June 20, 1972 P. A. GUINARD 3,671,152

ELECTRIC PUMP ASSEMBLY FOR USE IN PUMPING EXPLOSIVE OR DANGEROUS LIQUIDS

Filed Feb. 10, 1970 4 Sheets-Sheet 1

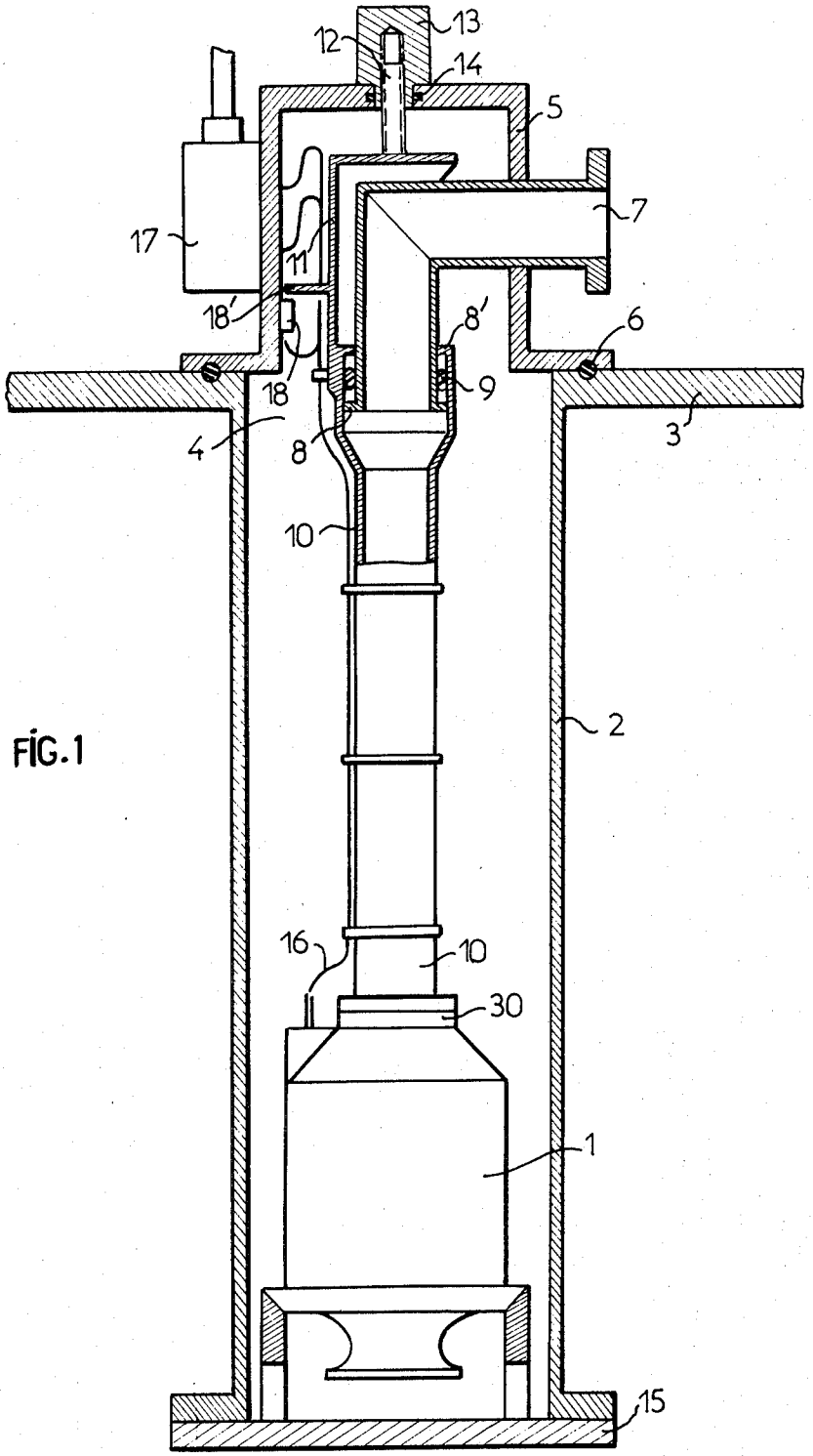
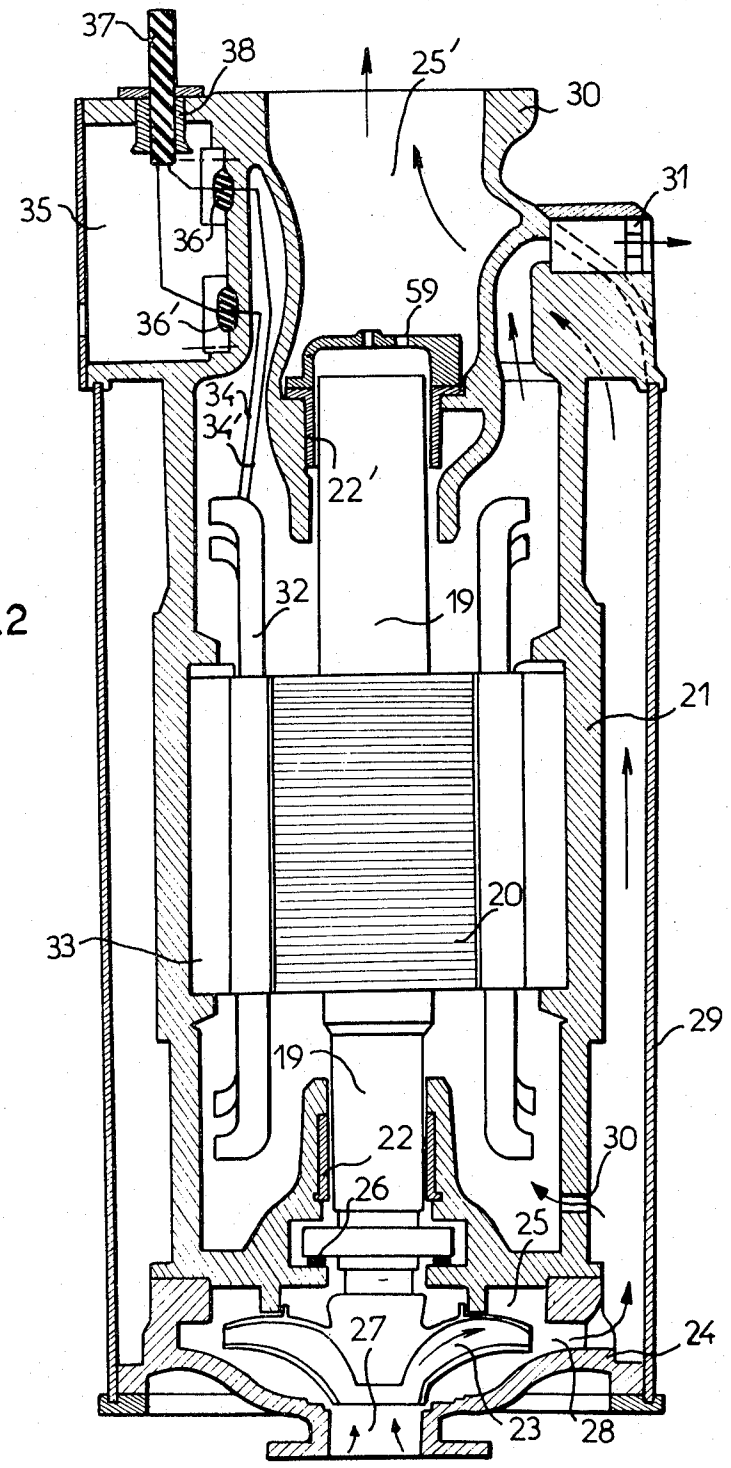


FIG. 1

FIG.2


37
38
25'
30
31
35
36
36'
59
34
34'
22'
32
19
21
20
33
29
19
22
30
26
25
27
24
23
28

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ELECTRIC PUMP ASSEMBLY FOR USE IN PUMPING EXPLOSIVE OR DANGEROUS LIQUIDS

Filed Feb. 10, 1970 4 Sheets-Sheet 3

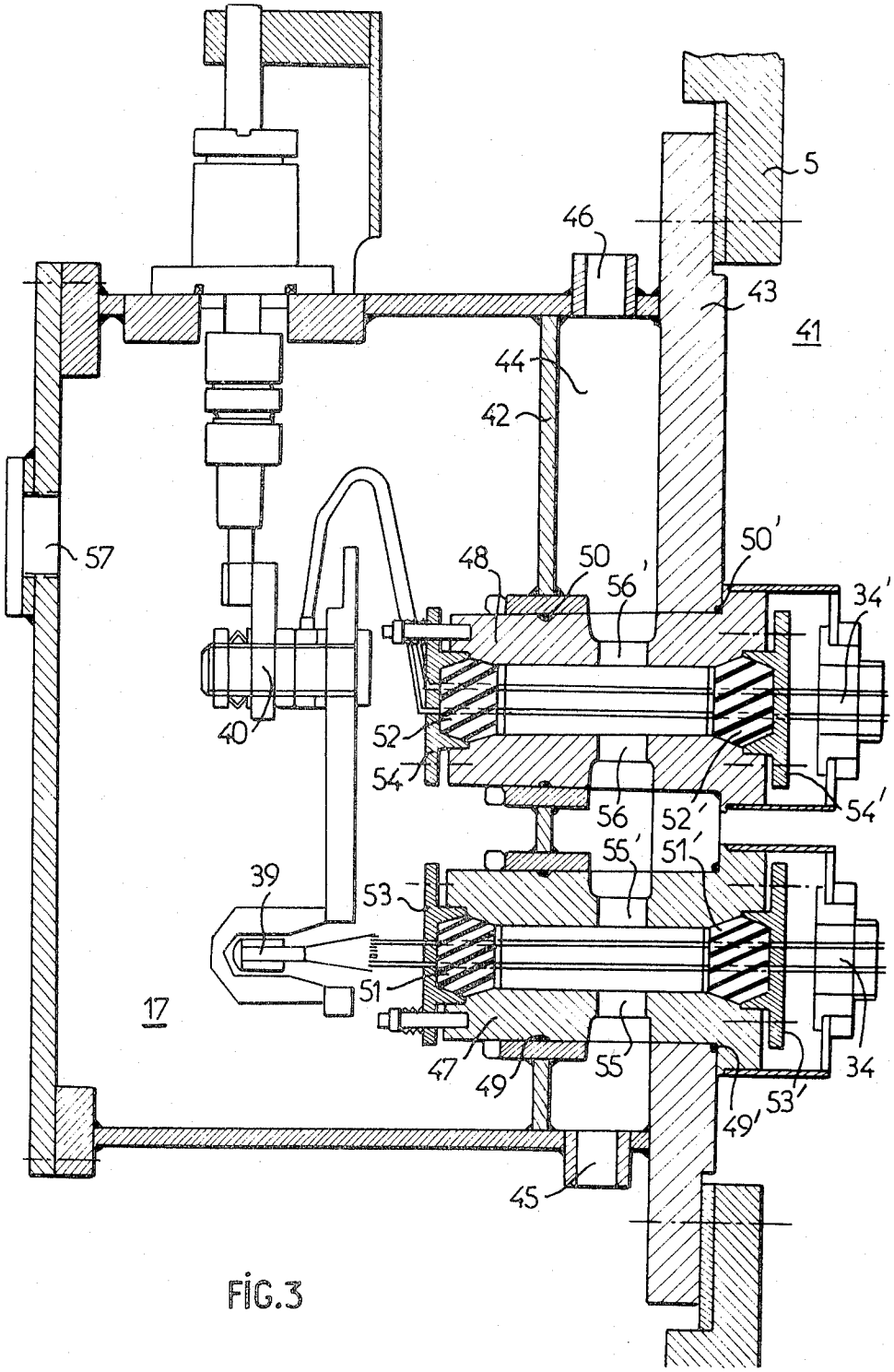
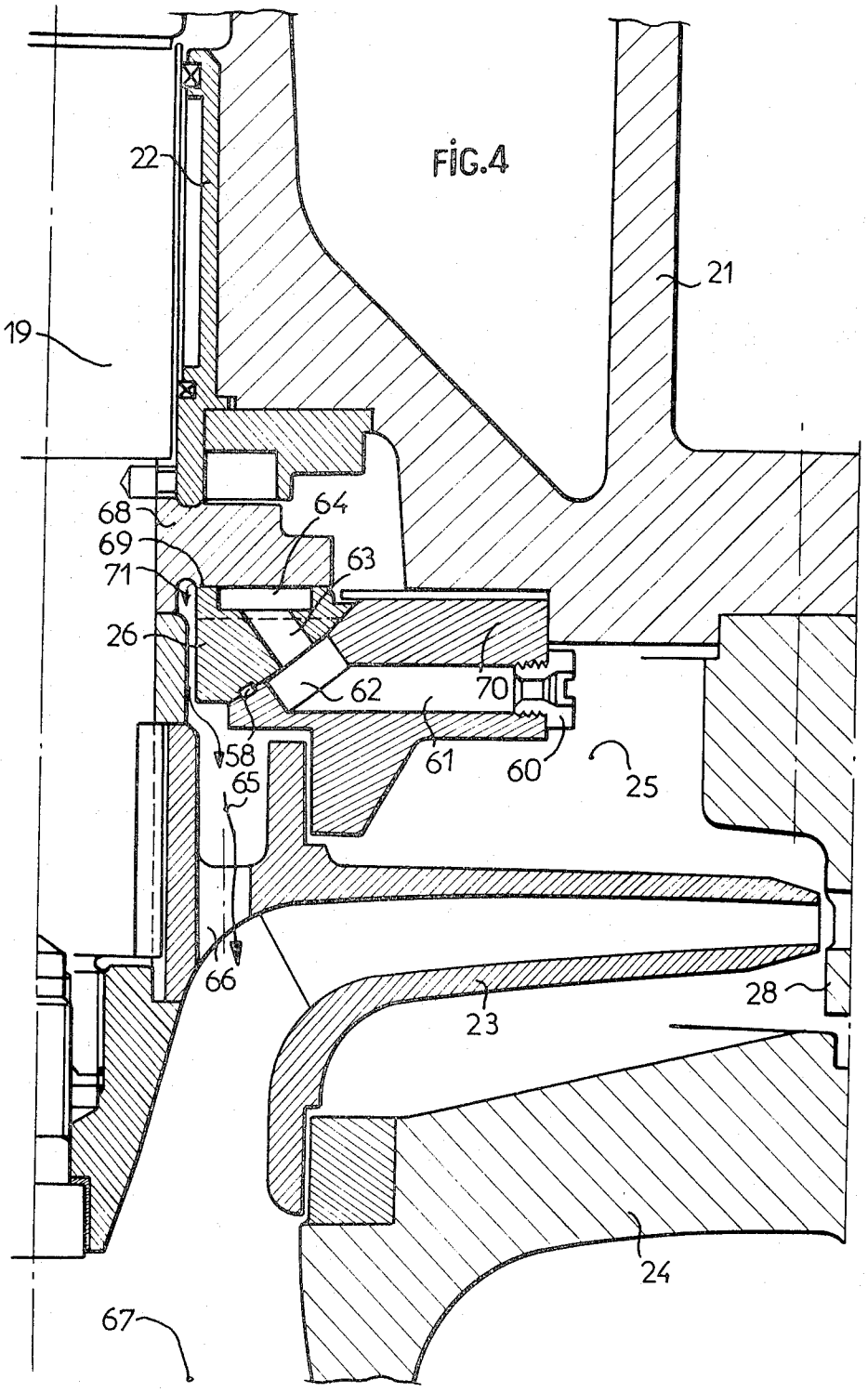


FIG.3

FIG.4



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ELECTRIC PUMP ASSEMBLY FOR USE IN PUMPING EXPLOSIVE OR DANGEROUS LIQUIDS

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U.S. Cl. 417—422 3 Claims

ABSTRACT OF THE DISCLOSURE

This invention relates to an electric pump assembly for use in pumping explosive or dangerous liquids in containers, the assembly comprising a fluid tight container, an electric pump mounted within said container, a pump liquid inlet within the container, and a pump liquid outlet, the pump comprising an electric pump motor, said electric pump motor including a winding for submerging in a liquid in the container, said winding comprising at least one wire, a covering insulating said wire, which covering resists the liquid, sealing means through which said wire extends without discontinuity to the exterior of the container, and electric power input terminals on said wire.

FIELD OF THE INVENTION

The present invention relates to an immersible electric pump arrangement.

BACKGROUND OF THE INVENTION

There is a requirement for pumps particularly adapted for use in emptying large basins and containers accommodating explosive or dangerous liquids, in particular combustible liquefied gases, liquid ammonia or certain chemical products the handling of which calls for certain precautions. More particularly, powered pump arrangements are required which offer great safety in operation, both as regards mechanical and electrical components, thus excluding, in particular, all risk of heating up likely to cause fires; furthermore, such pump arrangements should be extremely well sealed against the exterior, thus enabling any outward leakage of dangerous liquid from the container to be prevented.

SUMMARY OF THE INVENTION

The electric pump arrangement forming the subject-matter of the invention and meeting the above-stated conditions is characterized in that it comprises a motor, which had a winding submerged in the pumped liquid, and the wires of the winding, completely insulated by a covering which resists this liquid, are extended, without a break, at their two ends and guided through sealing means to a junction box, outside the container, in which the electric pump arrangement is suspended in known manner and in a way in which a complete seal is obtained. The preceding characteristic enables the electric pump-motor to be perfectly sealed against the exterior, so that it is possible to circulate the liquid under pressure in the interior of this motor without difficulty, so as to ensure, on the one hand, cooling of the motor and, on the other, feeding of the hydrostatic bearings and a stop for the shaft of the rotor of the electric pump.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the invention, reference will now be made to the accompanying drawings, by way of example. In the drawings:

FIG. 1 is an elevation, partly in axial section, of an installed electric pump arrangement,

FIG. 2 shows an axial section through the electric pump arrangement,

FIG. 3 is a sectional view, on a greater scale, of the exterior terminal box of the electric motor of the pump arrangement, and

FIG. 4 is a partial sectional view, on a greater scale of the lower hydrostatic bearing and of the hydrostatic stop of FIG. 2.

DESCRIPTION OF SPECIFIC EMBODIMENTS

As shown in FIG. 1, a vertical electric pump arrangement **1** is disposed in a well **2**, let into a container, of which there is shown only part of the upper wall **3** which contains an opening **4** for fixing the tube forming the well **2**.

The opening **4** is closed in a liquid-tight manner by a member **5** in the form of a bell or cap secured to the top of the container by means not illustrated, with the interposition of O ring sealing means **6**. Welded into the cylindrical wall of the part **5** is a tubular elbow **7**, the vertical portion of which is connected, by a sliding joint comprising flanges **8** and **8'** and an O ring sealing member **9**, to the vertical delivery pipe **10**. The atter is extended at its upper end by a stirrup-shaped part **11**, fixed to the bell cap **5** by means of a screw-threaded rod **12** extending through an opening in the top of this bell cap and on which is screwed a nut constituting a plug **13**. Plug **13**, by means of sealing ring **14**, seals this opening in a liquid-tight manner.

The lower end of the well **2** is closed by a plate **15** which constitutes a flap valve which is opened when the electric pump **1** is moved down, this downward movement being brought about by rotating the plug **13**.

The insulated wire constituting the winding of the stator of the pump motor is extended and passes out of the motor casing at **16**. It is run to an exterior terminal box **17** secured to the bell cap in a sheath which provides insulation and complete protection against the liquid in the container. Connected to the wire **16** is a micro-switch **18**, secured to the interior of the bell cap **5** and actuated by a part **18'** integral with the delivery piping **10–11** and arranged to prevent start-up of the motor if the electric pump **1** is not lowered sufficiently to be submerged in the liquid in the container after the base valve **15** of the well **2** has been opened.

As shown in FIG. 2, the electric pump arrangement is constituted by an electric motor the interior of which is flooded by the liquid from the container. The motor shaft **19** carrying the rotor **20** is mounted in the casing **21** on two bearings **22** and **22'** of the hydrostatic type, lubricated by the pumped liquid. The impeller **23** of centrifugal type is mounted outside casing **21** on the lower end of the shaft

19; the impeller casing 24 is secured to the lower end of the motor casing 21, the shaft 19 having a flange resting on a stop 26, which supports the weight of the rotor and the hydraulic thrust, and which will be described by reference to FIG. 4.

The impeller casing has an axial intake opening 27 and a diffuser 28, the liquid being delivered under pressure into an annular passage between the motor casing 21 and a tubular part 29, the upper end of which is connected at 30 to the axial delivery pipe 10 of the pump.

In the case where the pumped liquid is a liquefied gas, it is necessary to prevent it from vaporizing inside the motor under the effect of heat generated by the latter. For this purpose, adequate circulation of liquid is achieved inside the motor with the help of an inlet bore 30, whereby the annular compression passage between the parts 21 and 29 communicates, near its lower end, with the interior of the casing 21, whilst a leakage bore 31 establishes communication between the upper part of the casing 21 and the interior of the container or of the well 2. The liquid compressed in this manner inside the motor casing may be utilized to feed the hydrostatic bearings 22 and 22' and the stop 26, but it appears more advantageous to feed them directly by the pressure built up at 25 and 25', as will be explained with reference to FIG. 4.

The winding 32 of the stator 33 of the motor is constituted by wire insulated by a liquid-tight coating which resists any chemical action of the pumped liquid. The ends 34 and 34' of the wire comprising the winding are passed out of the casing 21 into a lateral compartment 35 through transverse orifices fitted with elastomeric seals 36 and 36', and are then inserted in a sleeve 37, resistant to mechanical damage and fixed at 38 in the wall of the compartment 35 and run to the top of the container where the wires are introduced into the outer terminal box 17 (FIGS. 1 and 3), in a manner that will be described later.

The terminal box 17 (FIG. 3) is constituted by a liquid-tight enclosure in which are mounted connectors 39 and 40. Box 17 is mounted in a liquid-tight manner, by any known suitable means (not illustrated), on the edges of an opening 41 in the wall 3 of the container or of the bell cap 5, as illustrated in FIG. 1.

The box 17 preferably has a double-walled base 42, 43, defining a compartment 44 provided with openings 45 and 46 which enable this compartment to be flushed with air or a neutral gas to drive out leakage gases which might find their way into it from the container through the holes through which the electric wires 34 and 34' pass. These holes are formed in tubular parts 47 and 48 fitted through the walls 42 and 43 of the box 17 with interposed sealing rings 49, 49' and 50, 50'. The ends of the holes through tubular parts 47 and 48 are of cylindro-conical shape, and blocks 51, 51' and 52, 52' of elastically deformable material, through which the wires 34 and 34' pass, are clamped therein by caps 53, 53' and 54, 54' fixed, by means of screws, for example, on the ends of the tubular parts 47 and 48. In the region within the compartment 44 of the box 17, the tubular parts 47 and 48 contain lateral openings 55, 55' and 56, 56' through which any leakage gases can enter this compartment 44, from which they are removed by the above-mentioned flushing.

The interior of the terminal box 17 is filled, after fitting, with an insulating compound or a pressurized neutral gas, through an orifice having a closure means 57.

Reference will now be made to FIGS. 2 and 4, the latter of which illustrates, partly in section and on a greater scale, the hydrostatic stop 26 and the lower hydrostatic bearing 22. This stop 26 is of the swivel type, as indicated at 58, and it is fed, under the delivery pressure obtaining in the chamber 25, through the calibrated hole 60, the passage 61, the chamber 62 and the passage 63, in the direction of the stop chamber 64, the liquid being returned, as indicated by the arrow 65, through the hole 66 in the impeller 23 of the centrifugal pump, towards the suction side 67. It will be apparent that the lower hydrostatic bearing 22 may also be fed in a similar manner, not illustrated, from the chamber 25 in which the delivery pressure obtains, the liquid being returned in an identical manner towards the suction side of the pump. The upper hydrostatic bearing 22', as illustrated in FIG. 2, can likewise be fed from the region 25', through a calibrated hole 59, the liquid being returned to the well through the hole 31.

The employment of hydrostatic bearings and stops enables use to be made of clearances 10 to 100 times greater than that in conventional bearings, so that excellent cooling of these bearings is achieved, as well as lubrication, by circulation of the pumped liquid. It will be seen that in the case of a container of liquefied gas, in the installation that has been described the sealing elements are fitted in the low-pressure part, at the top of the container, where there is a gas volume located above the level of the liquefied gas, whereas in the high-pressure part, that is, on the delivery side of the pump, the interior of the well contains only permanent welded joints. The low-pressure seals are easily achieved with the help of pressure joints of appropriate material.

The pump arrangement described thus contributes to the provision of an installation for stocking and pumping dangerous liquids by means of a submerged electric pump, which installation is particularly safe.

What is claimed is:

1. In a system for storing and dispensing explosive and dangerous liquids of the group comprising combustible liquefied gases, liquefied ammonia and the like, the combination of a closed fluid-tight container for said liquid; an immersible pump assembly mounted within said container and comprising a housing provided with a liquid inlet and a liquid outlet, and a pump and an electric motor arranged within said housing; a junction box arranged outside of said container and provided with input terminals to which power supply wires are connected; said electric motor comprising a winding immersed in said liquid and wound of wire having insulation resistant to said liquid, said insulated wire of said winding extending without discontinuity through an opening in said housng and an opening in the upper part of said container to said terminals in said junction box, and fluid-tight sealing means provided in said opening of said container to prevent liquid or vapor thereof passing from said container into said junction box.

2. A system according to claim 1, comprising a compartment interposed between said container and said junction box and having means for venting said compartment, said insulated wire passing through said vented compartment in going from said container to said junction box.

3. In a system for storing and dispensing explosive and dangerous liquids of the group comprising combustible liquefied gases, liquefied ammonia and the like, the combination of a closed fluid-tight container for said liquid, an immersible pump assembly mounted within said container and comprising a housing provided with a liquid inlet and a liquid outlet, a pump and an electric motor arranged within said housing, said electric motor having a winding immersed in liquid in said container and wound of wire having an insulation resistant to said liquid, an opening for said wire from said housing into said container, an opening at the top of said container, a junction box mounted in a fluid-tight manner over said latter opening and provided with input terminals to which power supply wires are connected, the wire of said insulated winding extending without discontinuity from the motor through said openings to said input terminals, said junction box comprising a base plate and a partition forming a double walled base lower compartment and an upper compartment, inlet and outlet openings in said lower compartment through which said compartment is flushed with air or a neutral gas to drive out leakage gases, said input terminals being provided in the upper compartment, open-

ings provided in said base plate and partition, means for tightly guiding the extended insulated wires of the motor winding through said openings to said input terminals, said means comprising tubular members fitted in said openings and provided with internal conically flared ends, seals interposed between the tubular members and the periphery of the openings of said base plate and partition respectively, axially perforated blocks of elastically deformable material inserted in said conical ends and traversed by said wires, caps secured over said ends of the tubular members to compress said elastic blocks, and an insulating compound filling said upper compartment of the junction box.

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U.S. Cl. X.R.

417—424; 310—87