Vibrating "Mini-washing" Washing Machine Design

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Abstract

The paper puts forward a whole-new model of washing according to the main problems existed in the current mini-washing machine and ordinary big washing machine. In the meanwhile, it points out another new way of washing—vibrating style, combining the principles of Wheel washing machine and Drum washing machine, the two main kinds of washing machines in the market, and also analyzes its rate of clean washing. This style fuses scrubbing and beating, the two traditional ways of washing, and integrates their advantages as well. It features in high rate of clean washing, water-saving, little damage to clothes, evenly-washing, and no twist and so on.

Keywords: Mini-washing, Vibrating, Washing Machine.

1. The background and significance of the research

People's demand for health is getting higher and higher with the improvement of life quality. We may only do washing until many clothes are accumulated when using big washing machines, however, bacteria will be bred if dirty clothes are piled too long, which is not only harmful to our health but also will produce bad smell and pollute the air as well. Especially when summer comes, that people are easy to sweat makes a high frequency of washing with clothes small, amounts few and the intervals between exchanges short. At this time, a washing machine that can do the job promptly is needed. In addition, it is prone to bring cross-infection with clothes all washed together. Therefore, we should wash "underclothes and overclothes separately, baby's clothes alone, dark color and light color clothes separately…"

With such a kind of market demand, Haier first introduced its "small child prodigy washing machine", that's mini-washing machine, only 3/5 the size of common washing machine and 1/2 to 1/3 the washing capacity. But it enables users to wash in time any kind of clothes conveniently, small to a pair of socks and large to a quilt. Different kinds of clothes to be washed separately is also available, avoiding color mixed and health problem, moreover, it is more water-saving and electricity-saving than big washing machines. Those unique advantages makes mini-washing machine become the new focus in the market and gain a great success. That the calling for clothes washed separately, baby's and children's clothes washed alone, keep healthy and saving water and electricity has once been the fashion.

However, there are some problems that can not be neglected existed in the mini-washing machine. With its relatively small size, the electric power is less than the ordinary washing machine. That leads to a low rate of clean washing, especially when washing large clothes it can even not be driven. Even if users are washing small clothes, they have to wash several times, so that more time and more energy are needed. In the market today, most consumers generally choose to buy a min-washing machine after buying a big one as a supplement, which determines that it is only fit for rich families. At the same time, two washing machines indeed occupied much space of the family. These drawbacks greatly restrict the development of the mini-washing market and make the coverage of this healthy washing style not large.

Therefore, we need to find another new carrier for the healthy washing style so that more people can enjoy healthy washing.

"Mini-washing" washing machine has certain differences from mini-washing machine. "Mini-washing" washing machine is not just "mini" on the volume, but takes out the washing method of mini-washing machine, that is "mini" on the amount of clothes to be washed. So the size of its washing barrel may be the same as mini-washing machine while the whole size may not necessarily smaller than big washing machine. It can overcome the main problems that occurred when using big and mini-washing machines, separately satisfying the need of every kinds of washing of a family without buying a common big washing machine.

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2. Introduction of the model and principle of the new washing machine

2.1. New model of washing

"Mini-washing" washing machine has three barrels: clothing reservoir barrel, washing barrel and clothing aired barrel. Its icon is on the right: Figure 1. The clothing reservoir barrel is like a cupboard with many layers of drawers to put the clothes. Users first fold up those clothes that can be washed together and put them in one drawer. When the electricity is on, the machine will automatically start washing from the bottom up according to the order of the drawers. Every time it begins to wash the clothes in a drawer, the machine itself will flick out and the clothes fall into the washing barrel. Clothing washing is over until all of the drawers flick out. Then users shut the drawers manually. Such a kind of structure not only makes it convenient for the following drawer to drop clothes to the washing barrel but also gives users a feedback of the washing procedure—gets the washing schedule from the numbers of opened drawers. Clothes in each drawer will automatically be sent to the clothing aired barrel after being washed in the washing barrel. Both the clothing reservoir barrel and the clothing aired barrel can be torn down freely. When all clothes are washed, users can directly take down the clothing aired barrel to air clothes omitting the trouble of moving clothes from machines to another barrel. At the same time, the clothing reservoir barrel can be designed into different sizes and made into standard parts so that it could be used on the washing machines of different brands. Users can make a choice according to the conditions of their family when purchasing washing machines. Drawers in the clothing reservoir barrel should also be different in sizes. It is possible for users to choose freely according to the size and amount of their clothes. The machine can identify empty drawer as well and leapt it over.

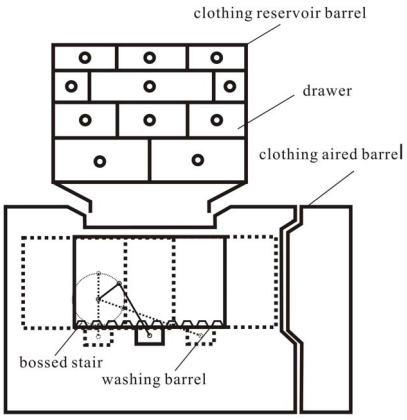

Figure 1. Vibrating "mini-washing" washing machine

This new model of washing enables users to wash promptly and healthily, in the meanwhile avoid the trouble of having to wash several times when using mini-washing machine, greatly changing people's washing habits and optimizing people's washing life.

2.2. New principle of washing

In current market of washing machines, there are mainly two kinds of washing style: Wheel washing style and Drum washing style, and the Wheel washing style is more universal. Wheel washing machine removes the dirt by making use of the rotation of the wave wheel to drive the washing liquid to rotate, and clothes rubbed with the wall of the barrel under the centrifugal force, at the same time the scour of water as well. This kind of washing style is similar to the washing principle of washboard. The biggest weakness of Wheel washing machine is that its damage to clothes is relatively high; hence some clothes like business suits and shirts can't be washed in Wheel washing machine. And this limitation is sure to be more obvious as people's requirement today for clothes and the level of clothes are both getting higher and higher. Drum washing machine removes the dirt by making use of the rapid water impaction after clothes are threw down from a certain height in a certain speed with the tail-wagging of the inside barrel. This kind of washing style is similar to the washing principle of using a stick to knock on clothes. Its damage to clothes is small but the rate of clean washing is not high.

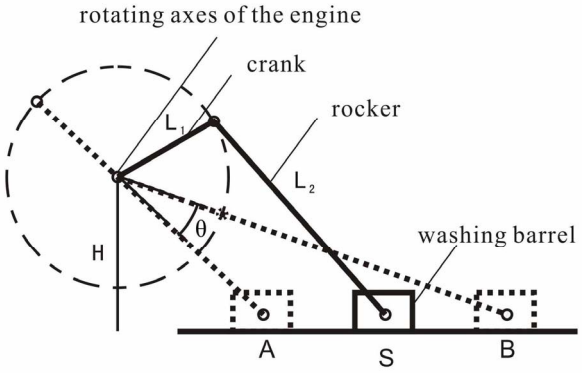

Figure 2. Vibrating structure

The style mentioned in the paper is the vibrating style that adopts the structure as follows (Figure 2) to make the washing barrel to vibrate right and left. When the washing barrel starts to vibrate, clothes and washing liquid will also vibrate together in the washing barrel, after the barrel is back, clothes mixed with washing liquid will impact the wall of the barrel, and during the impact, the dirt on clothes will be washed out by water. In this way, it follows the principle of Drum washing style. On the wall of the inside washing barrel, there are some bossed stair structure. The weight of the clothes

increases because of its immersion in the water, augmenting the friction between clothes and the inside wall. Clothes rub with the bottom of the barrel while vibrate right and left, playing the role of scrubbing. In this way it is similar to the principle of Wheel washing style.

3. Advantages of the vibrating style

Therefore, the vibrating washing style in fact combines the Wheel washing style and the Drum washing style with main attention on the Wheel washing style. Compared to those two styles, vibrating style has the following advantages:

3.1. High rate of clean washing

The rate of clean washing of a washing machine mainly has something to do with the relative speed of the impaction between clothes and the barrel. Take V_0、V respectively as the relative speed between clothes and the barrel, the speed of the crank when evenly rotate; Take H, L_1, L_2（L_2>L_1）, S respectively as the vertical height of the rotating axes of the engine and the washing barrel, length of the crank, length of the rocker, length of the washing barrel moved horizontally; take T_1、T_2 respectively as the time washing barrel spend when moving from A to B and from B to A in the icon; θ is the angle between the two marginal positions.

$$S^2=(L_1+L_2)^2+(L_2-L_1)^2-2(L_1+L_2)(L_2-L_1)\cos\theta \quad ①$$

$$V_0=\frac{S}{T_1}+\frac{S}{T_2}$$

$$T_1=\frac{180^\circ-\theta}{360^\circ}\times\pi\times\frac{2L_1}{V}$$

$$T_2=\frac{180^\circ+\theta}{360^\circ}\times\pi\times\frac{2L_1}{V}$$

From all above, we can get：

$$V_0=\frac{SV}{\pi L_1}\left(2+\frac{1}{\left(\frac{180^\circ}{\theta}\right)^2-1}\right) \quad ②$$

From ① we get: larger the angle θ, larger the S

Combining ② we get the conclusion: larger the angle θ, larger the S

Because

$$S=\sqrt{(L_1+L_2)^2-H^2}-\sqrt{(L_2-L_1)^2-H^2}$$

$$=\frac{(L_1+L_2)^2-(L_2-L_1)^2}{\sqrt{(L_1+L_2)^2-H^2}+\sqrt{(L_2-L_1)^2-H^2}}$$

$0\le H\le L_2-L_1$,

So when

$H=L_2-L_1$, $S_{\max}=\sqrt{(L_1+L_2)^2-H^2}=2\sqrt{L_1L_2}$

$$V_{0\max}=\frac{2}{\pi}\times\sqrt{\frac{L_2}{L1}}\times\left(2+\frac{1}{\left(\frac{180^\circ}{\theta}\right)^2-1}\right)\times V$$

Because: $0<\theta<90^\circ$ L2>L1

So: $V_{0\max}>\frac{4V}{\pi}>V$

From the data above we can know that the rate of clean washing is the biggest when the left limit position of the vibration of the touching point of the rocker and the inside barrel is right below the engine. And the engine is L_2-L_1 higher than the touching point. With the same power as Drum washing machine, the speed of impaction on clothes of vibrating style washing machine is larger than that of Drum washing machine. Therefore, its rate of clean washing is higher. Additionally, the inside wall of the washing barrel also scrubs the clothes that can further improve the rate of clean washing.

3.2. Water-saving

Today water resources in our daily life are getting more and more urgent and water used in washing takes a fairly large proportion. Therefore, water-saving washing machine is likely to be more popular. Clothes have to be totally dipped in water when using the Wheel washing machine as it tries to make clothes rotate through washing liquid. Whereas the vibrating style washing machine follows the advantage of Drum washing machine that clothes can be washed cleanly with a small quantity of water. At this time, the use of water is to dissolve dirt and scour clothes on one hand, on the other hand, it is to increase the weight of clothes so that clothes can rub and knead with the inside wall of the washing barrel. On the contrary, too much water will float clothes on the water, which makes it impossible to rub with the barrel.

3.3. Little damage to clothes

Vibrating washing machine does its job mainly through beating on clothes, with scrubbing as a supplement. Scrubbing can make up the shortage of low rate of clean washing and beating can avoid damages to clothes.

3.4. Evenly-washing with no twist

Wheel washing machine twists clothes together during its rotation. In that way, it is not only difficult for us to get out clothes but also makes clothes washed unevenly or even not clean at some points, forcing users to wash manually again, because those twisted parts are hard to rub with the washing barrel. Vibrating washing machine overcomes this disadvantage. Clothes can

freely unfold during the process of impact to make every part washed completely.

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