An invention of multifunction washing ball

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Abstract. Ultrasonic clean is a very fashionable trend in cleaning appliance and tools in domestic and international markets, from washing machine, electronic toothbrush to household, ultrasonic cleaning machine (for jewelry, watch, glasses, etc.) Every ultrasonic related thing is very popular and the price is raised immediately. For example, the washing machines under the same brand, the one with ultrasonic will be USD 180 more expensive than the other one as the price could up to 8 times of difference for the ultrasonic function of the electronic toothbrushes of the same brand. Multifunction washing ball is the pioneer creation of the world, which is advanced and can be applied for many purposes. It can replace various cleaning household appliances in modern family with the remarkable cleaning effect. Ultrasonic current powerfully get rid of the hidden dirt among the clothes fiber. It will definitely be popular with the collocation of the trend. In the environmental protection, it reduces washing powder usage, minimum power consumption, save the water, cherish the resource on earth.

1. Introduction

Human can hear the sound frequency from 16Hz to 20 KHz, ultrasonic means the frequency that human can not to hear. Ultrasonic cleaning uses cavitation bubbles induced by high frequency pressure waves to agitate a liquid[1]. The agitation produces high forces on contaminants adhering to substrates like dust, dirt, oil, pigments, rust, grease, algae, bacteria, polishing compounds, soot wax, and so on[2].

Ultrasonic cleaning machine is conversed to the mechanical vibration with the same frequency through the piezoelectric inverse-transforming effect of the transducer, and then it will radiate forward intensively in the cleaning solution in the form of ultra-audio-frequency longitudinal wave (The ultra-audio frequency longitudinal wave spreads alternatively between zones of negative pressure and positive pressure), producing ten thousands of small bubbles to explode in turn. These small bubbles which form and grow in the zone of negative pressure, and explode instantaneously in the zone of positive pressure[3], to strike with high pressure the surface, gap, and small local of a cavity to be washed, leading to peeling off of fouling quickly[4].

2. Method

2.1. Past technique

Clothing is generally washed in machines nowadays. However, some articles such as women’s undergarments and infants clothes, do not need to go into a washing machine and some may even be damaged if this were done. Hand washing can be inconvenient and some people may not like to send their washing to a hotel laundry when they are traveling. It is also not a good idea to use detergents for
infants clothing because they can cause asthma, allergy and irritation to the infants skin. That is why pediatricians do not recommend using them for washing baby cloths [5]. Furthermore, the use of copious quantities of water to remove the large amount of detergents needed for very dirty washing can stress the biological habitat and is environmentally unfriendly.

2.2. TRIZ theory
TRIZ is the abbreviation of the Russian "Teoriya Resheniya Izobretatelskikh Zadath", translated into English as the Theory of Inventive Problem Solving (TIPS), [6] which means the theory of innovative problem solving. This theory aims to solve the problems during innovative invention. TRIZ was developed by Soviet patent researcher Genrish Squilovich Altshuller (1926-1998) from the analysis of the basic concept of patent documents. He found that various innovative invention problems in different fields had common basic problems and problem-solving skills; hence, he proposed the same solution to be used in the problems in different fields and different periods. From these patents, various problem models were systematically sorted out, and he proposed the approach of innovative invention and its problems-solving methods. [7] The theory of TRIZ was published in 1959.

The hypothesis assumed that "there exists some universal invention principles which can be used as the basis for the inventing of new advanced skills. If these invention principles can be confirmed and organized to teach the inventors, then the invention process will be more predictable." The study was divided into several phases and lasted for 50 years. [8] More than one million patent documents were analyzed, and the patents were graded according to the difficulty of the invention. Three findings were obtained:
1. Repeated use of the standard questions and standard solutions in both industry and the scientific community
2. Repeatedly occurring types of technological evolution in both industry and the scientific community
3. Ability to facilitate technological innovation by using the scientific effects outside the field of interest

As a result, he has proposed that the inventive method theory must satisfy the following conditions:
1. It should be a systematic, repetitive, and reliable problem-solving procedure
2. It can guide the inventor to find the ideal solution from various answers
3. It is a method that can increase the invention knowledge
4. It is a structured and convenient system that enables the inventors to overcome the psychological barriers to enhance creativity.

TRIZ is a problem-solving method. It analyzes the problem and finds the contradiction. The contradiction is divided into Physics Contradiction and Technique Contradiction. [9] Different solutions are taken for each contradiction. The theory contains a series of innovative methods, but the most commonly used tool is the Contradictions Matrix and 40 Inventive Principles derived by Altshuller. The application of TRIZ has gradually been valued by Western countries in recent years and caused extensive discussion worldwide[10].

Mechanical engineers usually encounter conflicting issues when they solve engineering problems. Solving one of the problems will result in another problem, which implies that improving one engineering characteristic of the system will result in the deterioration of another engineering characteristic. The TRIZ method can effectively help engineers to solve engineering system interactive problems. To solve the problem, first, the Contradiction Characteristics of the system must be matched to Altshuller’s engineering parameters. Then, one finds the relevant inventive principles to solve the problem using the Contradictions matrix flowchart as shown in Figure 1.
2.3. Improvement
A washing ball with ultrasonic function is disclosed here. The washing ball may be vibrated by using a motor. The washing ball includes a shell body with at least one wing part formed thereon. The motor is configured into the shell body and has an off-centered component. A battery chamber is used for accommodating a dry battery to provide power for the motor.

This type of new multifunction washing ball utilizes ultrasonic technology for cleaning and is completely waterproof. This ball can be placed inside a washing machine to effectively turn it into an ultrasonic washer[11]. The ultrasonic washing ball can reduce the amount of detergent needed by half and still achieve complete cleaning of the cloth. No detergent is needed for washing infants clothes, just clean water. The strong ultrasonic agitation removes hidden dirt from the fabric fibers. This washing ball can upgrade and turn a traditional washing machine into an ultrasonic washer. The washing ball can also be used without a machine. When traveling, just place the washing ball in a wash basin with some water and your intimate clothing. There will be no need for any hand scrubbing. The multifunction washing ball will do the job and is clean and environmentally friendly.

3. Description
In this study, we developed a washing ball with a main shell. The outer part of the shell is equipped with wings along different directions. The shell is housed in left and right shells, which can be screwed together. A circular rubber gasket is arranged between the shells to prevent water from entering the shell. A battery-powered ultrasound device is arranged inside the shell. When the two shells are screwed together, the device generates ultrasonic waves in the water to improve the cleaning effect through the conductive sheet of the battery. The shell g is made of ethylene-vinyl acetate (EVA) and plastic. The wings and shells are formed integrally. The shell can be spherical or elliptical. A semi-circular zigzag structure is designed at the edges of the wings to mimic rubbing during cleaning.
The wings have a few holes. The inner edges of the holes have fine fibers to assist with the generation of bubbles.

The washing ball described herein is slightly larger than a conventional laundry ball. It consists of a shell 13 with wings 2 in different directions. The shell 13 and the wings 2 are formed integrally by using EVA and plastic or rubber. The shell 13 can be circular, elliptical, or arbitrarily shaped. The edges of the wings 2 are arc-shaped to increase the effect of rubbing during cleaning. A few holes 3 are distributed on the wings 2. The inner edges of the holes have fine fibers 17 to guide the flow of water and assist with the generation of bubbles to enhance the cleaning effect. Figure 2 shows the appearance of the multifunction washing ball.

Figure 3 shows a cross-sectional view of the developed washing ball, including the left shell 20 and right shell (21), wings in the outer portion 2, holes 3 distributed on the wings with fine fibers 17 to guide the flow of water and assist with the generation of bubbles. The inner part houses the ultrasonic device 7 and the battery chamber 11. The ultrasonic device 7 and the battery chamber 11 are arranged inside the left shell 20 and the right shell 21, respectively. The battery inside battery chamber 11 is used as a power supply. The actual application is shown in Figure 4.
4. Conclusions
The multifunction ultrasonic washing ball has already been granted a patent as well as many awards. This is a brand new type of cleaning method. The strong ultrasonic cleaning power reduces the amount of detergent required, it also conserves water and is environmentally friendly. This product provides a convenient and safe alternative for homemakers as well as those who travel. Just use clean water with no detergent for cleaning infants undergarments and avoid the danger of chemical allergy and skin rash. This multifunction ultrasonic cleaning ball is very convenient for cleaning underwear[12], socks or stockings when traveling. It can also be used for delicate items that cannot withstand the churning of a washing machine. However, it is also very useful in the washing machine, for normal washes where it will not only add ultrasonic cleaning but will also stop washing from knotting up. Important clothing will not be damaged by the machine. In the past people often threw a few washing balls into the washing machine to prevent cloth from knotting up. This new ultrasonic washing ball has the added function of strengthening water flow. Just one ball can prevent clothing from knotting up and become hard to take out.

This device can also be used for cleaning in dangerous or narrow and small locations, such industrial chemical tanks or water towers where hand cleaning might be difficult or even hazardous. The washing ball makes cleaning more effective and improve labor safety, which can satisfy the requirements of disaster prevention and hazard mitigation.

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