April 12, 1966 E. J. SCHAEFER 3,246,186

CARRYING HANDLE AND SWITCH ASSEMBLY FOR AN ELECTRIC MOTOR

Filed Aug. 13, 1963 2 Sheets-Sheet 1

Fig. 1.

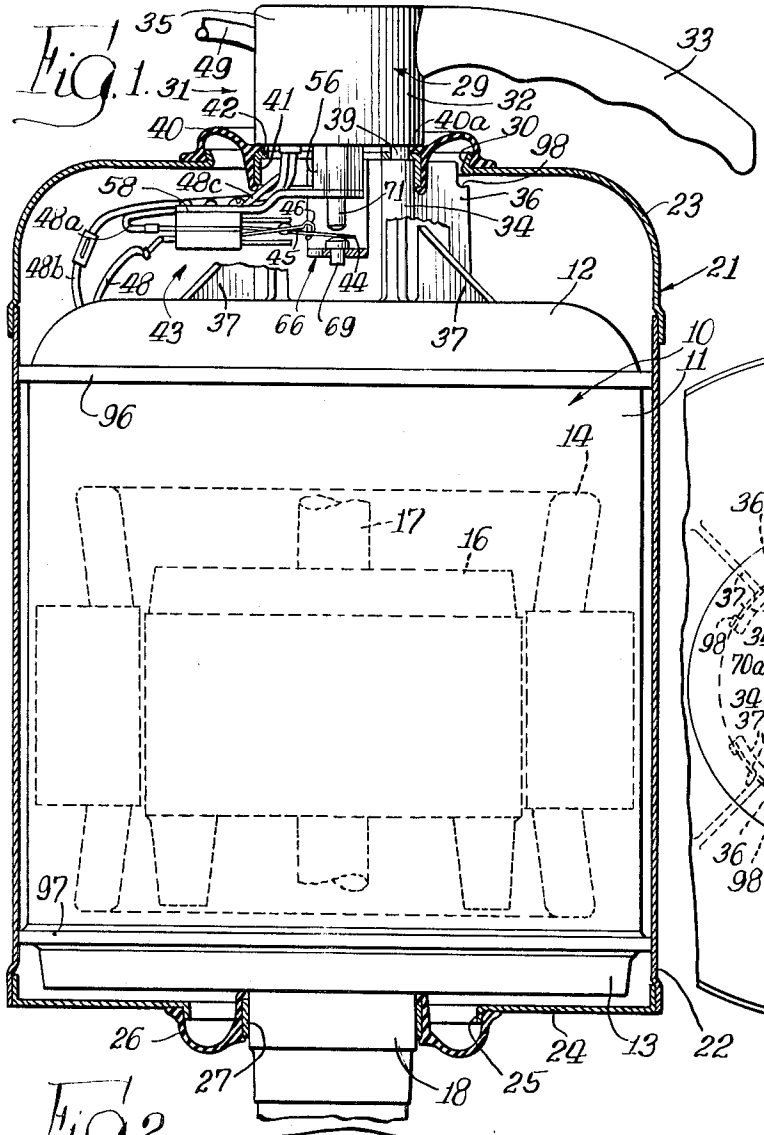


Fig. 3.

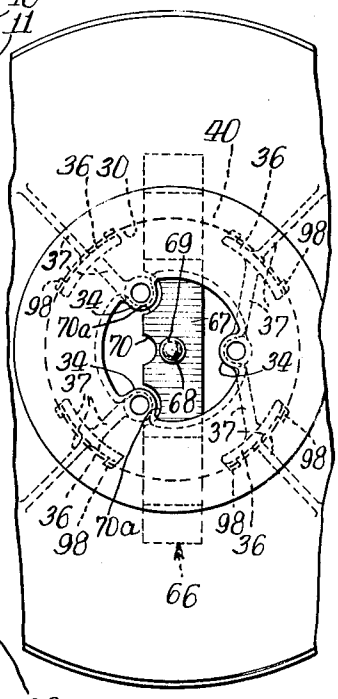
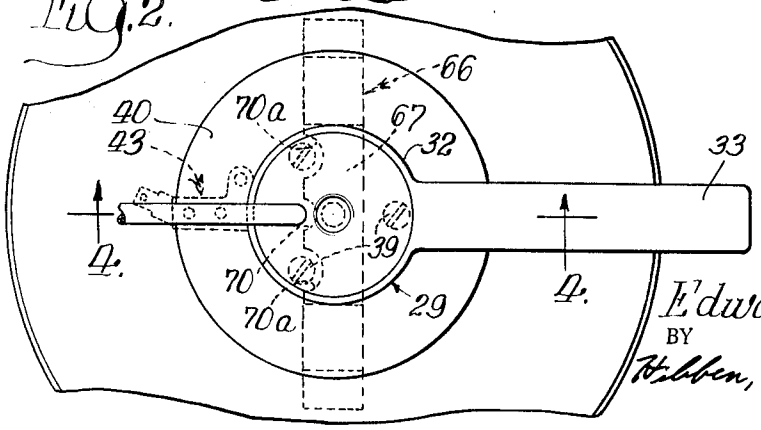


Fig. 2.



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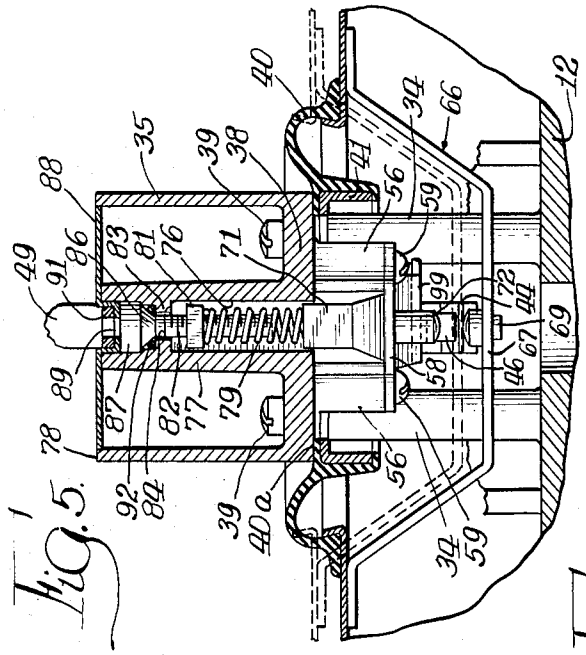

FIG. 5.

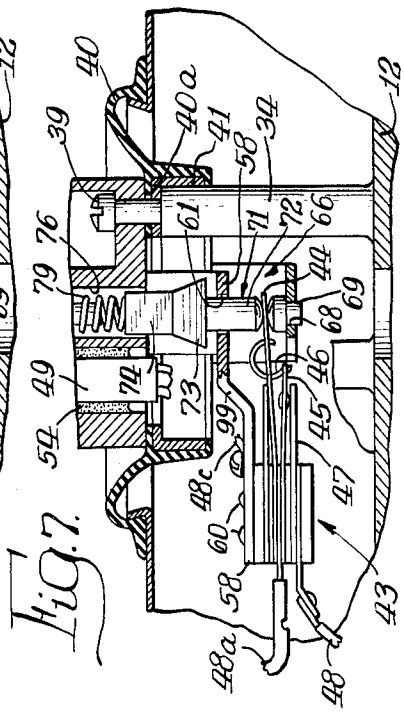

FIG. 7.

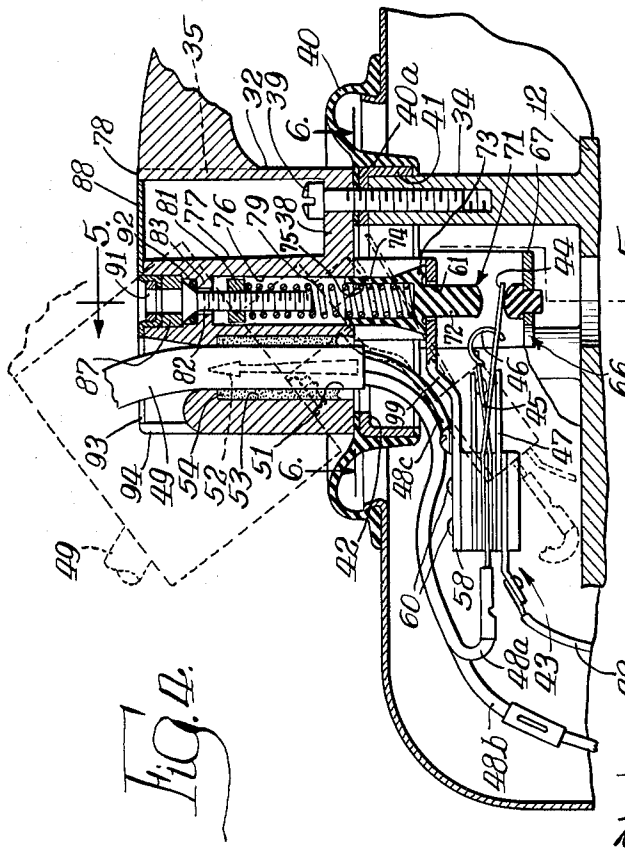

FIG. 4.

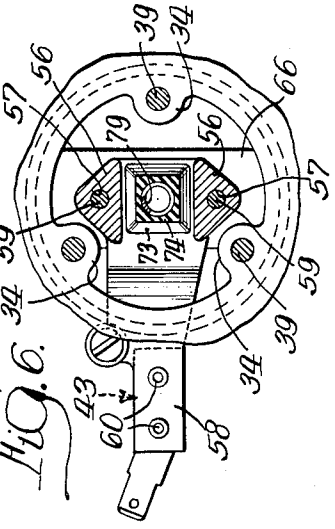

FIG. 6.

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United States Patent Office 3,246,186 Patented Apr. 12, 1966

3,246,186

CARRYING HANDLE AND SWITCH ASSEMBLY FOR AN ELECTRIC MOTOR

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Filed Aug. 13, 1963, Ser. No. 301,764
9 Claims. (Cl. 310—87)

This invention relates to submersible motors, and more particularly to a motor having a combination carrying handle and switch assembly.

A submersible motor adapted to be connected to drive a sump pump, for example, may be provided with an on-off control switch for the motor, and a float connected to actuate the switch. The switch is mounted at a position where it is protected against contact by liquid, and the float is connected to actuate the switch in response to changes in liquid level. To protect the motor and the switch against contact by liquid, the float has preferably been constructed to form a liquid tight enclosure, and the motor and the switch have been mounted within the enclosure formed by the float.

Some difficulty has been encountered with this construction when servicing or replacement of the switch is required. This is due to the fact that considerable time and effort are required to dismantle the float in order to get at the switch.

Accordingly, it is an object of this invention to provide a submersible motor including a float and switch wherein the switch is mounted within a liquid tight enclosure formed by the float and yet is readily accessible for servicing or replacement.

A further object is to provide a motor of the foregoing character, having a removable assembly comprising the aforesaid switch and a handle for carrying the motor.

It is another object to provide a novel carrying handle and switch assembly for a submerisible motor.

Other objects and advantages of the invention will become apparent from the following description taken in conjunction with the accompanying figures of the drawings, in which:

FIG. 1 is a view partially in section of a submersible motor construction embodying the invention and including a carrying handle and switch assembly.

FIG. 2 is a fragmentary top plan view of the structure shown in FIG. 1;

FIG. 3 is a view similar to FIG. 2 but showing the motor construction with the carrying handle and switch assembly removed;

FIG. 4 is an enlarged fragmentary sectional view taken on the line 4—4 of FIG. 2;

FIG. 5 is a sectional view taken on the line 5—5 of FIG. 4;

FIG. 6 is a sectional view taken on the line 6—6 of FIG. 4; and

FIG. 7 is a view generally similar to FIG. 4 but showing a different position of the carrying handle and switch assembly.

In general, a submersible motor embodying the invention comprises a motor having a housing member, a float member, and a carrying handle and switch assembly. The handle and switch assembly is adapted to be connected to the housing member and the switch is adapted to be positioned within a liquid tight enclosure formed by one of the float and housing members. Further, the float member is connected to the housing member and to the assembly such that movement of the float member relative to the motor and to the assembly is permitted, and such relative movement of the float member actuates the switch. The construction and method of attachment of the various parts is such that the assembly including the switch may be easily disconnected from the motor and from the float member for servicing.

The construction shown in FIG. 1 comprises an electric motor **10** of a conventional design including a housing having a cylindrical central portion **11** and upper and lower end bells **12** and **13**, the portions **11**, **12** and **13** of the housing being secured together by any desired means. A stator assembly **14** is secured within the central portion **11** of the housing, and a rotor assembly **16** including a shaft **17** is positioned within the stator assembly **14**. The shaft **17** is journaled in the upper and lower end bells **12** and **13** in a conventional manner, and it extends downwardly through a cylindrical hub **18** of the lower end bell **13** for attachment with a pump (not shown) below the motor, a seal being provided between the shaft **17** and hub **18**.

A liquid tight enclosure around the motor **10** is formed by a shell or float **21** comprising a generally cylindrical central portion **22** and upper and lower end portions **23** and **24**. The portions **22**, **23** and **24** of the float are preferbly made of sheet metal secured together as by soldering. The lower end portion **4** has a hole **25** formed in it through which the hub **18** and the shaft **17** extend, and the end portion **24** is connected to the hub **18** by means of a flexible diaphragm **26** made of a material such as rubber, and an annular metallic band **27**. The band **27** tightly engages the outer periphery of the hub **18** and the diaphragm **26** is preferably secured to both the band **27** and to the margin of the hole **25** in the lower end portion **24**, thereby providing a liquid tight connection between the lower end portion **24** of the float **21** and the motor **10**.

At the upper end of the motor, a carrying handle and switch assembly **31** extends through an opening **30** in the upper end portion **23** of the float **21** and is secured to the upper end bell **12** of the motor housing. The assembly **31** comprises a handle **29** which include a generally cylindrical hub **32** and an arm **33**, the arm **33** preferably being formed integrally with the hub **32** and extending radially outward so that it may be grasped for carrying purposes.

The hub **32** is positioned above the upper end bell **12** of the motor and is preferably coaxial therewith. For the purpose of securing the hub **32** to the motor housing, three upwardly extending bosses **34** are formed on the upper end bell **12**, each boss **34** having an internally threaded hole at its upper end. The three bosses **34** are preferably equidistant from the axis of the end bell **12** and they are preferably 120° apart (FIGS. 3 and 6). Four upwardly extending arcuate guides **36** (FIGS. 1 and 3) are also preferably formed on the upper end bell **12** for the purpose to be described hereinafter, the guides **36** being positioned at a greater radial distance from the axis of the end bell **12** than the bosses **34**. Further, ribs **37** preferably extend from the bosses **34** to the guides **36** and from the latter outwardly, in order to strengthen them.

The hub **32** includes a cylindrical outer wall **35** and a bottom wall **38**. The bottom wall **38** (FIGS. 4, 5 and 7) has three holes aligned with the bosses **34**, and bolts **39** extend through these holes and are threaded into the bosses **34** in order to secure the hub **32** to the motor housing. To provide a liquid tight connection between the hub **32** and the float **21**, a flexible diaphragm **40** is provided which, at its outer periphery, is secured to the margin of the opening **30** in the upper end portion **23** of the float. At its inner periphery, the diaphragm **40** is secured to and embraces the outer surface of a rigid ring **41** and has a lip **40***a* overlying an inwardly extending upper flange **42** (FIGS. 1 and 4) of the ring. The outer diameter of the ring **41** is substantially equal to that of the hub **32**, and the lip **40***a* is interposed between the upper surface of the flange **42** and the underside of the hub **32**. At the locations of the bosses **34**, the width of the flange **42** is increased sufficiently to extend inwardly

over the top of the bosses 34, and holes are formed in the flange 42 and the lip 40*a* through which the bolts 39 extend. Thus, when the bolts 39 are tightened into the bosses 34, the lip 40*a* of the diaphragm 40 on the upper surface of the flange 42 of the ring 41 is clamped between the flange 42 and the bottom wall 38 of the hub 32, thereby providing a liquid tight seal between the hub 32 and the float 21.

The carrying handle and switch assembly 31 further comprises an on-off motor control switch 43 which is adapted to be actuated by movement of the float 21 and which is secured to the hub 32 and is positioned within the enclosure formed by the float 21. The switch 43 is a conventional over-center type including a flexible actuating arm 44, a flexible contact arm 45, a spring 46 connecting the arms 44 and 45, and a stationary contact arm 47. As will be described hereinafter, the contact arms 45 and 47 are out of engagement when the actuating arm 44 is in its lower position and may be placed in engagement only by upward movement of the actuating arm 44. One contact arm of the switch 43 is connected to the windings of the motor 10 by a conductor 48 (see FIG. 1) and the other contact arm is connected to an electrical power cord 49 by a conductor 48*a*, the connections at the switch being such that a direct connection is made between the conductors 48 and 48*a* when the contact arms 45 and 47 are in engagement. Another conductor 48*b* runs from the power cord 49 directly to the windings of the motor, and still another conductor 48*c* is secured to a switch bracket 58 for the switch, the conductor 48*c* being used to ground the bracket 58. It will be understood that when the cord 49 is plugged into a suitable electric outlet and the contact arms 45 and 47 are in engagement power is connected to the windings of the motor. From the switch 43, the power cord 49 extends upwardly through an opening 51 formed through the bottom wall 38 of the hub 32. To prevent the cord 49 from moving relative to the hub 32, an anchor pin 52 (FIG. 4) may be forced into the center of the cord 49, and a portion of the opening 51 around the cord 49 may be recessed as at 53 (FIG. 4) and an epoxy and hardener composition 54 poured into the recess around the cord.

To secure the switch 43 to the hub 32, two downwardly extending, spaced apart lugs 56 (FIGS. 5 and 6) are formed on the underside of the bottom wall 38 of the hub 32. An internally threaded hole 57 is formed in each lug 56 which extends from its bottom surface upwardly, and a switch mounting bracket 58 is positioned against the bottom surface of the lugs 56 and secured thereto by screws 59. The lugs 56 are offset from the axis of the hub 32 and are on opposite sides of this axis, and the bracket 58 bridges the space between the two lugs 56. A hole 61 (FIGS. 4 and 7) is formed through the bracket 58 on the axis of the hub 32 for a purpose to be described hereinafter. The bracket 58 extends generally radially outward from the hole 61, and the switch 43 is secured as by a plurality of rivets 60 to the underside of the bracket 58. The switch 43 is positioned such that its actuating arm 44 is underneath the hole 61 in the bracket 58.

The construction of the switch 43 is such that the switch is turned on and power is connected to the motor 10 when the actuating arm 44 is in the up position shown in FIG. 7, and the switch is turned off and power is disconnected from the motor 10 when the arm 44 is in the down position shown in FIGS. 1 and 4. The actuating arm 44 is preferably provided with a permanent set which urges it downwardly and consequently the switch 43 to its off position. To actuate the switch 43 from its off position to its on position when the float 21 rises relative to the motor 10, a bow shaped float bracket 66 is positioned with its center portion 67 underneath the switch actuating arm 44, and with its ends extending upwardly and outwardly, the ends of the bracket 66 being secured to the inner surface of the upper end portion 23 of the float 21. A hole 68 is formed through the center portion 67 of the bracket 66, and a lower button 69, made of insulating material, is positioned in this hole 68. The hole 68 and the button 69 are substantially coaxial with the end bell 12 and with the hub 32 and, they are positioned below the actuating arm 44 of the switch 43. As shown in FIGS. 4 and 7, the upper portion of the button 69 is enlarged to prevent the button 69 from falling through the hole 68, and the upper surface of the button 69 is preferably rounded off.

In addition to the hole 68, a center notch 70 and two outer notches 70*a* (FIGS. 2 and 3) are formed in one edge of the center portion 67 of the bracket 66. The outer notches 70*a* are provided so that the bracket 66 will not contact the bosses 34 of the upper end bell 12, and the center notch 70 is provided so that the bracket 66 will not contact the spring 46 of the switch 43.

Above the actuating arm 44 is mounted a biasing mechanism for urging the arm 44 downwardly, including a plunger 71 which is made of insulating material and is substantially coaxial with the lower button 69. The plunger 71 comprises a cylindrical lower portion 72 which extends through the previously mentioned hole 61 in the switch mounting bracket 58, an enlarged shoulder portion 73 which may rest on the upper surface of the bracket 58 to prevent the plunger 71 from falling through the hole 61, and an upper portion 74 having an upwardly opening cavity 75 formed therein. The upper portion 74 extends upwardly into an opening 76 formed in a center projection 77 of the hub 32. The center projection 77 extends from substantially the center of the bottom wall 38 of the hub 32 upwardly to a level slightly below the upper edge 78 of the outer wall 35 of the hub 32.

The plunger 71 is urged downwardly by a coiled compression spring 79 which is positioned beween the plunger 71 and an adjusting nut 81 which threadingly engages an adjusting screw 82. The lower end of the spring 79 is positioned within the cavity 75 of the plunger 71, and from this end it extends upwardly through the opening 76 in the projection 77, around the adjusting screw 82, and into engagement with the nut 81. The opening 76 and the nut 81 are preferably made with an out-of-round cross section, preferably a square, so that the nut 81 cannot rotate relative to the hub 32.

Above the nut 81, an inwardly extending ledge 83 (FIGS. 4 and 5) is formed within the opening 76 of the projection 77, the ledge 83 thereby forming a reduced area portion 84 of the opening 76. An adjusting screw 82 is positioned with its head above the ledge 83 and its shank extending through the reduced area portion 84.

The adjusting screw 82 is held against axial movement relative to the hub 32 by means comprising a retaining washer 87 which is pressed into the opening 76 and into engagement with the upper surface of the screw head 86. The washer 87 is substantially coaxial with the screw 82 and a hole at the center of the washer 87 is sufficiently large that a screwdriver may be inserted through it in order to turn the screw 82. The retaining washer 87 may be held in place by staking the inner periphery of the opening 76 just above the washer 87, or by providing a circular top enclosing plate 88 which may be positioned across the upper end of the hub 32. The center of the plate 88 has a hole 89 formed in it, and the portion of the plate 88 around the periphery of the hole 89 is tightly pressed into the upper end of the opening 76 and against the washer 87 to prevent the washer 87 from coming out. Further, a metal ring 91 may be pressed into the opening 76 over the plate 88 in order to reinforce the plate 88 and hold it tightly against the inside of the opening 79. Thus, the screw 82 is prevented from moving axially upward relative to the hub 32 by the washer 87, the plate 88, and the ring 91, but, nevertheless, the head of the screw 92 is accessible to a screwdriver through the holes in these members. Of course, downward axial movement of the screw 82 is prevented by the ledge 83.

An O-ring seal 92 is preferably positioned between the head 86 of the screw 82, which is of the flat head type, and the upper surface of the ledge 83 in order to prevent liquid from leaking into the float enclosure through the opening 76.

The top plate 88 is generally circular and covers the space formed by the outer wall 35 of the hub 32. A slot 93 (FIG. 4) is preferably formed in the top plate 88 for the power cord 49. Further, the outer wall 35 of the hub 32 adjacent the slot 93 may be provided with a downwardly extending recess 94 to permit the cord 49 to extend laterally from the hub 32.

When constructed as described and shown, the float 21 forms an air and liquid tight enclosure around the motor 10 and the switch 43. Limited axial movement of the float 21 relative to the motor 10 is permitted, however, due to the flexibility of the two diaphragms 26 and 40. Circular ridges 96 and 97 (FIG. 1) may be formed on the motor housing, which slidingly engage the inner surface of the float 21 and guide its axial movement. The extent of upward movement of the float 21 is limited by the lower end portion 24 of the float, which moves into engagement with the lower end bell 13 of the motor 10 and the extent of downward movement of the float 21 is limited by the upper end portion 23 of the float 21 moving into engagement with two ledges 98 formed on each of the four guides 36 on the upper end bell 12. The two ledges 98 (FIGS. 1 and 3) of each guide 36 are positioned to engage the margin of the opening 30 in the upper end portion 23 of the float 21 when the float moves downwardly. Further, the vertical portions of the guides 36 above the ledges 98 are positioned to engage the margin of the opening 30 and thereby prevent transverse movement of the upper end portion 23 of the float.

Assume that the structure shown in FIG. 1 is positioned in a sump and that the lower end of the motor shaft 17 is connected to a pump. Assume also that the liquid level in the sump is relatively low and, consequently, the float 21 is in a lowered position relative to the motor 10. The bracket 66 and the lower button 69, which are attached to the float 21 are then also in a lowered position relative to the switch 43, which is attached to the motor 10. In this position, shown in full lines in FIGS. 1, 4 and 5, the switch actuating arm 44 is in a downward position and the motor is turned off. As previously explained, the arm 44 preferably has a permanent set which urges it downwardly.

If the liquid in the sump rises, the float 21 rises too, due to its buoyancy. The lower button 69 forces the switch actuating arm 44 upwardly into engagement with the plunger 71 and the plunger 71 also rises against the force exerted by the compression spring 79. At a predetermined liquid level and position of the float 21, the upwardly displaced actuating arm 44 causes the flexible contact arm 45 to snap overcenter and connect power to the motor 10. Before the plunger 71 starts to rise, however, the water level relative to the float 21 must rise to a level greater than previously existed because the downward force of the compression spring 79 is added to the weight of the float 21, and it is thereafter necessary for the buoyancy of the float 21 to balance both the force of the spring 79 and the weight of the float 21. When the motor 10 is on, the pump is driven and gradually lowers the liquid level in the sump. The float 21, carrying the bracket 66 and the button 69, lowers with the liquid level, and the actuating arm 44 of the switch 43 follows the button 69. The enlarged portion 73 of the plunger 71 eventually engages the bracket 58 and stops moving downwardly but the lower bracket 66 and the actuating arm 44, due to its permanent set, continue to move downwardly. After the portion 73 of the plunger 71 engages the bracket 58, the spring 79 no longer forces the float 21 downwardly and the buoyancy of the float 21 is balanced only by its weight. Accordingly, at this position there is again a change in liquid level relative to the float 21 before the float 21 continues its downward movement with the liquid level. At a certain liquid level and position of the float 21, the spring 46 of the switch 43 causes the contact arm 45 to snap to the off position and turn the motor off.

The liquid level at which the switch 43 is turned on may be adjusted by adjusting the force exerted by the spring 79. This is accomplished by inserting a screwdriver through the holes in the ring 91, the top plate 88, and the washer 87, and turning the screw 82. Since the screw 82 cannot move axially and the nut 81 cannot rotate, the nut 81 must move axially as the screw 82 is turned, such axial movement of the nut 81 varying the force on the spring 79. The liquid level at which the switch 43 is turned off is determined by the weight of the float 21.

In the event servicing or replacement of the switch 43 is required, the top enclosing plate 88 is first pried loose from the hub 32 and the three bolts 39 are then removed. The handle and the switch may thereafter be tilted to the dashed line position shown in FIG. 4 in order to withdraw the bracket 58 and the switch 43 upwardly through the opening formed by the ring 41. The wires 48 connecting the switch 43 to the motor 10 should of course be long enough to permit the entire switch 43 to be taken out of the float 21. After servicing or replacement of the switch 43, the switch 43 is placed back into the float enclosure, and the bolts 39 and the plate 88 are replaced. The switch mounting bracket 58 is preferably axially offset as at 99 (FIGS. 4 and 7) to make removal and reinsertion of the switch 46 easier. The bracket 66 and the lower button 69 remain within the float of course while the switch is being serviced.

If desired, the switch 43 may be constructed such that, when the motor 10 is on and the liquid level and the float 21 are being lowered, the switch will turn off while the plunger 71 is still in contact with the actuating arm 44 of the switch 43. Thus, the switch 43 will turn off when the force exerted by the compression spring 79 overcomes the force due to the buoyancy of the float 21. The level at which this occurs may also be changed by adjusting the screw 82.

The foregoing construction is advantageous because the switch may be removed for servicing with a minimum of time and effort. Nevertheless, the switch is protected within a liquid tight enclosure and it readily responds to a change in the position of the float.

I claim:

1. In combination, an electric motor having a housing, at least one outwardly extending boss formed on said housing, a carrying handle removably attached to said boss, said boss holding said handle in spaced relation to said housing, an on-off control switch attached to said handle and positioned between said housing and said handle, a float positioned around said motor and said switch and movably attached to said motor and to said handle in such a manner as to form a liquidtight enclosure around said motor and switch, and means attached to said float for actuating said switch upon movement of said float relative to said motor, said switch including a movable actuating arm, and said means for actuating said switch extends underneath said actuating arm and is adapted to engage said arm and force said arm upwardly upon upward movement of said float relative to said motor, said switch being operable to move said arm downwardly when said switch actuating means moves downwardly.

2. The combination of claim 1, and further including a plunger movably mounted on said handle above said actuating arm and adapted to engage said actuating arm, and biasing means mounted on said handle for forcing said plunger and hence said actuating arm downwardly.

3. The combination of claim 2, and further including

means mounted on said handle for adjusting the force applied by said biasing means.

4. The combination of claim 3, wherein said adjusting means is mounted on said handle such that it is accessible for adjustment from the outside of said handle, whereby an adjustment may be made without removing said handle.

5. In combination, an electric motor having a housing, at least one outwardly extending boss formed on said housing, a carrying handle removably attached to said boss, said boss holding said handle in spaced relation to said housing, an on-off control switch attached to said first handle, a float positioned around said motor and said switch and movably attached to said motor and to said handle in such a manner as to form a liquidtight enclosure around said motor and said switch, and means attached to said float for actuating said switch upon movement of said float relative to said motor, said float being attached to said handle by a flexible diaphragm, said diaphragm being attached at its outer periphery to said float and having a generally circular opening formed in it, said switch extending from substantially the axis of said opening to a location which is radially spaced from said axis and beyond said opening, a relatively rigid annular member attached to said diaphragm at the margin of said opening, at least one connecting means for securing said annular member to said handle, and said connecting means also attaching said handle to said boss, whereby said handle and said switch are disconnected from said motor and said diaphragm when said connecting means is removed, and the opening in said annular member being sufficiently large that said switch may be passed therethrough when said handle and said switch are tilted relative to said axis.

6. A carrying handle and switch assembly for a submersible unit including a motor and a float, said float having switch actuating means and being mounted for movement relative to said motor, said assembly comprising a handle adapted to be secured to said motor, and a switch attached to said handle and adapted to be actuated by said switch actuating means on movement of said first float relative to the motor, said assembly being adapted to be removed as a unit from said motor and float only by tilting said assembly relative to said motor and said float.

7. A carrying handle and switch assembly for a submerisble unit including a motor and a float, said float having switch actuating means and being mounted for movement relative to said motor, said assembly comprising a handle adapted to be secured to said motor, and a switch attached to said handle and adapted to be actuated by said switch actuating means on movement of said float relative to the motor, said assembly being adapted to be removed as a unit from said motor and float, said switch including an actuating arm adapted to be urged by said actuating means in one direction upon movement of the float, and further including means mounted on said handle for urging said actuating arm in an opposite direction.

8. A carrying handle and switch assembly as in claim 7, wherein said switch is a two position switch and is normally in one of said two positions, and said means mounted on said handle is adapted to urge said switch to said one position.

9. A carrying handle and switch assembly as in claim 7, wherein said switch includes a flexible actuating arm and said switch is off when said arm is in one position and on when said arm is in another position, said switch being constructed such that said arm is normally in said one position, said switch actuating means is adapted to urge said arm to said other position upon movement of said float in one direction, and said means mounted on said handle is adapted to urge said arm to said one position upon movement of said float in the other direction.

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