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HIGH WATER ALARM FOR DRAINAGE SUMP

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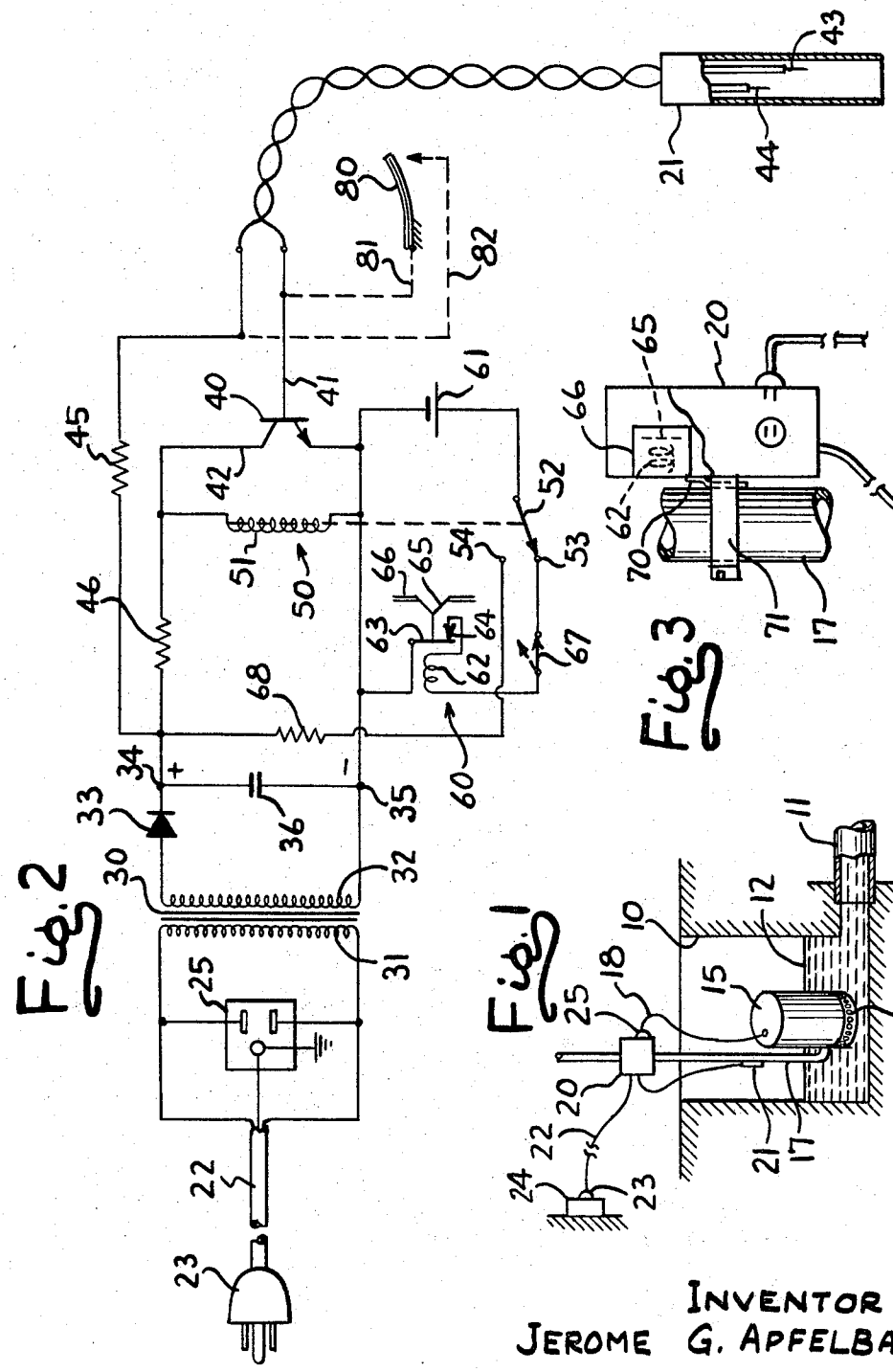


Fig. 2

Fig. 3

Fig. 1

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HIGH WATER ALARM FOR DRAINAGE SUMP

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ABSTRACT OF THE DISCLOSURE

A high water alarm for a sump pump including a relay, normally energized by the regular A.-C. supply line, which is dropped out to complete a circuit including a buzzer alarm and a battery by reason of a rise in water level or by reason of failure of the supply line voltage. Means are provided for maintaining the battery constantly in condition to operate the buzzer alarm and for transmitting the vibrations from the buzzer alarm through the connected piping.

A householder who places reliance on a sump pump to operate without maintenance over a long period of time invites the trouble and expense of a flooded basement. It is an object of the present invention to provide an alarm for use with a sump pump which reponds to any increase in water level above the point for which the pump has been set so that the householder is alerted before flooding can occur. It is also an object of the present invention to provide an alarm device which is sensitive and positive in operation, being directly actuated by conduction through the water, and which does not, therefore, have to rely upon floats or other mechanically operated switching devices.

It is a further object of the invention to provide an alarm device for sump pump installation which is fail-safe and which sounds an alarm not only on an abnormal rise in water level but upon failure of electrical power for any reason whatsoever. In this connection it is an object to provide an alarm for a sump pump or the like in which the alarm device does not rely upon power from the usual A.-C. outlet but in which the alarm device is driven by a self-contained battery which is at all times maintained in a condition of readiness. It is more specifically an object of the invention to provide an alarm of the type described which has provision for applying a trickle charge to the battery at all times and which achieves a long useful life using either a miniature storage battery or a dry cell.

It is yet another object of the present invention to provide an alarm for a sump pump installation or the like in which the alarm device, although of limited power input, is nevertheless effective to sound the alarm beyond the immediate vicinity of the pump and in which the alarm signal is transmitted, in audible form, throughout the house via the plumbing system.

It is still another object of the present invention to provide an alarm for a sump pump which is compact and easily installed by the householder in a few minutes time without necessity for special knowledge or tools and the efficacy of which can be easily checked by the householder at the time of installation or from time to time thereafter.

Other objects and advantages of the invention will be apparent upon reading the attached detailed description of the invention and upon reference to the drawing in which:

FIGURE 1 is a diagram showing a typical sump pump installation employing an alarm constructed in accordance with the present invention.

FIG. 2 is a schematic diagram showing the circuit components and connections.

FIG. 3 is a fragmentary view, in partial section, showing the manner in which the alarm enclosure is secured to the associated piping.

Turning now to the FIGURE 1 there is shown a sump **10** having an inlet connection **11** receiving water from a drainage system, for example, drainage tiles encircling a building foundation. In the usual sump installation the rate of entry of water depends upon outside conditions but there is almost always casual drainage causing the water level **12** to rise. Suspended within the sump is a sump pump **15** of the submersible type having an inlet **16** and a discharge pipe **17**. The power is supplied to the pump via a supply line **18**, and self-contained means (not shown) are provided for turning the pump on and off in response to changes in water level. For example, in one popular type of pump the outside housing or shell is floatingly mounted and serves to operate an on-off switch by means of buoyancy. It will be understood, however, that the present alarm is not limited to use with any particular type of sump pump and may be employed wherever it is necessary to detect an abnormal rise in water level.

In the present embodiment of the alarm all the main parts are included within a compact metal enclosure **20** having a level detecting probe **21** and with power being furnished through a supply line or "cord" **22** terminating in a plug **23** which is plugged into a regular electrical outlet, or "wall socket" **24**. A socket **25**, connected to the cord **22**, is preferably provided in the wall of the enclosure for plugging in a cord **18** which supplies power to the pump motor.

Turning next to FIG. 2 the A.-C. line voltage is stepped down by means of a small transformer **30** having a primary winding **31** and a secondary winding **32**. The output voltage is rectified by a rectifier **33** having D.-C. positive and negative output terminals **34** and **35** shunted by a capacitor **36** to reduce the amount of ripple. D.-C. voltage from the rectifier serves to energive a solid state device **40** which may be an inexpensive NPN transistor having a base input circuit **41** and emitter-collector output circuit **42**. The base is connected to an electrode **43** in the probe **21**. A companion electrode **44** is connected through a resistor **45** to the positive D.-C. terminal **34**. The output circuit **42** of the transistor is connected to the D.-C. terminals with an interposed voltage dropping resistor **46** in the collector leg. Using a conventional (non-power) transistor, and with a D.-C. supply voltage on the order of 10 volts, the resistor **45** may have a resistance on the order of one thousand ohms and the resistor **46** may have a resistance on the order of one hundred ohms.

In accordance with the present invention a relay is connected in the circuit in such a way that when the transistor is non-conducting the relay is held in and when the transistor becomes conducting the relay is dropped out thereby to complete a connection between an alarm device and the self-contained battery for the purpose of sounding the alarm. More specifically in accordance with the invention the coil of the relay is connected in shunt with the collector-emitter output circuit of the transistor so that when the transistor is turned "on," drawing current to saturation, the coil is effectively short circuited and with sufficient voltage drop in the voltage supply to insure dropout of the relay. In the present instance the relay, indicated at **50**, has a coil **51**, an armature **52**, a normally-closed contact **53**, and a normally-open contact **54**. The resistance of the relay coil **51** is preferably about 50 times higher than the resistance of the output circuit of the transistor under conditions of current saturation and the resistance of the dropping resistor **46** is sufficient to drop the voltage on the relay, during transistor conduction, to about 5 percent of the normal value.

In carrying out the invention, the normally closed con-

tact is utilized to close a circuit between a vibratory alarm device **60** and a battery **61**. The alarm device has a coil **62** and a vibratory armature **63** operating a pair of normally closed contacts **64**. The armature is connected to a vibrating diaphragm **65** which is anchored in a small housing **66**. It will be recognized by one skilled in the art that the armature, acted upon by the coil **62** causes a rapid make and break at the contacts **64** producing vibration of the diaphragm **65**. The device **60** is preferably of the type widely used as a bicycle horn, capable of producing vibration and piercing sound even when energized by a low voltage battery, for example, a single size "D" flashlight cell having a voltage of one and a half volts. A disabling switch **67** connected in series with the coil **62** is provided to prevent sounding of the alarm prior to installation.

For the purpose of maintaining the battery **61** in a freshly charged condition of readiness at all times, the normally-open contact **54** on the relay is connected to the positive voltage terminal **34** via a current limiting resistor **68** which may, for example, have a resistance on an order of one thousand ohms. The battery **61** may be a small storage battery of the size and shape of an ordinary dry cell, or a dry cell may be used, in which case the current not only maintains the cell in a condition of readiness but tends to overcome deterioration and the developing of high internal resistance which occurs in the usual dry cell upon passage of time. Utilizing a conventional size "D" dry cell with a continually applied but exceedingly small trickle charge, it is found that reliable operation of the alarm **60** may be achieved on a stand-by basis for up to a year or even longer. Thus the user needs to change batteries only infrequently, achieving reliability on the order of that provided by a constantly charged storage battery but at negligible expense.

While the operation will be apparent to one skilled in the art based upon the above description, it may be summarized briefly as follows: The alarm is plugged into the wall socket and the cord from the sump pump is plugged into the receptacle **25** forming a part of the alarm device. With the alarm circuit energized, the relay **50** is picked up, closing the normally open contact **54** and connecting the battery **61** to the charging circuit. Any abnormal rise in water level causes the water to bridge the electrodes **43**, **44** in the probe, applying a positive voltage to the base or input circuit of the transistor, causing the transistor to conduct saturation current. The device is highly sensitive so that even relating pure, fresh water of low ionic content is sufficient to trigger the flow. This not only causes diversion of the current from the relay coil by its short circuiting effect, but the transistor draws sufficient current so that a substantial voltage drop occurs in the dropping resistor **46** thus reducing the voltage across the terminals of the relay coil to below the level required for hold-in. Thus the relay drops out, closing the normally closed contact **53** and connecting the battery **61** to the alarm device **60** to sound the alarm.

In accordance with one of the aspects of the invention a direct vibration-transmitting connection is made between the alarm device and the metal wall of the enclosure **20** so that the entire enclosure becomes a sound transmitter. Still further in accordance with the invention means are provided on the enclosure for making a direct vibration-transmitting connection to the piping associated with the sump pump. Thus as shown in FIG. 3, the housing has a mounting clip **70** which may be connected by a strap **71** to the discharge pipe **17** leading upwardly from the pump. It is found that the vibrations originating in the device **60** are ecectively transmitted through the plumbing system so that the alarm is audible even at remote locations. Experience has shown that it is not necessary to make any direct connection to the armature **63**, which would create a loading too heavy to be carried by the battery **61**, but on the contrary it seems to be sufficient to make good physical contact between the housing **66** of the vibrating device and the enclosure **20** of the alarm as a whole. Moreover, it is found that sound generated by the diaphragm **65** is not substantially muffled by the enclosures since the thin walls of the enclosure tend to act as a sounding board. Thus the alarm operates efficiently not only as a direct sound producer but indirectly as a vibration producer to produce the vibrations travelling throughout the plumbing system.

It is one of the features of the invention that the alarm not only signals a rise in water level but failure of power from the regular electrical supply lines. It sometimes happens that sump pumps are temporarily disconnected at the wall socket in order to plug in lights or power tools and the user neglects to make the reconnection. Such inadvertency is impossible with the present alarm. Moreover the alarm protects against accidental pulling of the plug **23** from the wall socket, for example by a child. In order to insure that this fail-safe feature is continuously active and available means may be provided, at the option of the user, for maintaining the plug on the cord **18** from the sump pump permanently secured in the receptacle **25**.

While the above device has been particularly described in connection with a water level alarm, it will be apparent to one skilled in the art that it is not limited to this use and may be utilized to signal other emergency conditions by providing auxiliary thermostats or switches. For example a thermostat **80** may be provided in a food freezer and connected by light lines **81**, **82** to suitable input terminals. When the input circuit is closed by a abnormal rise in freezer temperature, the alarm is sounded and the user can then determine and correct the emergency condition. Thus freezer protection is provided at the nominal additional cost of the thermostat and a pair of connecting lines.

In the following claims the term "probe" is intended to cover any remote device capable of making electrical contact in an emergency condition. The term "spaced electrodes," as applied to the probe, shall be considered to mean electrodes spaced at any distance; for example, a probe may be used having but a single electrode, with a ground connection serving as the opposite electrode. The term "saturation resistance" shall be understood to be that resistance exhibited by the output circuit of the transistor when the transistor is carrying saturation current. The term "wall socket" refers to any domestic A.-C. outlet.

Although the invention has been described in connection with an audible alarm, it is contemplated that the relay switch terminals **52**, **53** may be connected, if desired, to control a visual alarm, for example, a lamp which may be remotely located in a position easily seen. The lamp may, for example, be viewed by neighbors when the owners are away. Conveniently, an auxiliary set of normally closed contacts may be provided on the relay **50** to accomplish this, in which case a convenient A.-C. receptacle may be utilized as the current source in lieu of the battery **61**.

I claim as my invention:

1. An alarm for use with a sump pump or the like connected to an A.-C. source, comprising, in combination, a transistor having an input circuit and an output circuit, means including a probe having spaced electrodes controllingly connected to the transistor input circuit, means including a rectifier and series dropping resistor connected to the A.-C. source for energizing the transistor output circuit, a relay having a coil and a set of normally-closed contacts, a buzzer alarm having a battery in series therewith connected to the normally-closed contacts, the relay coil being connected in parallel with the transistor output circuit and subject to the voltage from the rectifier so that upon failure of the A.-C. source the relay drops out producing closure of the normally closed contacts and energization of the buzzer alarm, said coil having a resistance which is relatively high compared to the saturation resistance of the transistor so that upon closure of the

circuit in the probe the voltage at the coil is reduced to below the dropout value producing closure of the normally-closed contacts and energization of the buzzer alarm, said relay having a set of normally open contacts connected to the battery and rectifier means so that charging current flows to the battery during the time that the relay is energized to insure that the battery is in charged condition capable of operating the buzzer alarm upon dropout of the relay.

2. An alarm for use with a sump pump having a discharge pipe and powered from an electrical wall socket, the combination comprising a metal enclosure, a supply line leading to the enclosure and having a plug for plugging into the electrical wall socket, a transistor having an input circuit and an output circuit, means including a probe having spaced electrodes controllingly connected to the transistor input circuit, means including a rectifier coupled to the supply line for energizing the transistor output circuit, a relay having a coil and a set of normally-closed contacts, a buzzer alarm having a battery in series therewith connected to the normally-closed contacts, the relay coil being coupled to the transistor output circuit

so that upon (a) failure of voltage in the supply line due to dislodgement of the plug from the electrical wall socket or the like or (b) closure of the transistor input circuit by the probe, the relay is dropped out causing energization of the buzzer alarm, the buzzer alarm being secured to the wall of the enclosure and the enclosure having means for clampingly mounting the same on the discharge pipe for audible transmission through the pipe of vibrations originating in the buzzer alarm.

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