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(54) Titre : SYSTEME DE TRAITEMENT DE L'EAU
(54) Title: WATER TREATMENT SYSTEM

(57) Abrégé/Abstract:
A water treatment system has a battery rechargeable by a manual generator, thus eliminating the need for an external power source. The water treatment system uses the rechargeable battery to power a pump and a UV lamp. After the water passes through a filter, the UV lamp treats the water being pumped through the apparatus. The system optionally includes a flashlight, also powered by the rechargeable battery.

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(54) Title: A WATER TREATMENT SYSTEM

(57) Abstract: A water treatment system has a battery rechargeable by a manual generator, thus eliminating the need for an external power source. The water treatment system uses the rechargeable battery to power a pump and a UV lamp. After the water passes through a filter, the UV lamp treats the water being pumped through the apparatus. The system optionally includes a flashlight, also powered by the rechargeable battery.

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WATER TREATMENT SYSTEM

BACKGROUND OF THE INVENTION

The present invention relates to water treatment systems and more specifically to portable water treatment systems.

Water treatment systems may remove pathogens, chemical contaminants and turbidity from water. In some water treatment systems, a filter is used to remove particulates and an ultraviolet (UV) lamp is used to irradiate the water. A pump is often used to propel water through the systems.

The operation of such a water treatment system using a lamp requires electricity. However, water treatment systems are often needed in areas where electricity is not provided. Water treatment systems have been developed for use where electric power may not be available.

One such water treatment system is shown in U.S. Patent 4,849,100 for "Portable Water Treatment subsystem," which issued to Papandrea. The water treatment system includes a particulate filter, a UV reactor and a de-calcification unit. The system receives power from either an AC outlet or a 12 V DC power source. Although the system is relatively small, the system is transported in a disassembled state and must be assembled at the time of use. Further, the system requires a separate electric power source.

Another portable water treatment system is shown in U.S. Patent 5,900,212 for "Hand-held Ultraviolet Water Purification System," which issued to Maiden et al. The Maiden system is directed to a water treatment system having a UV lamp for treating water. The system includes a 3.4 volt rechargeable lithium battery to function as

a power source. The Maiden system is designed to provide a UV lamp that can be submerged in standing water, for example, in a canteen or bucket, to subject the water to UV light.

Although conventional portable water treatment systems are capable of removing unwanted chemicals, pathogens and other contaminants from water, they have shortcomings. First, conventional water treatment systems must be connected to a power source to provide power to the UV lamp. If the system includes a battery, the system is unusable until the battery is recharged or a new battery is obtained. Second, the units are relatively large. These systems are usually too large to fit in a conventional backpack or handbag. This can be a significant problem when a user has to transport the system a considerable distance. Finally, if the water system is connected to a battery, the battery may fail to adequately power the UV lamp such that the water is not properly irradiated.

An improved water treatment system to overcome these shortcomings is therefore highly desirable.

SUMMARY OF THE INVENTION

In a broad aspect, the present invention seeks to provide a water treatment system comprising a pump for moving water through the water treatment system, an ultraviolet transmissive reactor, an ultraviolet lamp for irradiating the water, a battery for powering the pump and the ultraviolet lamp, and a manual charger for charging the battery.

In a further aspect, the present invention comprehends a water treatment system comprising a housing, a treatment subsystem treatment section contained within the housing,, wherein the treatment subsystem treatment section includes a UV lamp. There is a battery for powering the treatment subsection treatment section, a charger contained

within the housing and connected to the battery, and a manual generator connected to the charger. There is provided a controller for regulating the operation of the water treatment system, a lamp monitor for monitoring the UV lamp coupled to the controller, a pump for moving water through the water treatment system coupled to the controller, an external power source wherein the charger is coupled to the controller and the controller selectively provides power to the charger from the external power source.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram of a water treatment system.

Fig. 2 is a flowchart showing the operation of the water treatment system.

Fig. 3 is a flowchart showing another aspect of the operation of the water treatment system.

Fig. 4 is a perspective view of a portable water treatment system according to a preferred embodiment of the present invention.

Fig. 5 is an exploded view of the water treatment system.

Fig. 6 is a cross-sectional view of the water treatment.

DETAILED DESCRIPTION OF THE DRAWINGS

Fig. 1 is a functional block diagram for water treatment system 5. Filter 10, UV transmissive reactor 14 and UV lamp 16 form treatment subsystem treatment

subsystem for water treatment system 5. Water first enters the system and passes through filter 10. Filter 10 may be any filter capable of removing contaminants from water, such as a carbon filter. Pump 12 moves the water through the system. Pump 12 is preferably a DC (direct current) pump. Pump 12 could be contained within the housing or part of the inlet assembly. After water leaves pump 12, it then passes to UV transmissive reactor 14. Light from UV lamp 16 decontaminates the water in UV transmissive reactor 14. The water then leaves the water treatment system.

Controller 18 regulates the operation of water treatment system 5. Controller 18 could be a microcontroller or a microprocessor. If controller 18 were a microcontroller, external memory and other supporting circuitry could be provided.

Controller 18 controls pump 12 so that water has sufficient time in UV transmissive reactor 14 to be irradiated. Lamp sensor 20 provides information to controller 18 as to the operational characteristics of UV lamp 16. If lamp sensor 20 detects that UV lamp 16 is not operating with sufficient intensity, controller 18 will disable pump 12 to stop further attempts to treat water. In some applications, water treatment system 5 could optionally operate without a functioning UV lamp 16, providing the user with filtered water.

Charge storage device 22, illustrated as a "battery" in Fig. 1, which could be rechargeable, provides power for water treatment system 5. Charge storage device 22 could be comprised of a dry-cell battery, a wet-cell battery, a capacitor, a super capacitor, or other electric charge storage. Charge control circuit 24 monotors charge storage device 22 as well as power source 26. Charge control circuit 24 provides information regarding the status and type of charge storage device 22 to controller 18.

Charge control circuit 24 also monitors the status of power source 26. Power source 26 could be a hand crank electric generator having a dynamo, a spring

generator, a solar power cell, fuel cell, a DC power source, or an AC power source. If excess power is available from power source 26, charge control circuit 24 determines whether charge storage device 22 could be further charged. If so, charge control circuit 24 could allow charging of charge storage device 22.

To perform this function, a memory either internal to or coupled to controller 18 could contain the power requirements to operate UV lamp 16 and pump 12. By comparing the power provided by power source 26, controller 18 can determine whether sufficient power was present to operate UV lamp 16 and pump 12 and simultaneously replenish charge storage device 22.

Controller 18 is also connected to flashlight control circuit 28. Flashlight control circuit 28 is connected to flashlight 30. If controller 18 receives a signal from, for example, one of switches 32 (described below) to energize flashlight 30, controller 18 determines whether sufficient power is available from charge storage device 22. If sufficient power is available, then controller 18 enables flashlight control circuit 28 to energize flashlight 30. If sufficient power is not available, flashlight 30 is not energized.

Display 34 provides information about the operation of water treatment system 5. Display could be a liquid crystal display (LCD), a series of light emitting diodes (LEDs), an audible enunciator, or some other device capable of providing information to a user. Display 34 is optional and can be eliminated in some applications.

Switches 32 allow a user to send a variety of commands to controller 18, such as "turn on flashlight" or "purify water." The controller can also have preset timing as to UV on-time vs. dose and the microcontroller can allow proper UV time-on before pumping water. It is known that UV intensity increases as the lamp warms up, the microprocessor can assure a better point on this curve with or without a light sensor.

Controller 18 is also coupled to lamp enable circuit 36. Lamp enable circuit 36 controls ballast circuit 38. Ballast circuit 38 is any of the many well known circuits for energizing UV lamps.

Fig. 2 shows a method of operating a water treatment system. After the system is started by the user activating switches 32, controller 18 determines whether sufficient power is present to energize UV lamp 16 and to operate pump 12 and any other devices currently operating. Step 40. If sufficient power is not present the user is notified of the lack of power and the process terminates. Step 42. The process is then ended and the display indicated this to the user. Step 56.

If sufficient power is present, then the lamp is energized. Step 44. The UV lamp output is then tested by lamp sensor 20. If the sensor is not used the design will have appropriate design margins to assume the lamp is on via current sensor and wait the designated warm up period to assure intensity level. Step 48. If the UV lamp output or lamp current is not sufficient, then the user is notified of a lamp failure. Step 50. The process is then ended. Step 56. Alternatively, a user could manually override the lamp failure and enable operation of the system.

On the other hand, if UV lamp output is sufficient, then a pump rate is calculated based upon the UV lamp output. Step 52. The pump is then energized to operate at the appropriate rate. Step 54. In one embodiment, about 8 watts of power is required to energize the lamp or 250mA for a 36 milliliter reactor at a flow rate of about .8 gallons per minutes. Slower flow rates and lower currents can be used to conserve power and extend use.

Fig. 3 shows the operation of flashlight 30. The available power is checked. Step 60. If sufficient power is available to power flashlight and any other

devices currently operating, then the flashlight is energized. Step 62. If not, then the user is notified of insufficient power. Step 64. The process then ends. Step 66.

Fig. 4 shows water treatment system 5. In the illustrated embodiment, water treatment system 5 includes inlet 101 for providing water to the system, outlet 103 for dispensing water from the system and charging crank 76 for supplying power to water treatment system 5. Case 70 and face 72 form a housing to contain water treatment system 5. Water treatment system 5 of the present invention can be manually recharged, eliminating the need for an external electric source to charge the system.

Water control switch 94 controls the pumping of water through system 10. Light switch 96 controls flashlight 72.

Fig. 5 is an exploded view of water treatment system 5. Flashlight 73 can be used independently of the other components of water treatment system 5. Case 70 could be constructed of reinforced plastic.

Face 72 includes crank cavity 74. Crank 76 is preferably housed within the crank cavity 74 when crank 76 is not in use. Crank 76 fits through port 78 to engage gears 80. Reflector 88 fits around UV lamps 83 to increase the exposure of UV transmissive reactor 14 to the output of UV lamps 83.

Charger 82 is connected to generator 84. Charger 82 could be connectable to an external AC or DC power source, such as a wall outlet, a solar cell or battery.

Generator 84 is a manually chargeable generator. Crank 76 is operationally engaged with generator 84. Generator 84 can be any conventional manual generator, such as the manual generators disclosed in U.S. Patents 6,133,642 to Hutchinson and 6,472,846 to Hutchinson et al, which may be referred to for further details.

Alternatively, the generator could be foot-actuated as well as hand cranked.

When turned, crank 76 powers generator 84. In one embodiment, generator 84 transfers a charge to charger 82, which in turn charges battery 86. In another embodiment, generator 84 could be used to directly power the system. Crank 76 can be returned to crank cavity 74 after use. Alternatively, each of these power systems may be used remotely with the water treatment system. In another alternative, crank 76 would be used to mechanically power pump 104.

Referring to Fig. 6, case 70 contains filter 102, pump 104, coil 92 and UV lamps 83. Water passes through inlet 100 and through filter 102. Filter 102 may be any filter capable of removing contaminants from water, such as a carbon filter. Water moves from filter 102 to pump 104 by way of pipe 105. Pump 104 may have different operating speeds.

Coil 92 may be directly connected to pump 104 or may be connected to pump 104 by additional tubing. Coil 92 preferably is circumferentially disposed about UV lamps 83. Coil 92 can be constructed of any UV transparent material, such as soft glass, Quartz or polytetrafluoroethylene (more commonly known as Teflon™). Reflector 88, shown in Fig. 5, may be used to increase the exposure of the water in coil 92 to the light from UV lamps 83.

UV lamps 83 are connected to ballast 90. Controller 108 is connected to ballast 90 and controls the powering of UV lamps 83. To control the water passing through the system, controller 108 is also connected to pump 104. Controller 108 may be connected to flashlight 73.

Controller 108 preferably is connected to water control switch 94 and light switch 96 located on case 70. Switches 94, 96 allow the user to select between two or more operation modes. Switches 94, 96 could be moved between multiple operation modes.

For example, system 5 could additionally operate as a night light, or emergency flasher.

Controller 108 preferably is programmed to distribute power appropriately between flashlight 73, pump 104, charger 82 and UV lamps 83. Controller 108 could distribute necessary power to all of the devices, or it could power devices based upon their priority.

Water control switch 94 would signal the controller 108, which in turn would signal pump 104 to pump water. Similarly, light switch 96 has at least an "on" position and an "off" position. If flashlight 73 includes multiple lights or multiple modes, such as a flash mode, light switch 96 may include positions to actuate these alternative functions.

Flashlight 73 could be connected to a light control circuit. The light control circuit may be programmed to power light 110 in multiple modes, such as a flash mode. Alternatively, the light control circuit could power a plurality of lights.

Inlet tube 101 is placed in a water source such as a stream, a pond, a lake, a river, or any other source of water, including a sink or bathtub containing water. Pump 104 draws the water through inlet tube 101 into filter 102. The pump may also be located within or at the end of the inlet tube. Filter 102 removes contaminants from the water. Water is then pumped through coil 92, exposing the water to UV light from UV lamps lamp 83. The UV lamps deactivate microorganisms and bacteria in the water.

If pump 104 has variable speeds, the user selects the pump speed using the water control switch 94. The water is dispensed via outlet tube 103.

The above description is of the preferred embodiment. Various alterations and changes can be made without departing from the spirit and broader aspects of the invention as defined in the appended claims, which are to be interpreted in accordance

with the principles of patent law including the doctrine of equivalents. Any references to claim elements in the singular, for example, using the articles "a", "an", "the", or "said", is not to be construed as limiting the element to the singular.

WHAT IS CLAIMED IS:

1. A water treatment system comprising:

a pump for moving water through the water treatment system;

an ultraviolet transmissive reactor;

an ultraviolet lamp for irradiating the water;

a battery for powering the pump and the ultraviolet lamp;

a manual charger for charging the battery; and

a controller coupled to the pump and the battery, whereby the controller prohibits energizing the pump if the battery has insufficient power to energize the ultraviolet lamp at a desired intensity.

2. The water treatment system of claim 1 further comprising a lamp sensor for sensing light from the ultraviolet lamp.

3. The water treatment system of claim 2 further comprising a ballast circuit for energizing the ultraviolet lamp.

4. The water treatment system of claim 3 further comprising an enable circuit for energizing the ballast circuit.

5. The water treatment system of claim 4 further comprising a battery monitor circuit, the battery monitor circuit coupled to the battery and the controller.

6. The water treatment system of claim 5 further comprising a flashlight.

7. The treatment system of claim 6 further comprising a flashlight control circuit for energizing the flashlight.

8. The water treatment system of claim 7 further comprising a filter.

9. The water treatment system of claim 8 further comprising a battery charge circuit responsive to an external power source to allow charging of the battery by the external power source if the battery is below a maximum charge.

10. The water treatment system of claim 9 where the battery charge circuit prohibits further charge of the battery if the battery is at the maximum charge.

11. The water treatment system of claim 10 where the controller enables the flashlight control circuit to energize the ultraviolet lamp if the external power source is operational.

12. The water treatment system of claim 11 wherein the pump has variable speeds.

13. A water treatment system comprising:

a housing;

a treatment subsystem treatment section including a UV lamp contained within the housing;

a pump for moving water through the water treatment system;

a battery for powering the treatment subsystem treatment section and the pump;

a charger contained within the housing and connected to the battery; and

a manual generator connected to the charger;

characterized in that the battery is also arranged to power the pump, wherein manual operation of the manual generator charges the battery to provide power to both the treatment subsystem treatment section and the pump.

14. The water treatment system of claim 13 further comprising:

a controller for regulating the operation of the water treatment system.

15. The water treatment system of claim 14 further comprising:

a lamp sensor for monitoring the UV lamp wherein the lamp monitor is coupled to the controller.

16. The water treatment system of any one of claims 13 to 15 further comprising:

an external power source.

17. The water treatment system of any one of claims 13 to 16 wherein the charger is coupled to the controller.

18. The water treatment system of claims 16 and 17 wherein the controller is arranged to selectively provide power to the charger from the external power source.

19. The water treatment system of claim 13 wherein the manual generator includes a dynamo.

20. The water treatment system of claim 13 wherein the manual generator includes a spring generator.

21. The water treatment system of claim 14 wherein the controller is arranged to prohibit energizing the pump if the battery has insufficient power to energize the UV lamp at a desired intensity.

22. The water treatment system of claim 21 further comprising:

a ballast circuit for energizing the UV lamp.

23. The water treatment system of claim 22 further comprising:

an enable circuit for energizing the ballast circuit.

24. The water treatment system of claim 23 further comprising:

a battery monitor circuit, the battery monitor circuit coupled to the battery and the controller.

25. The water treatment system of claim 24 further comprising:

a flashlight.

26. The water treatment system of claim 25 further comprising:

a flashlight control circuit for energizing the flashlight.

27. The water treatment system of claim 26 further comprising:

a filter.

28. The water treatment system of claim 27 further comprising:

a battery charge circuit responsive to an external power source to allow charging the battery by the external power source if the battery is below a maximum charge.

29. The water treatment system of claim 28 where the battery charge circuit is arranged to prohibit further charge of the battery if the battery is at the maximum charge.

30. The water treatment system of claim 29 where the controller is arranged to enable the flashlight control circuit to energize the UV lamp if the external power source is operational.

31. The water treatment system of claim 30 where the pump has variable speeds.

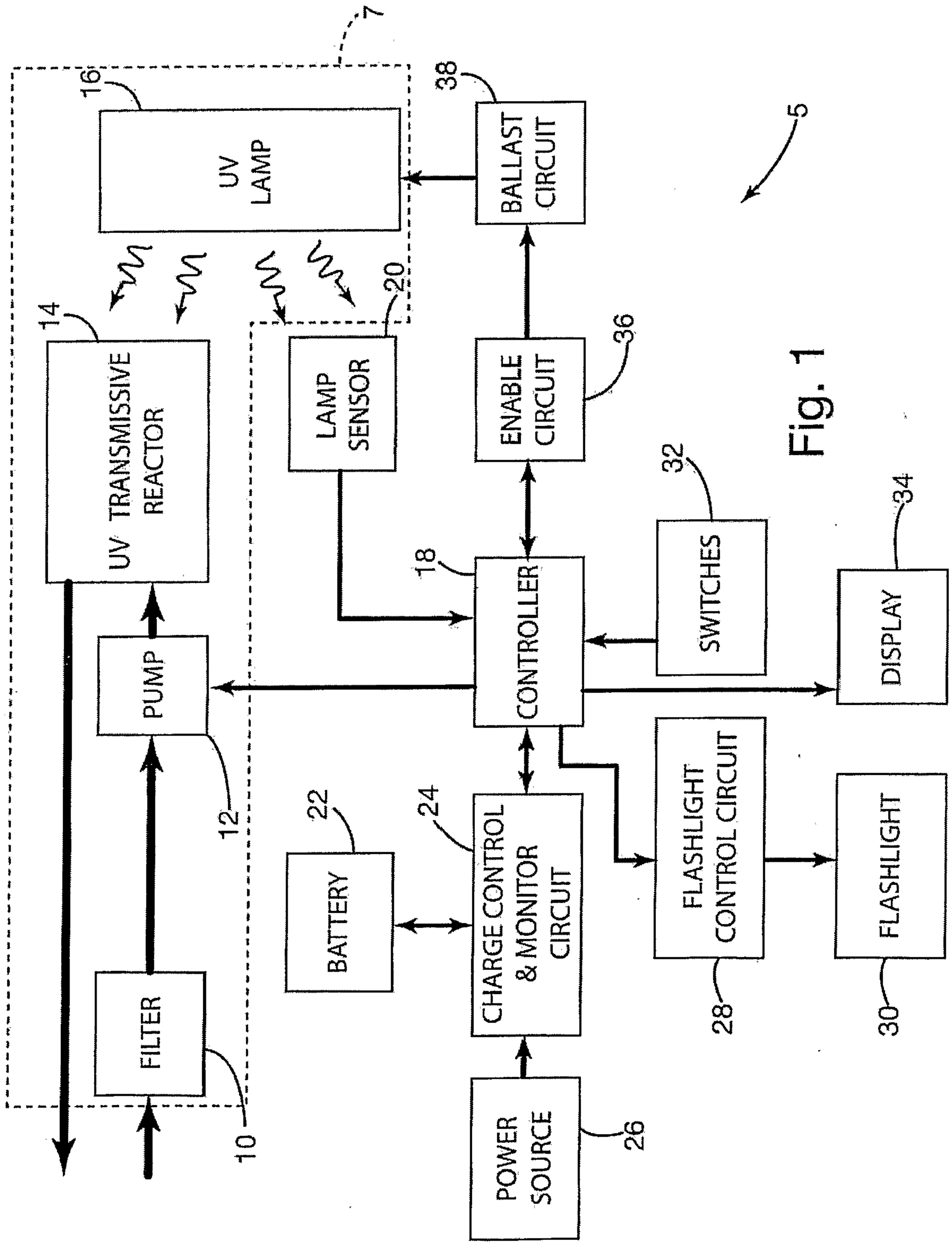
5
7
UV LAMP
16
BALLAST CIRCUIT
38
14
20
UV TRANSMISSIVE REACTOR
LAMP SENSOR
ENABLE CIRCUIT
36
18
CONTROLLER
SWITCHES
32
DISPLAY
34
PUMP
12
22
24
BATTERY
CHARGE CONTROL & MONITOR CIRCUIT
FLASHLIGHT CONTROL CIRCUIT
28
FLASHLIGHT
30
FILTER
10
POWER SOURCE
26

Fig. 1

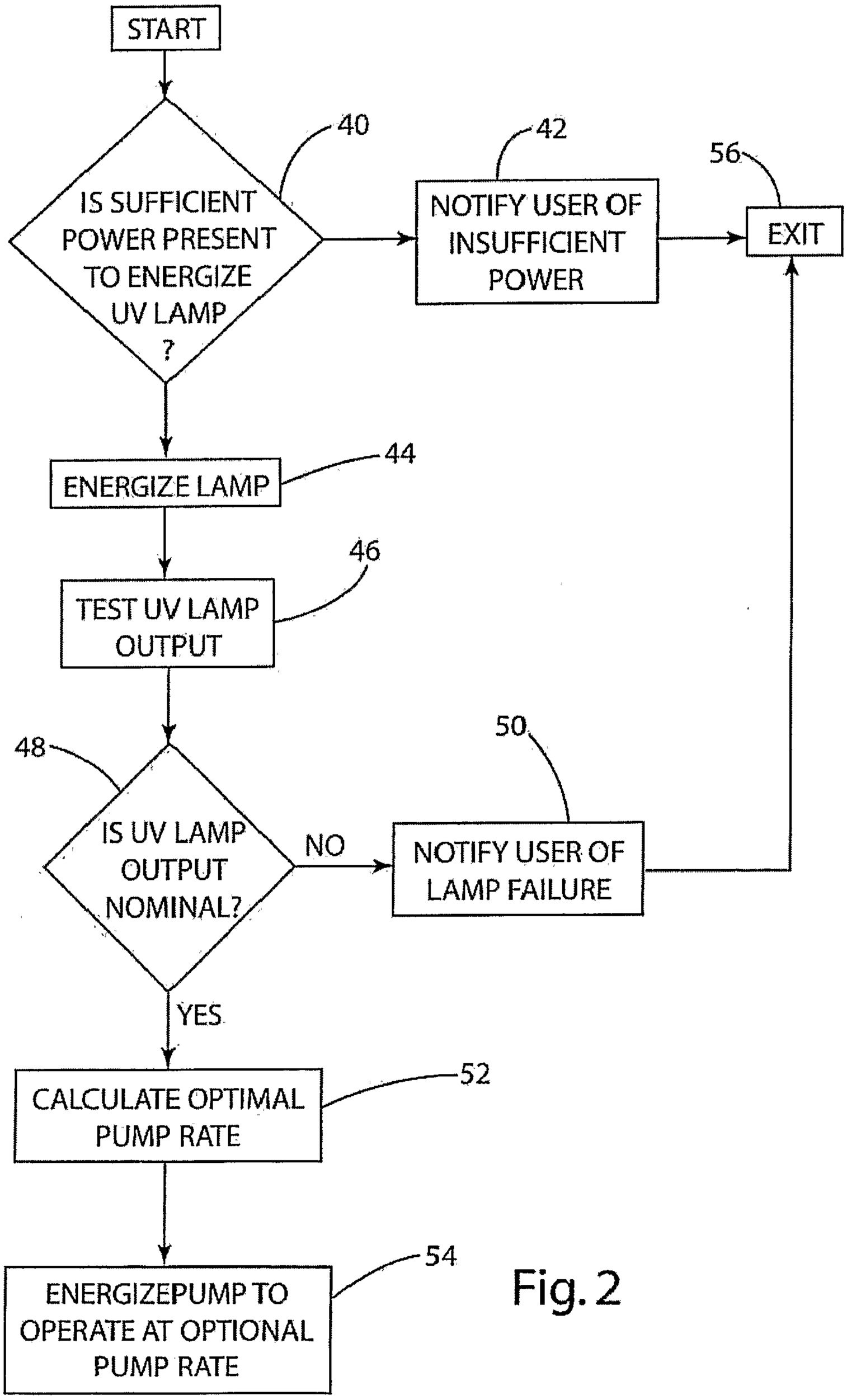
START
IS SUFFICIENT POWER PRESENT TO ENERGIZE UV LAMP ?
40
NOTIFY USER OF INSUFFICIENT POWER
42
EXIT
56
ENERGIZE LAMP
44
TEST UV LAMP OUTPUT
46
IS UV LAMP OUTPUT NOMINAL?
48
NO
NOTIFY USER OF LAMP FAILURE
50
YES
CALCULATE OPTIMAL PUMP RATE
52
ENERGIZEPUMP TO OPERATE AT OPTIONAL PUMP RATE
54

Fig. 2

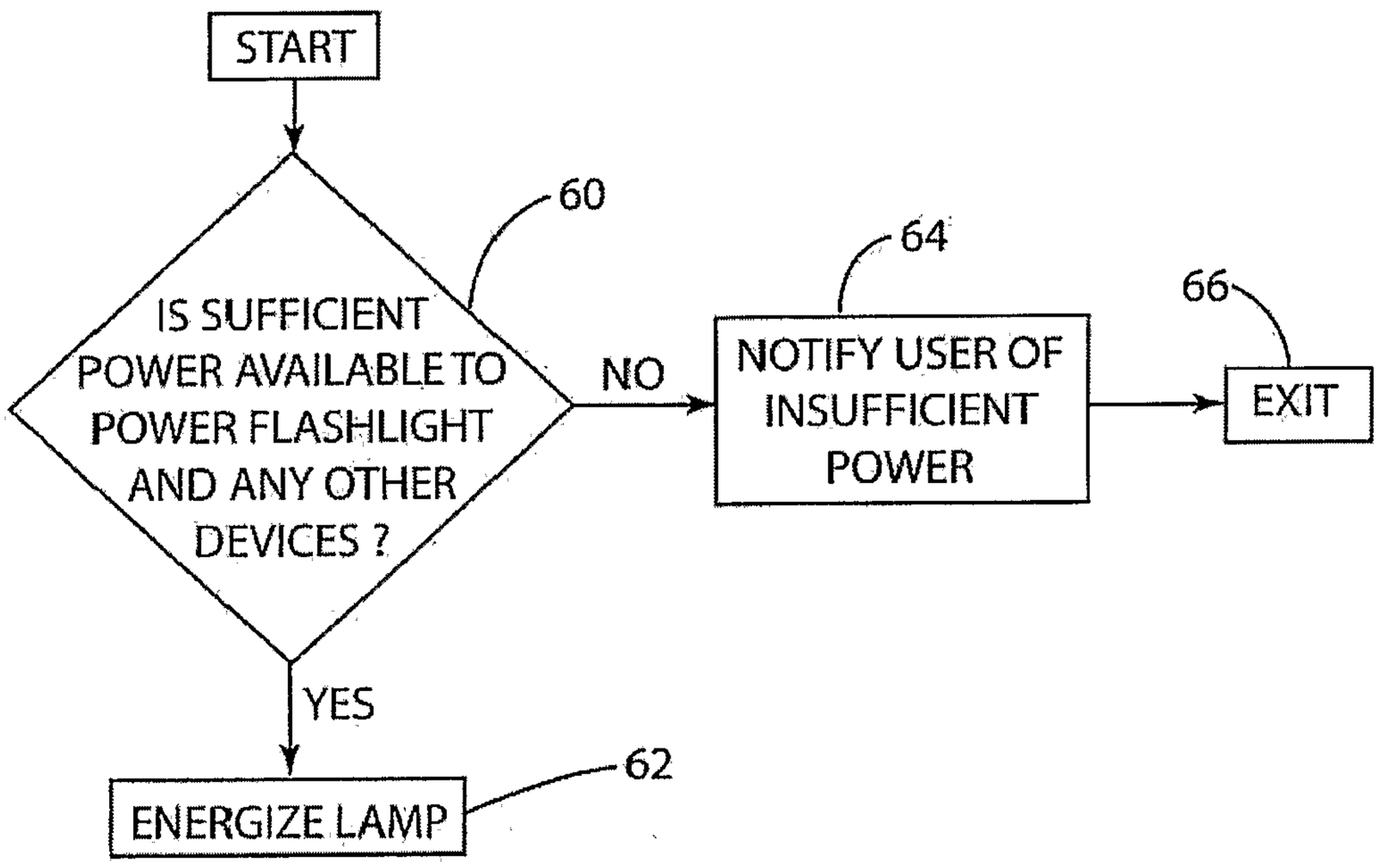
START
60
IS SUFFICIENT POWER AVAILABLE TO POWER FLASHLIGHT AND ANY OTHER DEVICES ?
NO
64
NOTIFY USER OF INSUFFICIENT POWER
66
EXIT
YES
62
ENERGIZE LAMP

Fig. 3

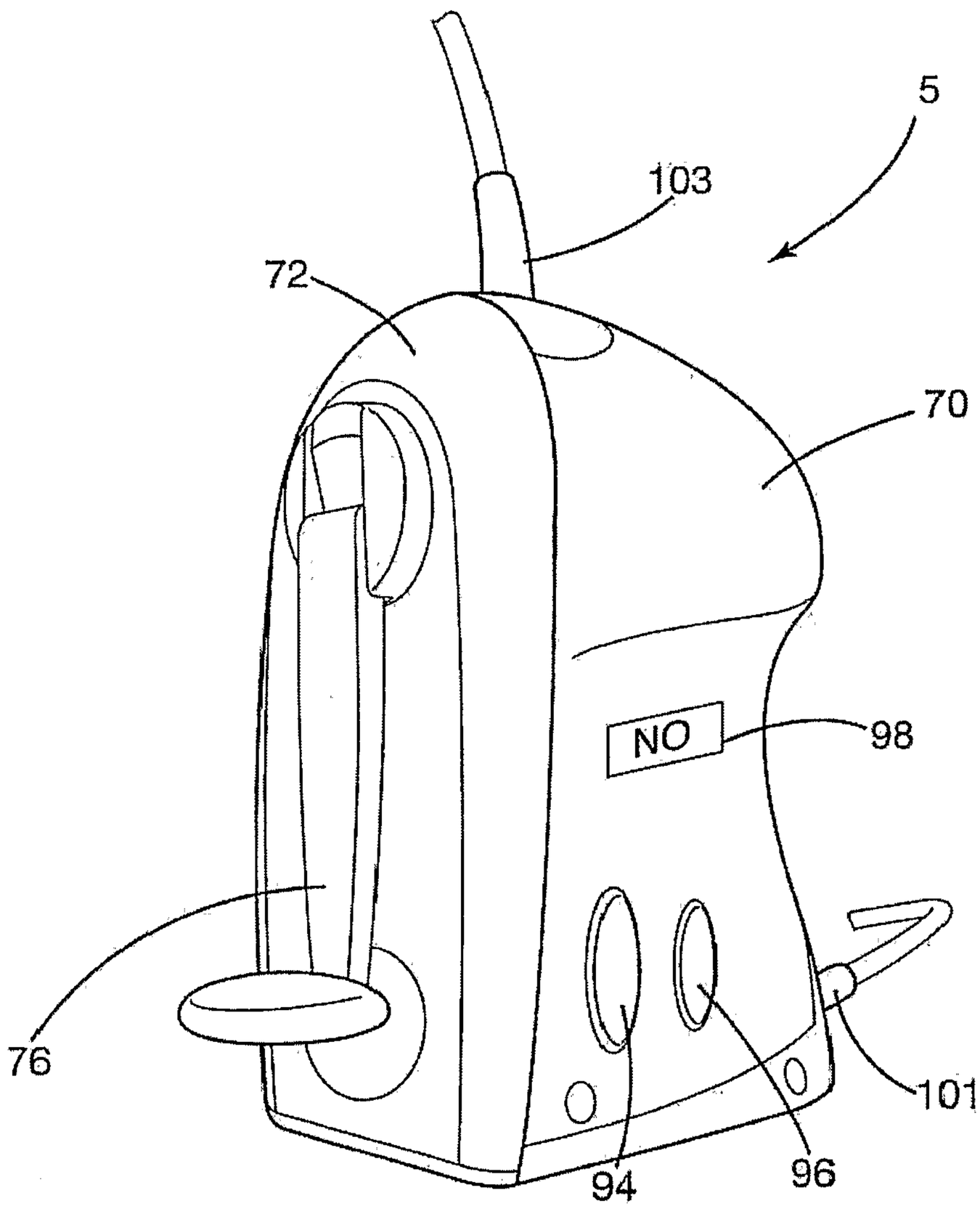

Fig. 4

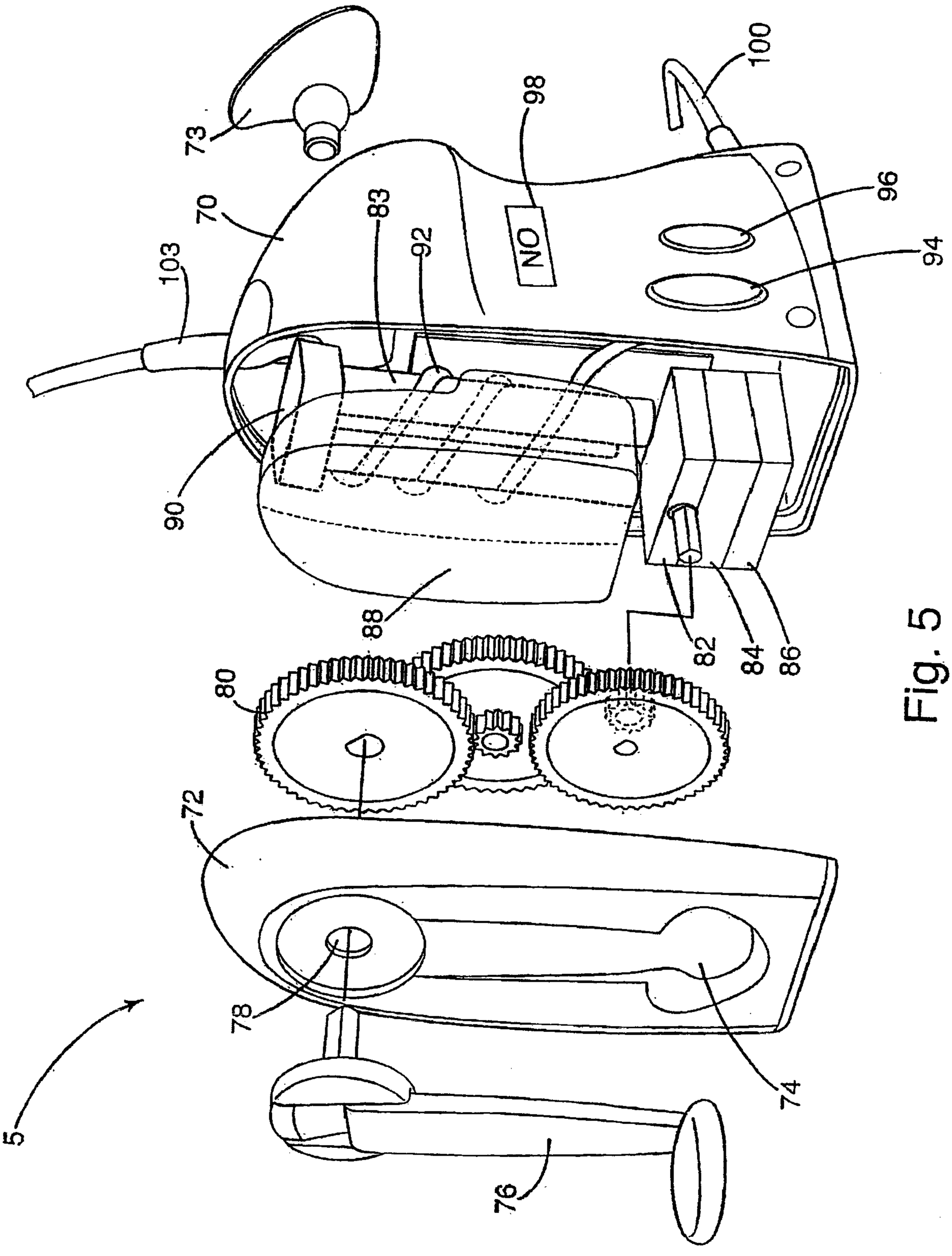

Fig. 5

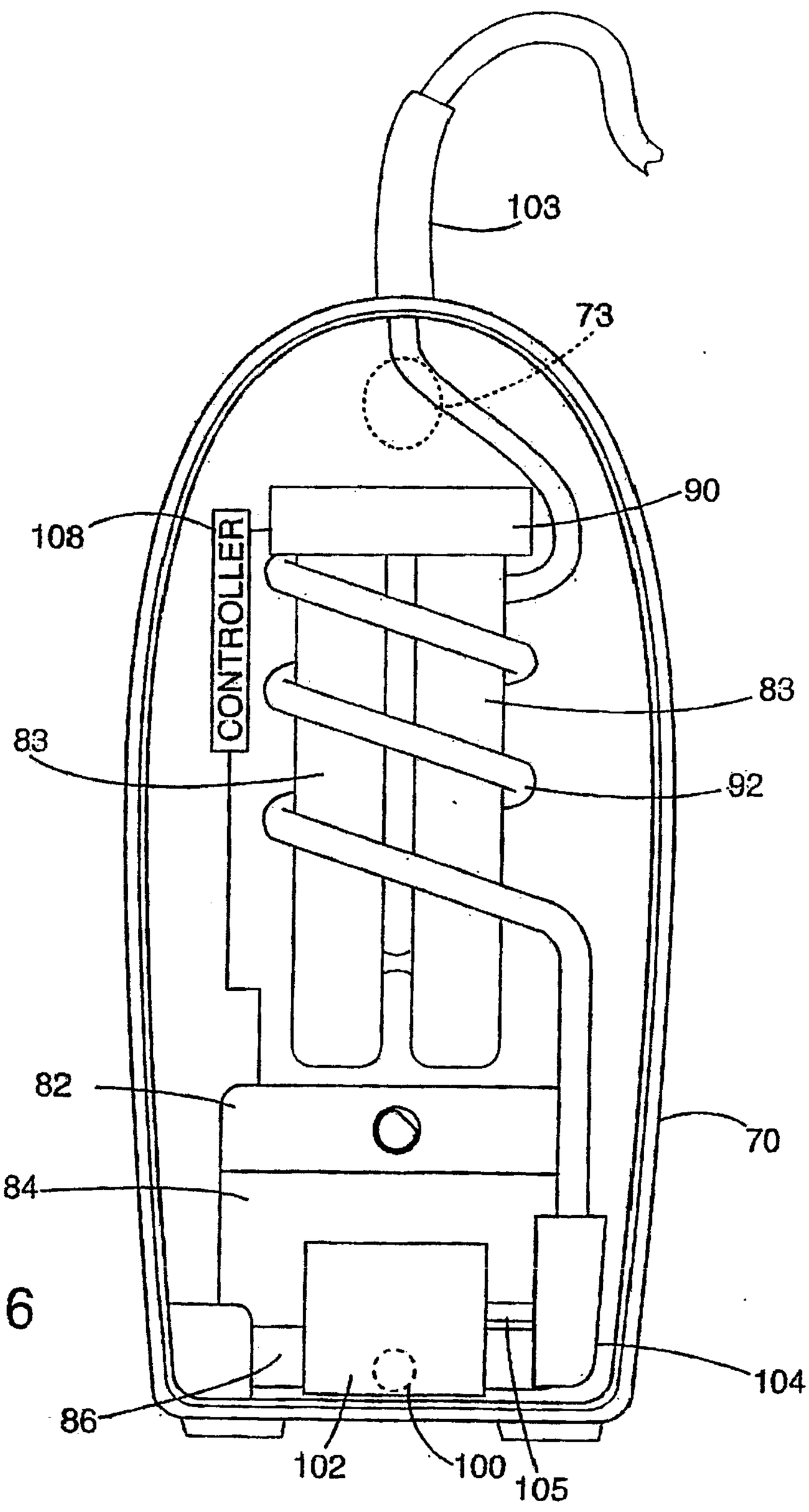

Fig. 6