Design of muffled singing masks

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Abstract. Nowadays, we are not allowed to speak loudly and sing loudly in outdoor environment and our environment. Based on this, the design of muffler masks is proposed. This design adds a circuit which transmits the electric signals generated by microphones to the earphone on the normal headphones to realize the ear return function. After that, different materials are studied through experiments. The change of penetration rate and respiratory resistance of masks with different structures and layers under different flow rates; and the change of singing voice under different layers was detected by noise analyzer, and the optimum layers of sound-proof cotton were finally determined, so as to achieve the effect of silencing.

1. Preface

In recent years, with the rapid development of cities, the material life is constantly improving, public transport travel is becoming more convenient, people are more pursuing spiritual enjoyment. Masks, the basic consumables of life, are not only used as warmth and haze-proof items with the development of the times. More and more young people have added decoration, beauty and other functions to them. At the same time, the moral standard of public places has also become a hot topic. And making calls in public places is a hot topic. It is excusable to answer telephone calls in public places. It is difficult to use laws and regulations to forbid calls in public places. But some people are used to talking loudly, which has certain influence on the people around them. Similarly, some people are introverted or chat content is more private, do not want others to hear, or the surrounding environment is noisy, the reception effect of the other party is not ideal. These are all problems encountered in public phone calls. You can see that a silent masks must have a vast market.
2. Working principle diagram

![Working principle diagram](image)

**Fig. 1** Working principle diagram.

3. Selection of sound insulation materials
Initially, sound insulation package was used, but the effect was not obvious. After consulting relevant materials, many materials were tried. Finally, we decided to use sound absorbent cotton. There were many holes in the material. When the sound wave came in, it would reflect, so the sound would become smaller after the superposition of the sound wave. Through the frequency formula of coincidence effect, we know that the coincidence effect makes the sound insulation effect of a certain frequency range worse. Generally, this frequency occurs in the middle and high frequency. Choose sound-proof cotton as sound-proof material. Cut the sound-proof cotton and fill it into two masks to ensure that the thickness of the sound-proof cotton is even. It also ensures that it can not only isolate most sounds, but also has good air permeability, ensure the smooth breathing of each breath, and the breathing resistance should conform to the national standards of Engineering masks.

4. Implementation method of real-time voice monitoring
Normal headphones only convert the sound signals received by the microphone into electrical signals and transmit them to the mobile phone. The electric signals of the mobile phone are transmitted to the microphone and converted into sound signals, which can not achieve real-time ear return. So we can achieve the function of ear return by adding the circuit that transmits the electric signal generated by the microphone to the receiver. Rechargeable batteries are added to the ear return, which can be charged by connecting the mobile phone, and can also be realized without connecting the mobile phone. Based on this research, we decided to use the external ear echo card to achieve, the external sound card has a unique power supply design, so that it can work independently without relying on the host.

5. Experimental instruments

5.1 respirator respirator resistance tester
The specific parameters are as follows:
1. flowmeter range: 0 ~ 100L/min
2. flowmeter accuracy: 3%
3. electronic digital display flow
4. range of micro pressure gauge: 0 ~ 1000Pa
5. real-time display of test pressure
6. pumping rate: 100L/min (adjustable)

The test results are shown in the following table:

**Table 1. Data for breath suction test.**

| Serial number | Number of materials       | Expiratory resistance (pa) | Inspiratory resistance (pa) |
|---------------|---------------------------|----------------------------|-----------------------------|
| 1             | Ordinary mask             | 92                         | 143                         |
| 2             | Pitta+1 level silencer    | 126                        | 176                         |
| 3             | Pitta+2 level silencer    | 182                        | 235                         |
| 4             | Pitta+3 level silencer    | 237                        | 287                         |
| 5             | Pitta+4 level silencer    | 248                        | 344                         |

5.2 AWA6270 noise analyzer
(1) upper limit of measurement: 130dB
(2) monitor: 128*64 dot matrix LCD
(3) working temperature range: -10 to +50 degrees.

5.3 acoustic sensors
Using MP201 microphone, its quality and reliability have been certified by the metrological institutions of the United States, Britain, France and other countries. It meets the IEC 60651 standard. The main performance indicators are as follows:
(1) open circuit sensitivity (250Hz): 50mV/Pa;
(2) frequency response (20Hz to 20kHz): conform to IEC 60651I standard;
(3) temperature coefficient (250Hz): -0.01dB/K;
(4) pressure coefficient (250Hz): -0.02dB/kPa.

The test results are shown in the following table:

**Table 2. Noise test data sheet.**

| Serial number | Number of materials       | Noise dB(A) |
|---------------|---------------------------|-------------|
| 1             | Ordinary mask             | 82          |
| 2             | Pitta+1 level silencer    | 53          |
| 3             | Pitta+2 level silencer    | 32          |
| 4             | Pitta+3 level silencer    | 30          |
| 5             | Pitta+4 level silencer    | 28          |

5.4 respiratory effect and noise reduction analysis
In conclusion, the noise-reducing material chosen in this design is sound-proof cotton. In the experiment, the chosen mask is the skin PITTA mask which is popular today.
material used in the PITTA mask itself is a three-dimensional mesh structure. After precise processing and sewing, a high-density dust blocking space is formed, and the dust blocking rate is high. To an astonishing 99%, pollen, cold virus, dust have a super defense, so in peacetime application can not only play a sound insulation function, but also to the pollen allergic people play a great help. The air resistance tester is used to detect the breathing condition, and the noise tester and acoustic sensor are used to detect the noise. The analysis shows that the effect of using three layers of filling noise reduction material is the best. Because when using three layers, the test results show that the breathing resistance increases obviously, but the change of noise reduction degree is not obvious, so three layers are chosen. The filling material is used as noise reduction material to reduce noise.

6. Conclusion
By adding an ear-return circuit between the inner earphone and the microphone of the mask with sound-absorbing cotton, the signal received by the microphone can be transmitted directly to the microphone. Without affecting sound recording, the effect of singing can be detected in real time. At the same time, the best effect can be determined through the selection of sound-insulation materials and experimental research. Ultimately, it can prevent voice from playing out, and it does not affect other people's work and life. At the same time, it can prevent pollution and protect the skin. So this mask has practical significance.

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