

# *The Structure Design of a New Kind Powder Dispenser*

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**Keywords:** smart pill box, powdered medicine, safe medication, structure design.

**Abstract:** Aiming at the problems of older people often forget to take medicine or take the mistake dose, The structure of an powder dispenser was designed, which was composed of a powder storage device, a powder delivery device, a powder collection device, a powder weighing device, a water heating device, a powder preparation device and a drug delivery device. The medicine dispenser is equipped with three reminding alarm clocks to meet the user's medication needs in three different time periods: morning, noon and evening. the alarm sounds, and the user only needs to press the corresponding powder button to realize the medicine out. The device can help the elderly and children simplify the steps of taking powdered medicines, prevent safety accidents such as burns when taking the powdered medicines, and enable the elderly and children to obtain the prepared medicines with one button and drink them directly.

## **1. Introduction**

Since the beginning of the new century, the world has been faced with the problem of aging population, resulting in an increase in the proportion of the elderly in empty-nest families. Facing this phenomenon, the first thing need to be solved is the health problems of the elderly. Smart medicine boxes designed for elderly become particularly important<sup>[1]</sup>, so that the health problems of the elderly at home can be guaranteed.

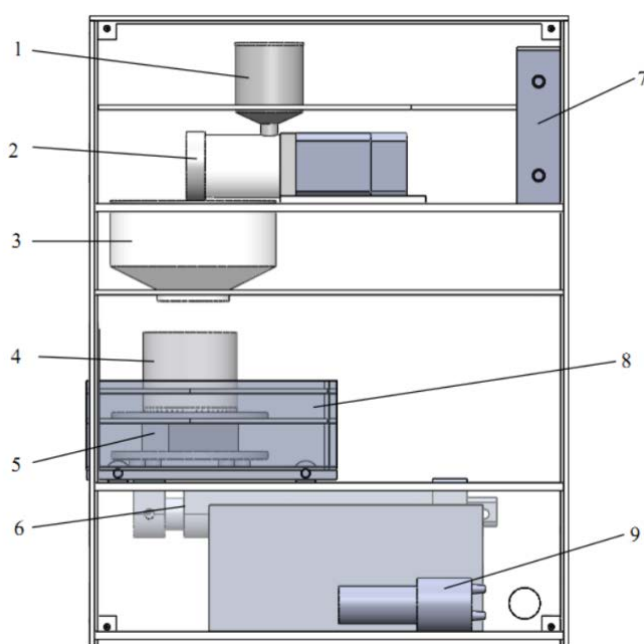
In recent years, scholars at home and abroad have designed a variety of smart medicine boxes for elderly people who often forget to take medicine or medication dosage. Limin Tang designed a smart medicine box with reminding patients of medication dosage and monitoring by using RFID technology and intelligent equipment<sup>[2]</sup>. Xiaochun Shen designed an intelligent drug box with STC15F2K60S2 to realize the functions of periodic voice prompt, voice prompt when the elderly enter the scope of taking medicine, automatic recognition and control of taking medicine<sup>[3]</sup>; PillDrill, an American company, designed an RFID-based drug distribution system<sup>[4]</sup>. Rxvitality has launched GlowCap, a smart box that combines sound and light as a reminder<sup>[5]</sup>. These intelligent boxes with diversified functions and humanized use process, especially for the elderly, their life style, life attitude and physiological and psychological characteristics are more special, which determines their special needs for the boxes.

The new kind of drug powder dispenser designed in this paper mainly realizes the functions of

dosage, infusion and timing reminder of powdery drugs for the elderly, and solves the inconvenience when the elderly take powdery drugs, so that the elderly can safely take powdery drugs without the supervision of their families.

## 2. The working principle of drug powder dispenser

The drug powder dispenser designed in this paper consists of powder storage device, powder conveyor device, powder weighing device, heating device, powder collecting device, drug conveying device, box body and control part.



*Figure 1: Structure of drug powder dispenser*

1. Powder storage device; 2. Powder conveying device; 3. Powder collecting device; 4. Medication cup; 5. Powder weighing device; 6. Electric putter; 7. Heating device; 8. Drug conveying device; 9. Micro pump.

Users need to pour the two powder drugs into A and B storehouse for storage in advance, and set the morning, noon and evening alarm clocks and the dose of A and B powder respectively. When the time set by the user is reached, the alarm clock rings, the user should press A or B button, and the powder will fall into the powder conveying device from the storehouse, and the screw conveying rod will be driven by the stepping motor to transport the powder. The powder falls into the powder collecting device, collects and slides into the medicine cup, and the pressure sensor module monitors the weight of powder from time to time. When the weight set by the user is reached, the stepping motor stops, and the conveying of powder stops. The micro water pump starts to work and sends the drinking water to the medicine cup through the heater to wash the powder. After a certain amount of hot water is injected, the micro water pump stops working. The electric push rod drives the drug delivery device to push out the drug, and the user takes the drug cup and drinks the drug. The Fig.1 is Structure of drug powder dispenser.

### 3. Design of powder storage and conveying device

The powder storage device consists of two storehouses (Fig. 2). Users can store the powder in two storehouses according to the prescription of the doctor. When the user needs it, the powder dispenser will transport the powder to the conveying tube controlled by the stepper motor according to the type of powder the user needs. The cover of drug storehouses mainly plays the role of dustproof, sealing and so on to prevent the deterioration of drug powder.

Powder conveying device is composed of stepper motor, screw conveying rod, conveying tube, bearing and two covers before and after conveying tube, as shown in Fig.3. The device is the core part of the whole powder dispenser, The 28 stepper motor with the control of single-chip microcomputer, drives the screw conveyor rod rotation, so as to achieve the purpose of conveying powder to the powder collection bin.

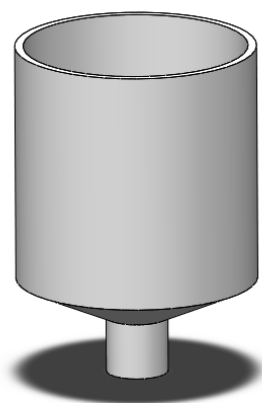


Figure 2: Storehouse

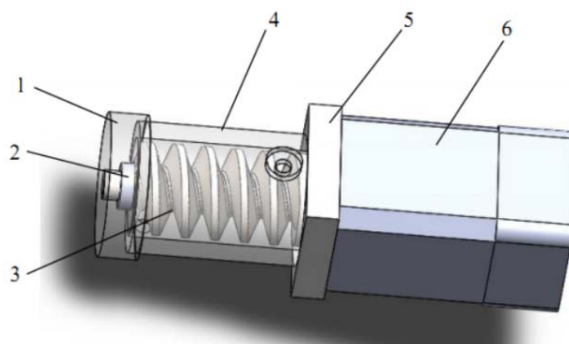


Figure 3: Drug conveying device

- 1. Left end cover; 2. Bearing; 3. Screw conveyor rod;
- 4. Conveying tube; 5. Right end cover; 6. Stepper motor.

### 4. Design of Powder weighing device

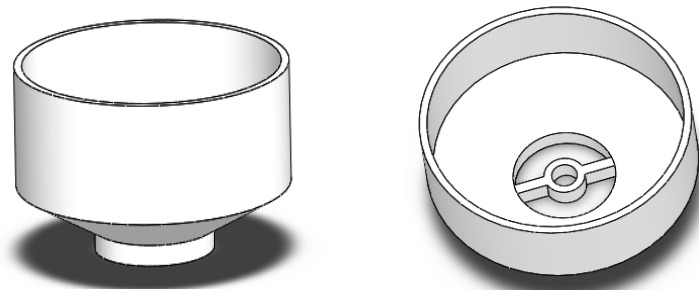
Powder collecting device is to collect by powder conveyer conveying powder drug, make the powder into the set in drug storehouse, due to the drug storehouse is inverted pyramid structure, and under the influence of gravity will make unified slipped to set all the collected powder at the bottom of the drug storehouse, so all powder can accurately fall to the bottom of the medicine cup, to be collected, waiting for powder dissolver.

The powder collecting device is mainly composed of a powder collecting bin and a cover. There

are two round holes at the bottom of the powder collecting bin. The big round hole is mainly responsible for dropping the powder leaked from the powder conveying device into the medicine cup below. The function of the small round hole is to transport the hot water heated by the upper heating device to the medicine cup through the hose. The hose needs to be positioned through the small round hole so that the hot water in the hose can accurately fall into the medicine cup and dissolve the powder. The appearance of the storage bin is shown in Figure 4.

The main purpose of the cover is to prevent dust. There are two square holes and one round hole on the cover of the collecting bin. Two square hole is used for precise alignment respectively two out of two powder conveying equipment, makes the powder conveyer conveying of powder can be through the square hole accurate falling into a set of drug storehouse and collected, and the role of the round hole is fixed conveying hot water hoses, and set at the bottom of the drug storehouse round hole, the fixing position of the hose, It can accurately transfer hot water to the medicine cup to dissolve the powder.

The powder collected in the powder collecting device falls into the cup placed above the powder weighing device through the outlet reserved at the bottom of the powder collecting bin, and waits for the powder weighing device to weigh the powder in the cup. The single chip microcomputer module is AT89C52, powder weighing device uses HX711 module and 5 kg pressure sensor composed of weighing sensor electronic balance module. AT89C52 module by reading the user starts to set the weight of the class A or class B powder, judge whether the quality of the powder of falling into A medication cup to the weight according to user's requirements, if not reached set value, the weight of the powder is MCU signal, make the stepping motor drives the transmission rod rotation, conveying of powder in drug storehouse to set, when A drug powder into the cup, The powder weighing device weighs the powder again. When the weight of the powder falling into the medicine cup reaches the weight set by the user, the powder weighing device will feed back the signal to the AT89C52 single chip microcomputer. After receiving the signal, the single chip microcomputer will give the signal of stepping motor stopping, so that the powder in the medicine powder conveying device will no longer fall into the medicine cup. In order to meet the user's need for the weight of powder. Because of the particularity of the design of product structure and the working process of the powder weighing device, the medicine cup is need to keep surface on the electronic scale weighing sensor module, medication cup itself has certain quality, have greater influence on the weighing of powder, so, in the process of each use will require the quality of the medicine cup, can eliminate the influence of medicine cup of weighing the quality of powder. So this product in the process of design, set when the powder drug machine electricity, if weighing transducer electronic module in any quality items above, will automatically to the function of the skin, so that when users use the product in the later to take medicine, don't because of the existence of medicine cups or other objects, which affect the powder dosage. The user can take the powder according to the dose.



*Figure 4: Powder collection bin*

## 5. Design of heating and powder dissolution part

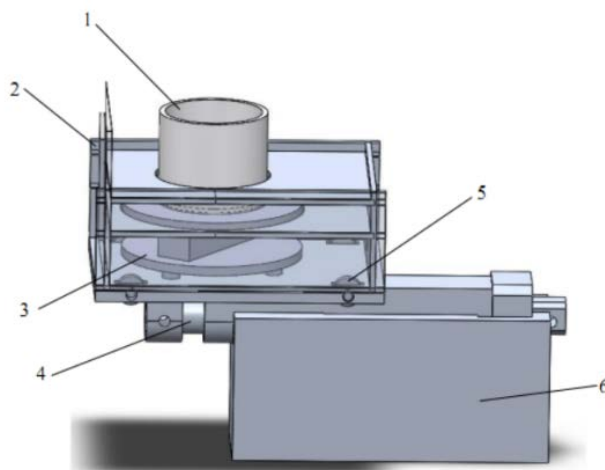
The dissolution of powder requires hot water, and hot water for the elderly and children, there are all kinds of safety risks, is a high risk factor. And young people need hot water when they want to take powders. It is also extremely easy to burn if not handled properly. Therefore, in the design of this product, a water heating device is added to avoid users being scalded when using hot water.

The water heater needs to heat the water by passing cold water through a heater. But the heater itself is only for heating, and does not draw cold water into the heater. Therefore, we need to add a micro water pump between the drinking water and the heater to draw the drinking water into the heater, so that the heater can heat the drinking water for the user. The rated voltage of the micro water pump is DC12 V, the rated current is 0.5~0.7 A, and the flow rate is about 1.2~1.5 L/min. The heater has two switches representing 50 watts and 100 watts respectively. When both switches are turned on at the same time, the power of the heater is 150 watts, so the heater can choose three power levels of 50 watts, 100 watts and 150 watts to heat the water.

The medicine collecting bin collects the powder transported by the powder conveying device and makes it fall into the medicine cup. When the weight of the powder reaches the user set value, the heating device and the mini suction pump start, and the hot water is added into the cup through the hose to achieve the purpose of dissolving the powder.

## 6. Design of drug delivery device

When the powder is dissolved, the cup containing the drug is still inside the powder fetching device. At this time, the cup needs to be sent out of the powder fetching device for the convenience of the user. The drug transporting device consists of drug cup, drug transporting trolley and electric push rod. The drug delivery device is shown in Figure 5.



*Figure 5: Drug delivery device*

*1. Medicine cup; 2. Medicine delivery trolley; 3. Pressure sensor;  
4. Electric push rod; 5. Bearing; 6. Electric push rod support block*

The drug transport car is to send the prepared drug to the inside of the drug powder dispenser, which is convenient for the user to take the medicine cup. The electronic balance module of weighing sensor is built into the drug transporting trolley, and its position is fixed by two supporting arcs, which is convenient for weighing and measuring the powder falling into the drug cup. The medicine cup is placed on the electronic scale module, and the position of the medicine cup is determined by two brackets, so that users can not determine the position of the medicine cup when they take out the

medicine cup and put it into the transport car again, so that the powder and hot water falling into the medicine cup can not be prepared to fall into the medicine cup, causing losses. Another function of the hoop is to prevent the cup full of medicine from shaking and spilling the medicine when the electric push rod pushes the trolley, or worse, making the cup turn over and spill all the medicine. Four 16 mm×5 mm×5 mm bearings are installed at the bottom of the trolley as the wheels of the trolley to reduce the friction between the trolley and the guideway plate. And there is a guide rail on the guide board, so that the bearing at the bottom of the transport car moves inside the guide rail, to prevent the transport car from deviating from the track in the transport process, causing losses.

## 7. Conclusions

This paper designs a kind of powder medicine dispensers, introduces its working principle, the structure design of main components and the selection of key components, which can realize the functions of dosage, infusion and timing reminder of powdery medicine for the elderly, and solve the inconvenience of the elderly when taking powdery medicine.

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