Computer Aided Design of Nose Warmer Based on Thermostat Control Technology

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Abstract. Whenever the season changes and the temperature changes suddenly, it is the flu outbreak period. During the period of influenza, it is often accompanied by the phenomenon of "nasal congestion". The appearance of "nasal congestion" can easily cause breathing difficulties, which can lead to difficulty falling asleep or seriously affect the quality of sleep, especially in infants suffering from "nasal congestion", which is likely to cause sleep quality degradation. Irritability, crying phenomenon, it is difficult to make parents serve; further, due to the decline in the quality of sleep, the body's own resistance and immune function will fall, which will prolong the rehabilitation of drug therapy. The flu phenomenon, through the treatment of drugs, often does not have an immediate effect and requires a course of rehabilitation. The nose warmer based on thermostat control technology uses the thermostat of the nose warmer to first detect the water temperature in the container of the warm steam generator. If the water temperature is lower than the set temperature, the heating chassis will be activated to heat up the water to ensure that the output warm steam is constant temperature, which plays a role in warming the nose, so as to dredge the patient's nostrils, reduce the patient's pain, and shorten the treatment time.

Keywords: nasal congestion, thermostat Control, nose warmer

1. Introduction

People who have had a cold are well aware of the uncomfortable taste of a cold-headaches, sneezing, runny nose, coughing and other symptoms are all at once. Worse, nasal congestion makes it difficult to breathe in or exhale, making people feel About to suffocate. Nasal congestion directly affects the quality of life, sleep quality, mood and work efficiency of patients, and brings heavy social, economic, spiritual and psychological burdens [1]. The cold is a disease that almost everyone suffers from. A cold and nasal congestion not only affect daily life and work, but also can't sleep well.

No matter how low the temperature, people will not feel cold when they inhale air into their throat. That's because the nose is warming up. One of the functions of the nose is to warm the outside world to the body temperature. If the outside temperature is 0 degrees Celsius, it has to be heated to more than 30 degrees. At this time, the turbinate expands to increase the temperature rapidly, and the nasal cavity space becomes smaller, which is prone to nasal congestion [2]. Therefore, when the nasal congestion, increase the humidity and temperature can alleviate the discomfort of nasal congestion.
2. Traditional physical methods
When nasal congestion, increasing humidity and temperature can alleviate the discomfort of nasal congestion [3]. The current physical method is hot compress: apply a hot towel to the nose, soak the towel in hot water, wring it out, and apply it to the affected area. A layer of towel or cotton pad can be covered on the hot towel to keep the heat. Towels are generally changed every 5 minutes, preferably alternately. The hot compress time is 15-20 minutes each time, 3-4 times a day.

Applying a hot towel to the nose or breathing hot water vapor can promote blood circulation in the nasal mucosa, help smooth the blood flow in the turbinate, and achieve the effect of alleviating nasal congestion and clearing the nose. However, in the application of hot compress therapy, attention should be paid to the temperature control to avoid burns.

This hot compress method is inconvenient to operate and requires frequent replacement of hot towels, especially for infants and young children, who may be reluctant to apply hot compresses. In addition, the temperature of the hot towel is not easy to control, the temperature is too low, the effect is not good; the temperature is too high, it is easy to burn. At present, there is a lack of easy-to-operate, temperature- and humidity-controlled hot compresses and equipment for realizing the method.

3. Design of nose warmer with thermostat control technology
This design mainly describes a clinical physical method that is conducive to dredging the nostrils and a portable temperature-controllable nose warmer designed based on this method. The nose warmer is a device that is simple to operate, portable and can dredge the nostrils quickly.

3.1. Clinical physical method based on nose warmer
This clinical physical method can be converted into water vapor by heating water. The patient wears the nose warmer on the bridge of the nose like glasses [4], and uses the constant temperature steam output from the vent of the nose warmer to warm the nose. The capillaries of the nostril expand, promote blood circulation, and facilitate the enlargement of the nostril, thus achieving the purpose of dredging the nostril and breathing smoothly.

3.2. The structure design of the nose warmer
A nose warmer designed based on the above-mentioned clinical physical therapy methods. The nose warmer includes the following parts, as shown in Figure 1:

① Warm steam generator: According to clinical needs, it can generate hot steam with a certain temperature and constant temperature;
② Warm steam output tube: The tube is a hose, which is used to connect the throttle valve of the warm steam generator and the air inlet of the nose warmer to deliver the warm steam to the nose warmer;
③ Nose wearers: like glasses, worn on the bridge of the nose, warm steam leaks from the vent of the nose warming wearer to warm the nose;
④ Warm steam recycled tube: The tube is a hose, used to connect the air outlet of the nose warmer and the mechanical valve of the warm steam generator to recover the remaining warm steam for easy recycling.
3.2.1. Basic structure of warm steam generator. The warm steam generator is composed of two parts, which are composed of the upper component of the warm steam generator and the lower component of the warm steam generator, as shown in Figure 2.

Fig 1. Nose warmer structure

Fig 2. Warm steam generator structure

1-1----The upper components of the warm steam generator are shown in Figure 3
The stirring device fixing plate is used to fix the stirring motor and the exhaust fan. The fixed plate of the stirring device is provided with vent holes as shown in Figure 4, so that the warm steam can circulate between the warm steam generator, the output tube, the nose warmer, and the recycled tube under the action of the exhaust fan.

![Fig 4. Vent structure](image)

1-2----The lower component of the warm steam generator are shown in Figure 5:

![Fig 5. Lower component of warm steam generator](image)

3.2.2. Functional characteristics of the nose warmer. The nose warmer is worn on the bridge of the nose like glasses. The wearer has an vent and tube connector, as shown in Figure 6 and Figure 7.

(1) Vent

(2) Tube connector

The flexible conduit is inserted into the connector and tightly connected by interference. This type of connection has a simple structure, good centering accuracy, can withstand torque, axial force or a combination of the two loads, and has a high load-bearing capacity, under shock and vibration loads. It can also work more reliably [5]. In order to ensure that the two will not fall off under the action of external force, they can be further tightened by way of tie after connection.
3.3. **principle of nasal warmer**

3.3.1. **Selection of thermostat.** Thermostat are widely used in industrial production and daily life, from the complex temperature control in industrial production to the room temperature control of household air conditioners, all of which are inseparable from the thermostat [6]. Generally speaking, thermostats can be divided into two categories: electronic thermostats and mechanical thermostats; according to different working principles, mechanical thermostats can be divided into bimetallic, pressure, and capillary thermostats [7].

The bimetallic thermostat is an electromechanical device used to control water temperature. Its working principle is to use a bimetallic disc element as a temperature sensor, and a contact and another static contact are designed on it. The principle that the dish-shaped element deforms at different temperatures can realize the closing and opening of the moving and static contacts within a certain temperature range to realize the control of the heater power supply [8], and realize the connection or disconnection of the circuit.

3.3.2. **Working principle of nose warmer.** At present, the temperature control method has been widely used [9]. The nose warmer adopts a bimetallic thermostat. The thermostat detects the temperature of the warm steam to determine whether it is boiling water (heating the chassis) or stirring to generate steam. We can set a temperature value. When the thermostat detects that the temperature of the warm steam has not reached the set value, start the heating site to heat the warm steam; when the temperature of the warm steam reaches the set value, stop heating and start The stirring device, the stirring motor drives the stirring rod component to rotate, and the warm water is easy to volatilize to produce water vapor during the rotation of the stirring rod component.

The mechanical valve is a steam recovery valve, which is used to control the flow rate of the return gas per unit time by adjusting the size of the valve port; the throttle valve is an output steam valve that limits a specific temperature range (45°~60°) through temperature control induction Steam output to avoid too high steam temperature, which may cause burns on the nose and skin. The throttle valve and the mechanical air valve cooperate with each other to control the flow rate and flow rate of warm steam output from the air outlet of the "nose wearer ". The output steam volume can be adjusted according to different needs and different patients.

The steam generated by the stirring meets the temperature conditions set by the throttle valve (which can avoid the scalding of human nose and skin caused by the overheated steam), the throttle valve is opened, and the exhaust fan starts to work to accelerate the steam delivery. The exhaust fan transfers the steam in the container of the thermostatic steam generator to the warm nose wearer (worn on the patient's nose like glasses) through the throttle valve and thermostatic steam output tube, and the thermostatic steam is directed to the patient from the outlet of the warm nose wearer The nose is heated to unclog the nostrils. The remaining warm steam after passing through the nose warmer wearer will be recovered to the warm steam generator container through the warm steam recovery pipe for recirculation.
4. Specific implementation methods and effects of the nose warmer

4.1. Starting the nose warmer
Press the switch to start the nose warmer. The thermostat of the nose warmer first detects the water temperature in the container of the warm steam generator. If the water temperature is lower than the set temperature, the heating chassis is started to heat up the water. The nose warmer The overall structure is shown in Figure 9.

4.2. Stirring system
The thermostat detects that the water temperature reaches the set temperature, the heating chassis stops working, and the stirring system works.
The stirring motor drives the stirring rod group to rotate, and the warm water is easy to volatilize to produce water vapor during the rotation of the stirring rod group;

②The steam produced by stirring meets the temperature conditions set by the thermostat valve (which can avoid the scalding of human nose and skin caused by superheated steam), the thermostat valve is opened, and the exhaust fan starts to work to accelerate the delivery of steam to the outside;

③As shown in Figure 10, the steam flow direction is shown in Figure a. The exhaust fan transfers the steam in the container of the warm steam generator to the nose warmer (worn on the patient's nose like glasses) through the throttle valve and the warm steam output tube. The warm steam warms the patient's nose from the vent of the nose warmer and dredges the nostrils;

④As shown in Figure 10, the steam flow direction is shown in Figure b. The remaining warm steam after passing through the nose warmer wearer will be recovered into the container through the warm steam recovery duct for recycling.

**Fig 10. Steam flow diagram**

### 4.3. Thermostat control

After the nose warmer is started, the thermostat first detects the temperature of the water contained in the barrel. When the water temperature is lower than the set temperature, the heating chassis is first started to heat up the water; when the water temperature reaches the set temperature, it is heated. The chassis stops working, and the stirring motor starts to drive the stirrer, so that the water in the barrel evaporates under the stirring of the stirrer to form water vapor; the thermostat is used to ensure that the output warm steam maintains a certain temperature value, which can keep the nose constant. The function of warming the nose can dredge the patient's nostrils.

### 5. Conclusion

The nose warmer under thermostat control technology is designed based on clinical practice experience, including warm steam generator, warm steam output tube, nose warmer, warm steam recovery tube. The nose warmer generates steam at a suitable temperature through the steam generator. The steam warms the nose through the wearer and promotes the expansion of the nostril capillaries. At the same time, the steam can reduce the viscosity of the nasal mucus, increase the fluidity, and prevent the nasal cavity from being blocked, thereby achieving dredge. The role of nostrils. The nose warmer acts as a physical treatment method by generating steam to warm the nose, which can dredge the nostrils, improve breathing, and improve sleep quality, thereby increasing the immune self-healing speed and shortening
the drug treatment cycle. Simple and portable wearing can be achieved through nose pads and legs. The use of the nose warmer is simple, practical, and easy to carry. It is a product that is easy to promote and use.

References
[1] Zhou Bing, Xu Geng. The mechanism and treatment of allergic rhinitis and nasal congestion[J]. Journal of Clinical Otorhinolaryngology Head and Neck Surgery, 2019, 33(08): 780-785.
[2] Mills Margaret K. Sarcoidosis Causing Complete Nasal Obstruction. [J]. Ent - Ear Nose & Throat Journal, 2021.
[3] Sir Christopher Andrewes. The Common Cold: Twenty Years' Work on the Common Cold[J]. Proceedings of the Royal Society of Medicine, 2016, 59(7).
[4] Mao Wei, Feng Qi, Yu Huali. Design of wearable artificial nose with automatic temperature and humidity control[J]. Electronic World, 2020(24): 122-123+126.
[5] Tao Defeng. Design method and experimental study of multi-layer cylinder interference connection [D]. Taiyuan University of Science and Technology, 2013.
[6] Wang Liheng, Zhu Zhifeng, Li Pengcheng. Design of an intelligent thermostat with control configuration [J]. Automation and Instrumentation, 2019, 34(09): 62-65+70.
[7] Feng Hongjiang. The protagonist of China's thermostat market [J]. Modern Home Appliances, 2011 (03): 42-44.
[8] He Jianqiang, Wei Xing, Hou Jiancheng, Fu Xiaorong. Research on the method of measuring the contact depth of sudden jump thermostat based on line laser vision[J]. Manufacturing Automation, 2019, 41(04): 7-9+35.
[9] Jing Xi, Gao Guowei. A constant temperature control system based on PID regulation [J]. Computer Measurement and Control, 2021, 29(04): 110-114.