the cooling water sprayed onto the portions of the motor liable to heat will evaporate quickly and increase the cooling effect, the vapor condensing on the cooler portions of the casing and flowing to the drains. Any suitable means for assisting condensation may be employed.

The casing is provided with feet *y* usually for convenience on the motor section, and with a suitable cable terminal box (not shown).

The delivery branch of the pump section may be arranged to extend in a right or left hand direction by attaching the pump section to one or the other end of the motor section, and arranging the spindle accordingly. When arranged horizontally no thrust bearings are used with the pump, the impeller *h* being so designed as to allow of the whole being run with a certain freedom for end play of shaft *i* as with an ordinary electric motor. For vertical suspension a suitable bearing would be provided to take the weight of the rotating parts.

The pump is specially designed so as to permit of working against large variations of head without alteration of speed being necessary to avoid overloading the motor, thus giving self regulation of power for such working conditions. Both pump and motor are of such a nature as to permit of the unit being used on dry land or submerged in the liquid the pump is dealing with.

With an arrangement such as described, water cooling of the motor can be effected when submerged and also when the apparatus is used on land without inconvenience from splashing. Moreover the quantity of the fluid present in the rotor chamber at any time will be substantially the same in each case so that frictional losses will not vary.

As will be understood the arrangement described is subject to considerable variation without departure from the invention, and is one which offers advantages as regards compactness, lightness and adaptability to varying conditions of employment.

What I claim is:—

1. The combination of a closed casing, an electric motor inclosed within said casing, means for delivering water from an external source onto the motor within said casing and means for reducing the pressure in said casing below atmospheric pressure and withdrawing water from the lower part of said casing, to thereby avoid flooding of the casing and to insure the motor running in a partial vacuum.

2. The combination of a closed casing provided with an inlet for water and means for supplying water under pressure from an external source, an electric motor inclosed within said casing and directly exposed to the incoming water and a centrifugal pump arranged to withdraw air and water from the lower part of said casing, the capacity of the withdrawing means being greater than the capacity of the supply means to thereby prevent flooding of the motor.

3. The combination of an electric motor, a centrifugal pump, a chambered casing inclosing the motor and pump in separate chambers thereof, bearings in said casing, a shaft mounted in said bearings carrying

the rotor of the motor and the impeller of the pump, means whereby cooling water is discharged into the motor chamber, and means whereby the pump is adapted to withdraw water from the lower part of the motor chamber, the capacity of the withdrawing means being greater than the capacity of the supply means to thereby prevent flooding of the motor.

4. The combination of an electric motor, a centrifugal pump, a chambered casing inclosing the motor and pump in separate chambers thereof, end covers to said casing, closed-in bearings in said end covers, a shaft mounted in said bearings carrying the rotor of the motor and the impeller of the pump, means whereby cooling water from the pump chamber is discharged into the motor chamber, and means whereby the pump is adapted to withdraw water from the lower part of the motor chamber, the capacity of the withdrawing means being greater than the capacity of the supply means to thereby prevent flooding of the motor.

5. The combination of an electric motor, a centrifugal pump, an inclosing casing common to said motor and pump, and means whereby said pump is adapted to discharge cooling water into the motor and to withdraw water from the lower part thereof, substantially as described, the capacity of the withdrawing means being greater than the capacity of the supply means to thereby prevent flooding of the motor.

6. The combination of an electric motor, a centrifugal pump, an inclosing casing comprising a motor section provided with an inlet for water from an external source, a pump section and end covers, a shaft common to the rotor of the motor and the impeller of the pump, and means whereby said pump is adapted to withdraw water from the lower part of the motor section of the casing, the capacity of the withdrawing means being greater than the capacity of the supply means to thereby prevent flooding of the motor.

7. The combination of an electric motor, a centrifugal pump, a chambered casing inclosing the motor and pump in separate chambers thereof, end covers to said casing, closed-in bearings in said end covers, a shaft mounted in said bearings carrying the rotor of the motor and the pump impeller, said impeller being provided with supplementary vaned passages in communication with the lower part of the motor chamber, and means for discharging cooling water into the motor chamber.

8. The combination of an electric motor, a centrifugal pump, a chambered casing inclosing the motor and pump in separate chambers thereof, end covers to said casing closed-in bearings in said end covers, a shaft mounted in said bearings carrying the rotor of the motor and the pump impeller, said impeller being provided with supplementary vaned passages in communication with the lower part of the motor chamber and a passage leading from the pump discharge to the motor through which passage cooling water is discharged into said chamber.

9. The combination of an electric motor, a centrifugal pump, an inclosing casing comprising a motor section, a pump section and end covers, a shaft common to the rotor of the motor and the pump impeller, said impeller being provided with supplementary vaned passages in communication with the lower part of the motor chamber and a passage leading from the pump discharge to the motor section through which passage cooling water is discharged into said chamber.

Signed at Hammersmith Iron Works, London, W., this third day of July 1911.

JOHN FREDERICK BREEZE.

Witnesses:
J. BUDWORTH,
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