Oct. 19, 1971 MASUO ICHIMORI ET AL 3,613,124

AUTOMATIC WATER-SUPPLY APPARATUS

Filed Aug. 26, 1969

FIG. 1

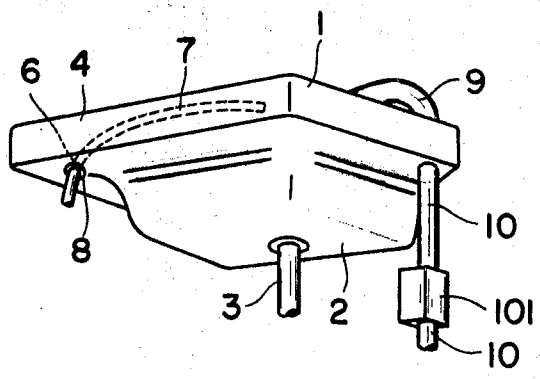


FIG. 2

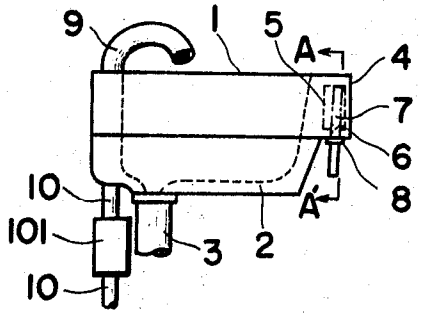


FIG. 3

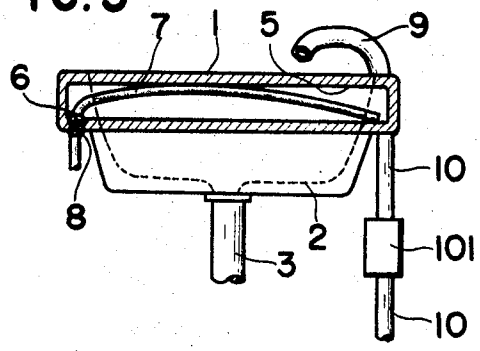


FIG. 4

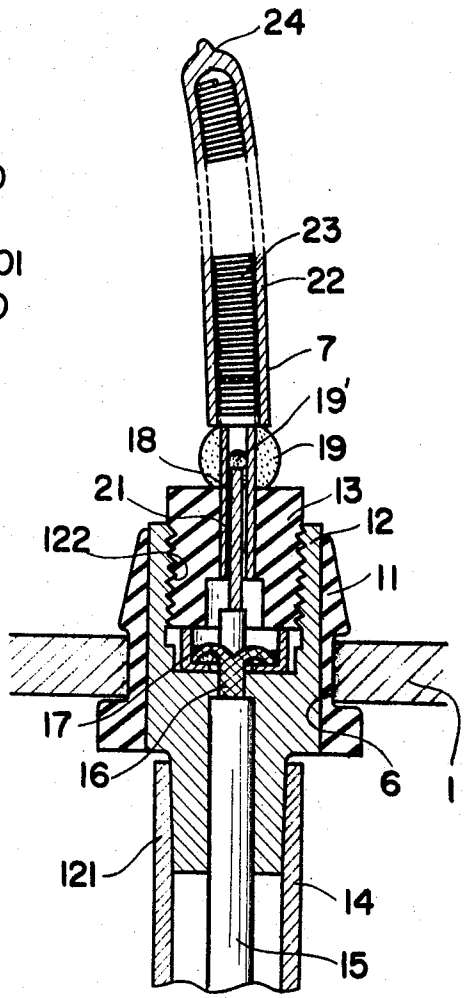
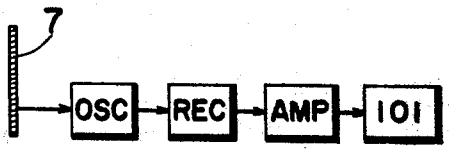


FIG. 5



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AUTOMATIC WATER-SUPPLY APPARATUS

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U.S. Cl. 4—166 13 Claims

ABSTRACT OF THE DISCLOSURE

An automatic water-supply apparatus, in which the water-supply to a basin is automatically controlled by the mere proximity to the basin of a human body, operating by means of a proximity switch to switch an electromagnetic valve in the event of proximity of a human body to an antenna; the antenna is made of a resilient metal rod for insertion into a cavity in the brim of the basin through a hole provided in the brim; the cavity is preferably provided in the front brim of the basin, that is, on the side the human thighs approach when using the basin.

The present invention relates to an automatic water-supply apparatus which is controlled in dependence of the proximity to the water basin of a human being using the basin.

An automatic water-supply apparatus for automatically supplying washing water to a basin when a hand is positioned in the basin is known as such in the prior art. In such a conventional prior art apparatus, an antenna for detecting the proximity of a hand, usually made of a metal plate, is located behind the basin and near the faucet. Because such antenna is a separate body and is placed near the basin by means of a clamping piece, such as a band wound around the water-supply tube, the conventional apparatus has the drawback that such an antenna requires a delicate adjustment in the location thereof so as to enable an electromagnetic water-supply valve to operate properly. Such adjustment of the antenna location is not an easy job for an ordinary plumber or water-works worker. Moreover, such conventional antenna entails the further drawback of being liable to deviate from its proper position when accidentally touched. There exists in the prior art another type of conventional antenna for such automatic water-supply apparatus, which is a metal plate or a metal bar fixed underneath the front part of a basin by means of a binding agent. This kind of antenna has the drawback that its Q-value is low on account of the existence of electric leakage between the moist basin and the antenna bound onto it. Moreover, in an automatic water-supply apparatus, the metal plate type antenna is basically not preferred because such antenna naturally has a large capacity, disadvantageous to the detection of a nearing or approaching object by means of the resulting capacity change.

Accordingly, it is an object of the present invention to provide an improved automatic water-supply apparatus. More particularly, this invention purports to provide an automatic water-supply apparatus capable of performing precise detection of the approach or proximity of a human body, in which an antenna can be safely and rigidly fixed to the basin to ensure stable detecting sensitivity, and this installation work can be easily done by any person having no special knowledge of electrical engineering.

Further objects and advantages of this invention will become more obvious from the following detailed description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a perspective view of the basin provided with an antenna, a water-supply tube, an electromagnetic valve, a faucet and a drain tube in accordance with the present invention,

FIG. 2 is a side view of the basin shown in FIG. 1,

FIG. 3 is a cross-sectional front elevation view of the basin taken at line A—A of FIG. 2,

FIG. 4 is an enlarged cross sectional view of the antenna and its fixing means in accordance with the present invention, and

FIG. 5 is a block diagram of the electric system used with the automatic water-supply system of the present invention.

Referring now to the drawings, a preferred embodiment of this invention will be described hereinafter; however, this description shall be understood as an illustration of the invention and not as limiting it to the particular construction shown and described.

A basin **1** comprises a bowl **2** and a surrounding brim **4** provided with a cavity **5** in the front part thereof. A drain tube **3** is connected at the bottom of the bowl **2**, and a faucet **9** is provided on the rear part of the basin **1**. A water-supply tube **10** is connected to the faucet **9**, and an electromagnetic valve **101** of conventional construction is inserted in the water supply tube **10**. Through an opening **6** located underneath the front part of the brim **4** and leading to the cavity **5** in the brim **4**, an antenna **7** is inserted into the cavity **5**, and is fixed by a fixing means generally designated by reference numeral **8** to the opening **6** of the basin **1**. The antenna **7** is a resilient metal rod which can be easily inserted through the opening **6** into the cavity **5**. Such resilient metal rod may be a non-coiled brass rod or a piano-wire, respectively, having a diameter of 0.5 to 3 mm., or a coiled rod made by densely coiling a finer brass wire or a finer piano-wire so as to form a coiled rod having an outer diameter of about 5 mm. The antenna **7** shall preferably be covered by an insulating and waterproof sheath so as to obtain a high Q-value by insulating the antenna **7** from the moist inner walls of cavity **5** of the basin **1**. The fixing means **8** fixes the antenna **7** to the basin **1**, as shown in FIG. 4, which illustrates an example of an antenna of densely coiled wire type and its fixing means. As shown in this figure, the antenna **7** is made of a coil **23** of brass wire which is coiled so densely that neighboring loops of the coil **23** are electrically conductively connected to adjacent loops and that no inductance is formed in the coil **23**. The coil **23** is preferably sheathed in polyethylene tube **22**. The end-tip **24** of the tube **22** is preferably sealed to avoid any admission of humidity into the coil **23**. The antenna **7** is fixed by solder **19** to the tip of a connecting tube **21** inserted therein, and the connecting tube **21** is supported by a nut **13** of insulating material. The nut **13** is screwed into a threaded hole **122** of a supporting member **12** made of metal. The supporting member **12** is tightly enclosed by a bushing **11** of rubber which is fixed in the opening **6** of the basin **1** as shown in FIG. 4. A shielding tube **14** is fixed on the tapered end **121** of the supporting member **12** so as to shield a coaxial cable **15** which connects the antenna **7** to the electric circuit (not shown in FIG. 4). An inner conductor **18** of the coaxial cable **15** is electrically connected to the coil **23** of the antenna **7** by way of an interior solder joint **19'**, the connecting tube **21** and the outer solder **19**. An outer conductor **16** of the coaxial cable **15** is electrically connected to the shielding tube **14** by way of a connecting washer **17** soldered thereto and the supporting member **12**.

The electric constitution of the above described apparatus is explained by reference to the block diagram of FIG. 5, in which the block designated OSC indicates a high frequency oscillator, the output level of which decreases or stops in a conventional manner when the antenna **7** detects the approach or proximity of human thighs as a capacity change, block REC indicates a rectifier for rectifying the output of the oscillator OSC, block AMP indicates a power amplifier which generates a control power for the electromagnetic valve **101** so that the valve **101** operates to open the water-supply line **10** with a decrease or stoppage of the output of the rectifier REC in the event of the proximity of a human body to the antenna **7** and thereby supplies water to the faucet **9**.

In one example of the apparatus, the antenna **7** made of a brass coil **23** having an outer diameter of 6 mm. and a length of 480 mm. sheathed in a polyethylene tube **22** of 1.5 mm. thickness, and inserted into a cavity **5** in the front part of the brim **4** of the basin **1** exhibited a Q of 100, and the capacity of the antenna **7** was 5 picofarads. In the above example, because the antenna **7** is located in the front part of the brim **4**, i.e., far from the faucet **9**, the influence of water running out of the faucet **9** is as small as a 0.02 picofarad increase of the capacity of the antenna **7**. Accordingly, there is no need of providing a compensation circuit in the electric circuits, which has hitherto been required to avoid keeping the electromagnetic valve **101** open unnecessarily as a result of an increase of the capacity in the antenna **7** due to the running of water from the faucet **9**.

As explained by reference to the example shown in the drawings the antenna touches the inner wall of the cavity only at two or three of its parts, and such contact areas are very small, because the antenna is resilient and its section is round. Therefore, a high Q-value of the antenna is ensured. Moreover, when sheathed in the insulating tube, the antenna is sufficiently insulated from the moist inner surface of the cavity in the brim, therefore, the Q-value becomes still higher. Besides, when the outer diameter of the antenna is selected to have a small value so as to make the capacity of the antenna small, the sensitivity of the apparatus for the detection of the proximity of a human body can be sufficiently improved. In the apparatus of the present invention, the location of the antenna does not change during the life of the basin, because the antenna is safely inserted into the cavity of the brim of the basin. Moreover, the antenna in the present invention can be easily inserted through the opening into the cavity, and its location can be easily set by the form of the cavity and, therefore, the setting of the antenna does not require any special skill or knowledge of high-frequency electrical engineering.

We claim:

1. An automatic water-supply apparatus comprising:
- a basin of insulating material having in its brim a cavity and a small opening leading thereto,
- an antenna of resilient metal rod inserted into said cavity through said small opening,
- an electric circuit to generate control power in accordance with the detection of a change of the capacity of said antenna, and
- an electromagnetic valve controlled by said control power.

2. An automatic water-supply apparatus as defined in claim **1** wherein said rod of the antenna is of a densely coiled resilient metal wire.

3. An automatic water-supply apparatus as defined in claim **2**, wherein said antenna is sheathed in an insulating tube.

4. An automatic water-supply apparatus as defined in claim **3**, which further comprises a fixed means for fixing said antenna to a wall portion defining the opening of the basin.

5. An automatic water-supply apparatus as defined in claim **4**, wherein said cavity, in which sand antenna is inserted, is located in the front part of the brim.

6. An automatic water-supply apparatus as defined in claim **1**, wherein said antenna is sheathed in an insulating tube.

7. An automatic water-supply apparatus as defined in claim **6**, which further comprises a fixing means for fixing said antenna to the opening of the basin.

8. An automatic water-supply apparatus as defined in claim **6**, wherein said cavity, in which said antenna is inserted, is located in the front part of the brim.

9. An automatic water-supply apparatus as defined in claim **8**, which further comprises a fixing means for fixing said antenna to the opening of the basin.

10. An automatic water-supply apparatus as defined in claim **1**, which further comprises a fixing means for fixing said antenna to the wall portions defining the opening of the basin.

11. An automatic water-supply apparatus as defined in claim **1** wherein said cavity, into which said antenna is inserted, is located in the front part of the brim.

12. An automatic water-supply apparatus as defined in claim **11**, which further comprises a fixing means for fixing said antenna to the opening of the basin.

13. An automatic water-supply apparatus as defined in claim **5**, wherein said fixing means comprises:
- a rubber bushing fixed to the opening underneath the brim of the basin,
- a metallic supporting member tightly inserted in a hole provided in the bushing,
- a nut of insulating material screwed into a threaded hole provided in said supporting member,
- a metallic connecting tube held by said nut, which supports the fixed end of the antenna and an end tip of the inner conductor of a coaxial cable leading to the electric circuit,
- and a connecting washer fixed to the bottom of the threaded hole of the supporting member by said nut and electrically connecting an outer conductor of the coaxial cable to the supporting member.

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