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Design and Prototype Development of a Cleaning Device for Outdoor Advertisement

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Abstract: *In order to solve the problems that the outdoor advertisementposting spreads all over the wall and is difficult to clean up effectively, a portable cleaning device for removal of outdoor advertisement was proposed and developed. This paper analyzes the mechanical structure, working principle, and main technical parameterof this cleaning device. The mechanical structure of this machine is designed to be modular.A physical prototype was developed and some tests were carried out. According to the indoor and outdoor tests, the function of this device is properly as designs, proving the feasibility of the designing scheme.*

Key words: *Outdoor Advertisement, Cleaning Device, Portable, Prototype*

I. INTRODUCTION

Nowadays, with the rapid development of the economy, advertisement has spread to every corner around us. All kinds of advertising really bring a lot of convenience to us, but also bring great distress to people's lives. In many cities you can see all kinds of outdoor advertising posting, on walls, on the lamp post, the doors of the residential buildings, the ground and so on. Everywhere is the breeding places of the outdoor advertisement posting which mostly are about the housekeeping, the fake certificates, the trafficking in illegal goods and other information. This posting not only affects the city's public security, disturbing the public order, but also affects the city's image seriously [1-2].

At present, most of the sanitation workers use the traditional cleaning tools such as the small shovel, the blade in cleaning these outdoor advertising paper, which is not only time-consuming, but also not efficient. Some other cleaning tools such as pressure water guns will need large equipment that are more expensive and not easy to use[3-4]. In view of this situation, there is a strong need to develop a portable cleaning device for cleaning the outdoor advertisement posting effectively.

In the study of the similar projects at home and abroad, the ads cleaning device just cleaned the surface covered with advertising paper, but not taking the cleaning of the scraps on the ground after cleaning the wall . At the same time, the traditional cleaning machine cannot replace the brush head according to different cleaning surfaces and cannot meet the needs of different height of the clean object, not to mention to meet the actual demand of people [5-7]. Usually the traditional cleaning devices are too inconvenient to carry and have location limitations, so the design of the new advertising cleaning device needs to take all these known drawbacks into consideration. Only improve the equipment portability of the device can it meet the needs of the society. In this paper, the mechanical structure and working principle of a new type of outdoor advertisement cleaning device are introduced. In addition, a physical prototype was developed and some tests were carried out. The device is specifically for the immediate needs of the sanitation workers and can effectively remove the outdoor advertisement posting. It is small in size, flexible and convenient, and can be applied to various situations. The device overcomes the weakness of the current similar machines, it has not only good practical and commercial value, but also good for the society in general.

II. THE MECHANICAL STRUCRUREOF THE CLEANING DEVICE

2.1 **The basic design idea**

This outdoor advertising cleaning device proposed in the test, including the clean-up box, the pipelineline and the cleaning-head this three main modules which connected in turn. Its working process is as follows: first of all, the gear motor drives the miniature hydraulic pump, the pump control ta nozzle to inject the organic solvent, softening the advertisement paper on the wall or other cleaning objects. Then, the motor drives the rotation of the spindle, the spindle drive the wire brush to rotate, tearing off the advertisement paper. Finally by the rotation of the cylindrical roller brush driven by the gear motor, pushing the confetti into the confetti collection box, completing the whole operation process. The whole device is powered by the battery (It should ensure the speed of the brush is not lower than 2000 r/min), which is placed in the cleaning box. According to the test, to achieve the goal of low-cost, multi-functional and efficient effect, the water softening device, the cleaning device and the confetti collecting device are set as a whole. Compared with the existing technology, the design of the outdoor advertising cleaning device proposed in this paper has the advantages of simple structure, convenient using, widely range of cleaning, etc.

Figure 1: The 3D model of the cleaning device

2.2 **The concrete design of the overall structure**

The mechanical structure of this device is designed to be modular and its main structure including the clean-up box, the pipeline device and the cleaning-head. The 3D model of the cleaning device is shown in figure 1. The Clean-up box including the solution tank arranged in the upper part of the clean-up box and the confetti cleaning-box arranged in the lower part of the box. The pipeline device includes a miniature hydraulic pump, the pipeline and a nozzle connected with the end of the pipeline. The cleaning-head comprises a telescopic rod, a motor and a brush head which is replaceable. At the bottom of the clean-up box is fixed with four universal wheels, which allow us to move the device according to any operational needs.

2.2.1 The design of the clean-up box

The clean-up box including the solution tank and theconfetticollecting-box. The solution tank is fixed in the upper part of the clean-up box and the confetti collecting-box is fixed in the lower part of the clean-up box. It includes the following specific parts: a battery, a solution tank, a miniature hydraulic pump, a geared motor, a cylindrical rolling brush, a confetti collecting-box. On the outside of the clean-up box, the box was connected with the telescopic rod through the pipeline and the pipeline passes through the telescopic rod. The other end of the pipeline connected with the nozzle which was fixed to the upper end of the telescopic rod. The solution tank which is fixed inside the clean-up box is connected with the miniature hydraulic pump via the pipeline. The small hydraulic pump control the nozzle to inject the organic solvent, softening the advertisement paper on the

wall or other clean objects. There are four universal wheels fixed at the bottom of the clean-up box to ensure the mobility of the device. The 3D model of the clean-up box is shown in figure 2. The 3D model of the confetti collecting device is shown in figure 3

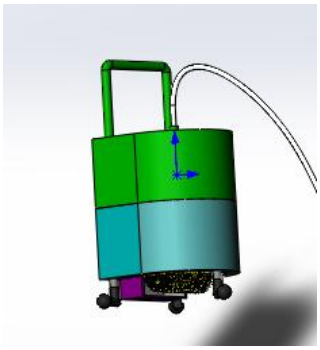

Figure 2: The 3D model of the clean-up box

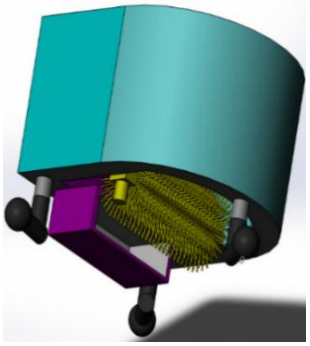

Figure 3: The 3D model of the confetti collecting device

2.2.2 The design of the cleaning-head

The cleaning-head comprises a telescopic rod, a motor fixed on the upper end of the telescopic rod and a brush head connected with the motor. The 3D model of the cleaning-head is shown in figure 4. After the nozzle injecting the organic solvent which can soften the advertisement paper, the motor drives the wire brush to rotate, tearing off the advertisement paper. The brush head including the steel wire brush and the plastic brush which can be replaced according to the different cleaning objects to achieve the protection of the objects.

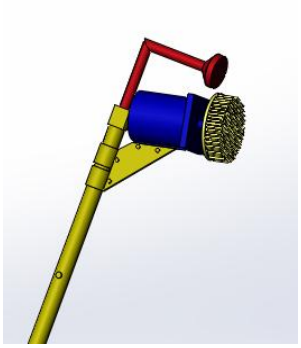

Figure 2: The 3D model of thecleaning-head

2.2.3 The design of the telescopic rod

A nozzle, a motor and a replaceable brush-head are fixed at one end of the telescopic rod and the other end of the telescopic rod is connected with the clean-up box through the water pipeline. The length of the telescopic rod can be adjusted freely to make the brush-head to reach any height, expanding the range of cleaning of the device and increasing the practicality of the device.

III. THE OPERATIONAL PRINCIPLE OF THE CLEANING DEVICE

The schematic diagram of the cleaning machine as shown in figure 5, is mainly composed of the clean-up box, the pipeline and the cleaning-head this three main modules.

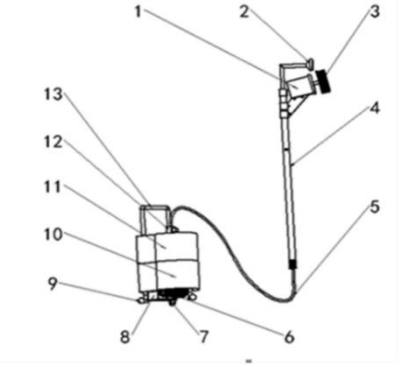

Figure 5: The schematic diagram of the cleaning machine

The specific work process of the cleaning device mainly includes three steps: the first step is the injection of solvent to soften the advertising paper, the second step is the rotation of the brush-head to tear off the advertising paper and the third step is the collection of the confetti. The solution tank fixed in the upper part of the clean-up box and at the top of the tank is fixed with a miniature hydraulic pump. The other end of the pipeline is connected with a nozzle. After open the switch of the gear motor， the gear motor drives the pump to control the nozzle to inject the organic solvent, softening the advertisement paper on the wall or other clean objects. Then, open the switch of the motor, the motor drives the wire brush mounted on the shaft to rotate, tearing off the advertisement paper. According to the different cleaning surface condition we can change the brush head to achieve not only the perfect cleaning effect but also the protection of the cleaning surface.Finally, according to any operational needs we can move the device owning to the universal wheels fixed at the bottom of the clean-up box. By screwing the retraction rod at the top of the cylindrical plastic universal wheel, the rolling brush touch the ground and at the same time the gear motor drives the rolling brush to rotate, which can push the scraps of paper into the collecting-box. The collecting-box can be disassembled for dumping the garbage. Turn off the power after the end of all processes.

This device is equipped with the telescopic rod which can guarantee the range of cleaning. Owning to the rod, those outdoor advertising paper of various heights can be cleared off . At the lower part of the cleaning box is arranged with the universal wheel, so the cleaning machine has the advantages of convenience and flexibility, reducing the burden of work. At the upper part of the cleaning box is arranged with the handle and the size is suitable for the ordinary adult to operate [8-9].

IV. THE DEVELOPMENT OF THE PROTOTYPE AND THE TESTS

The photos of the prototype is shown in Figure 6. Through the field experiment, the prototype can realize the function as follows: softening the advertisement paper on the wall or other clean objects;tearing off the advertisement paper; collecting the confetti. Making the prototype of the cleaning device mainly purchased the parts as follows: the brush as shown in Figure 7, the telescopic rod as shown in Figure 8, the nozzle as shown in Figure 9, the cylindrical brush as shown in figure 10. With the telescopic rod as the main body to develop the cleaning head and one end of the rod is fixed with a nozzle, motor and brush head can be replaced. The water pipeline passes through the telescopic rod, one end of the water pipeline is connected with a nozzle and the other end of the water pipeline is connected with the miniature hydraulic pump which is fixed in the solution tank. The development of the clean-up box mainly comprises two parts, one part is

the solution tank fixed in the upper part of the clean-up box, the other part is collecting-box for the scraps of paper fixed in the lower part of the clean-up box. The device of confetti collecting includes the gear motor, the cylindrical brush and the collection box.

Figure 6. Photo of the prototype

Figure 7. the brush

Figure 8. The telescopic rod

Figure 9. The nozzle

Figure 10. The cylindrical brush

In order to verify the design of the outdoor advertising cleaning device can achieve all the goals, we carried out a series of laboratory tests and outdoor tests, as shown in Figure 11 and Figure 12. In the actual experiment, the cleaning machine can achieve the goals of cleaning of the advertisement paper on the wall or other clean objects and the realization of the collection of the confetti. In addition, we have done a series of experiments at the newspaper board, the walls covering with all kinds of advertising paper and the effect is significant. We invited some sanitation workers to conduct the field work and get high praise. It has been used in some decoration companies and domestic Service Corporation and get good response. The main technical indexes of the prototype are shown in Table 1, and the parameters can meet the requirement of the actual work.

Figure 11 the laboratory test

Figure 12 outdoor test

Table 1: The main technical indexes of the prototype

The size of the clean-up box（m）	0.40(Length)×0.3（ width）×0.6(height）
The size of the telescopic rod（m）	The maximum length is 2, the shortest length is
The quality of the whole device(kg)	10
Battery	12V 9AH
Motor	12V
Miniature pump	12V 5W
Camera	12V
The other components	According to the specifications required to buy in

V. CONCLUSIONS

Taking the portable outdoor advertising cleaning device as research object, this paper puts forward a design scheme setting the solvent injection device, the brush cleaning device and the cabinet collecting device as a whole and analyzes the mechanical structure and the working principle of this small ads cleaning machine. The mechanical structure of this machine is designed to be modular, then a physical prototype was developed and some tests were carried out. The experimental results show that this device can achieve the goal of softening the advertisement paper, tearing off the advertisement paper and collecting the confetti. The device is specifically for the immediate needs of the sanitation workersand can be applied to various environment, not only has good practical value and commercial value, but also has higher social welfare.

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