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# A Crawler-type Amphibious Walking Device with Flexible Body-Filled Board

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***Abstract*—At present,with the development and utilization of river and sea resources at home and abroad, a kind of amphibious equipment which can realize the movement in various environments such as beach, lake and land is in urgent need. In which, the walking device occupies an important position. This paper provides a crawler-type amphibious walking device with a flexible body-filled board used for amphibious equipment, such as land and sea amphibious equipment for land,slope,swamp,ditches and other environments under high performance sports.**

***Keywords— Cleaning boat; Non-structural environments; Amphibious; Filled board***

## I. INTRODUCTION

With the development and utilization of river and sea resources at home and abroad, such as the development of small and medium-sized rivers need a kind of amphibious equipment which can realize the movement in various environments such as beach, lake and land. Good exercise performance and a series of characteristics of the walking device in the amphibious equipment occupies an important position.

According to the different forms of amphibious equipment and movement, the existing amphibious equipment can be divided into two types. Single drive type and compound drive type. However, the amphibious device with single driving method has simple structure and low efficiency. It's versatility is poor and difficult to fully meet the amphibious equipment in water or on the land of many required environments. Composite drive mechanism in recent years become a focus for amphibious equipment research, such as the wheel-crawler and propeller-crawler. Most of the equipment has the advantages of complex structure, complicated control, low efficiency and high cost. At the same time, few amphibious walking devices can meet the high performance of amphibious equipment in land, slope, swamp, river channel and so on. There are many types and specifications of cleaning machineries and equipment for small rivers. Such as the Fig.1 shows.

Fig.1 The existing cleaning boat

Except for this, there are several other oil sewage collection vessels; floating rubbish salvage ships; garbage transportation ships; cleaning boats and dirty-pushing machines. However, these devices are based primarily on wetlands excavators, dredging boats, bucket garbage boats, plant-harvesting boats and other traditional equipment, and most of the devices have the single function and only suitable for operations in water but can not be used for flat lands, slopes,obstacles, ditches and other non-structural environments simultaneously.This paper describes a new crawler-type amphibious walking device with flexible body-filled board that can be used for non-structural environments.

## II. SUMMARIZATION OF THE PROPULSION MECHANISM

Among the existing propulsion mechanism used for boats, wheeled and tracked are the most common[1] The wheeled propulsion has a poor ability to cross the ditches, stairs, and can not be used in the water; The crawler propeller has a strong ability to adapt to the terrains and it is suitable for traveling over rough grounds and also has the characteristics of high efficiency, small loads and compact design. However, it can't meet the requirements for working under the water.

This paper describes the mechanism has the characteristics of outstanding ability to adapt to terrains and meet the dual demands for working in water and on the ground, it is also well suited for complex, unknown and unstructured environments. The propulsion mechanism is characterized by:1. Only two kinds of special-shaped crawler are used to realize amphibious walking. 2.The hollowing structure adopts the hollow structure, which is lighter in weight than that of the solid track. 3. Even if the shell is damaged and leaked, the rigid flexible partitions can still keep the plate shape basically unchanged to ensure the normal walking of amphibious equipment.

## III. THE INTRODUCTION OF NEW AMPHIBIOUS WALKING DEVICE

The new amphibious walking device will now be described with reference to specific embodiments and the accompanying drawings. As is shown in Fig.2, a crawler-type amphibious running apparatus is provided with a flexible body-filled flat plate (0), which comprises a reticle body (1) and a connecting plate (2) .


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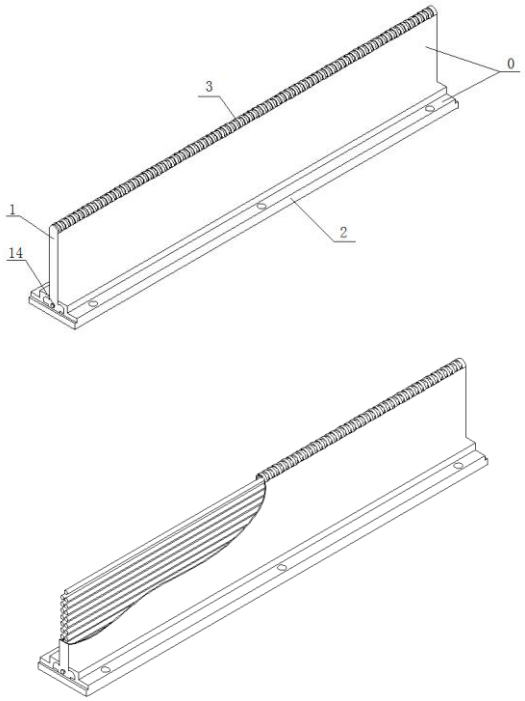


Fig.2 The schematic view of a flexible-filled scaffold for a crawler-type amphibious

As is shown in Fig.3, the board body 1 includes a rectangular housing 11, in which the front and rear surfaces are symmetrically protruded in a curved and the inside of the tightening connection portion 13 is a hollow structure and communicates with the inside of the casing 11.The casing 11 and the tightening connection portion 13 are filled with a hollow or solid flexible filler 12. The upper surface of the casing 11 is provided with an inflatable nozzle 14 on the left side. An arched shape inclined toward the front and rear surfaces of the casing 11. As is shown in Fig.2, the arch top of the reticle body 1 is provided with a tread texture 3 for increasing its frictional force with the ground.

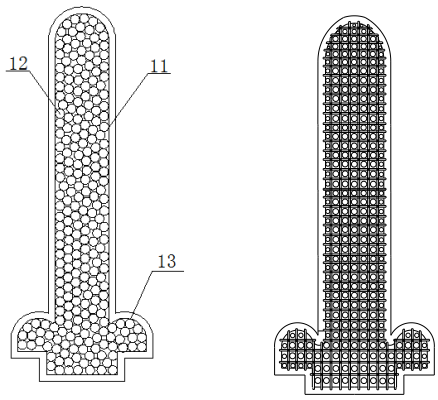


Fig.3 The internal structure of the reticle body

The lower surface of the tensioned connection portion 13 has a fan-shaped cross section, and the lower surface of the tightening connecting portion 13 has a plane parallel to the bottom surface of the housing 11. The upper surface of the tension connecting portion 13 is connected to the casing 11 and the tightening connection portion 13.The lower surface of the arc is greater than a quarter.

The flexible body filler 12 is a hollow or solid irregular, regular space geometry, or a regular strip of hollow or solid, and the hollow body may be inflated. As is shown in Fig.4, it may be a sphere, a cylinder, an irregular polyhedron, a positive dodecahedron or a columnar body, or an inflatable columnar body; On the one hand, there is a void between the objects 12, and on the other hand, the scaffold body 1 can be appropriately deformed to accommodate various terrain.

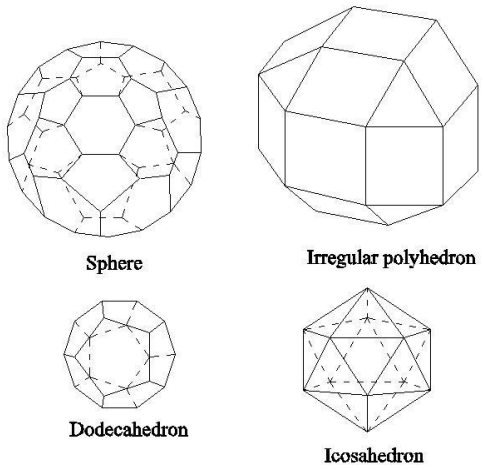


Fig.4 Schematic representation of a flexible body

The shell of housing 11 is made of a high strength, abrasion resistant rubber material and inflated to a certain extent.

As is shown in Fig.3 and Fig.5, the upper surface of the connecting plate 2 is symmetrically protruded from the center line of the connecting plate 2 and the engaging groove 21 is engaged with the tightening connecting portion 13 of the housing 11. The inner wall of the chuck 21 is opposed to the tightening connecting portion 13. The recesses 22 of the upper surface of the connecting plate 2 are provided with recesses 22 which are recessed to accommodate the lower fitting portion 13 and the lower sides of the upper surface of the connecting plate 2 are also symmetrically provided with a plurality of fixed holes.

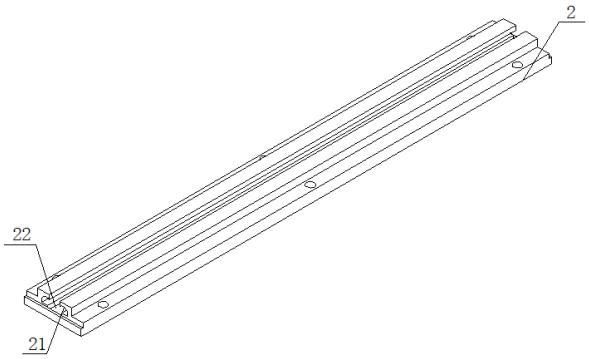


Fig.5 The connection plate structure diagram

The screed body1 is fitted into the card slot 21 of the connecting plate2 by means of the tightening connecting portion13 and is connected to the connecting plate2. The reticle body1 is inflated by the inflatable nozzle14 so that the tensioned connecting portion13 and the chuck21. The lower


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surface of the casing11 and the recesses22 are integrally formed integrally with each other, and as shown in Fig.6, the reticle body 1 is equally spaced in the direction of transmission along the chain of the connecting plate2.The cloth is fixed on the chain of the crawler amphibious walking device.

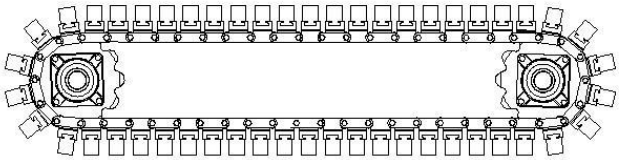

Fig.6 Schematic that the amphibious walking device connected to a chain

As is shown in Fig.7, the crawler-type amphibious walking device is mounted on the chain of the crawler-type walking device of the amphibious equipment by means of a flexible filling plate, and satisfies the requirements of the amphibious equipment in water and on the land.

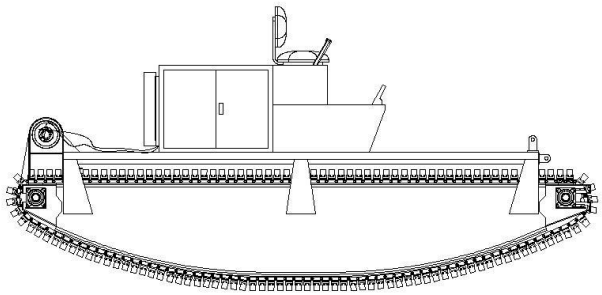

Fig.7 Schematic of an embodiment of the amphibious walking device

## IV. ANALYSIS OF WORKING MECHANISM

When the amphibious equipment is on land, the crawler-type amphibious device installed on the chain acts as a shaped tire with a flexible filling plate. Since the reel body 1 is filled with a flexible body filling material 12,The support rigidity of the crawler-type amphibious walking device is such that it can support the weight of the entire amphibious equipment and the hollow or solid structure of the flexible body filler 12 and the polygonal surface so that the scaffold body 1 is soft. The interaction between the body fillers 12 produces moderate deformation and improves the terrain adaptability of the amphibious equipment. The tread texture at the top of the dome body 1 can effectively increase its frictional force with the ground and facilitate the amphibious equipment to walk in the wet slippery on the ground.

When the amphibious equipment works in water, the crawler-type amphibious walking device installed on the crawler belt is filled with a flexible body-filled reticle as a water cut plate. Since the flexible body filler 12 and the hollow filler itself can be inflated, can effectively increase the amphibious equipment in the water buoyancy.

As is shown in Fig.3, when the screed body 1 is caused to be leaked due to scratches or other damages, the flexible body filler 12 serves as a schematic view of the board body 1 from the inflated state to the leaked state. The deformation of the body 1, its own support stiffness can ensure that the reticle body 1 will not produce excessive elastic deformation and affect the normal use.

## V. THE BENEFICIAL EFFECTS OF THE PRESENT AMPHIBIOUS WALKING DEVICE

1) Amphibious. The refillable reticles filled with soft objects act as irregular tires for supporting the weight of the entire amphibious equipment and provide forward momentum when forward on land; The refillable reticles act as paddles when working in water to provide the power forward and backward.
2) Increasing the supporting rigidity and reducing the reticle deformation. When the reticle appears scratched or other damages that lead to air leakage phenomenon, the supporting stiffness of hollow or solid soft objects filled in reticles themselves can guarantee the reticle from excessive elastic deformation so as to guarantee the normal use and long-term maintenance-free.
3) Increase the buoyancy. Between hollow or solid reticle within the soft body filler plus air-filled hollow filler and add the charge air increases the amphibious equipment in water buoyancy.
4) Good terrain applicability. The hollow or solid flexible filler between the interaction can make the plate to produce moderate deformation, improve the terrain adaptability.
5) The added rigid flexible partitions between the plate filler can ensure that the force when the overall shape of the plate is not changed, easy to use.

## VI. THE IMPLEMENTATION CONSEQUENT OF THE AMPHIBIOUS EQUIPMENT

Fig.8 The implementation of the amphibious walking device

## VII. CONCLUSION

Aiming at the river pollution status at home and abroad, a new kind of amphibious clean-up boat is designed and manufactured to solve the problem of river pollution; Based on our proposed flexible board, the overall of amphibious walking device was designed. The advantages of refillable reticle were explained. Finally, through the implementation of the operating conditions to the feasibility of the designed amphibious walking device was checked and verified. The


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paper provides a certain reference significance for the development of future amphibious equipment.

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