

Research Article

Study and Design on Amphibious Ship for Sightseeing Amusement

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Abstract: The study purposes is to design a new tourism appliance that is beautifully shaped, easy to operate, in line with the ergonomics and could happily combine fitness and entertainment. It is an amphibious ship applicable to park or amusement park, which not only travels in water, but also on ground. This article specifically researches its working principle, internal structure and appearance shape, including the design of aquatic motion mechanism and ground motion mechanism. And then its market prospect is analyzed. On this basis, the corresponding conclusions are reached.

Keywords: Amphibious ship, aquatic motion mechanism, ground motion mechanism, tourism appliance

INTRODUCTION

With the development of the modernization of life and the unceasing enhancement of people's living standard, all kinds of amusement places become the places by patronized frequently. Some novel sightseeing amusement equipments are not only popular with children, but also adults (Xin and Wang, 2007). Among the numerous sightseeing amusement equipments, the cars and boats are much concerned by people, but the existing cars and boats for sightseeing amusement either are shaped rigidly or lack humanity (Wei and Jiang, 2012). Of course, the main shortcoming is that their function is single, such as the cars could only walk on ground and the boats could only cruise in water, without a kind of car or boat could not only cruise in water, but also walk on ground. In this way it brings much inconvenience, such as to the lake it needs to take a boat and to the land it needs to take a car. The rearrangement of back and forth is very trouble, which often makes people tired (Jiang, 2013a).

Therefore, the study is to design a new tourism appliance that is beautifully shaped, easy to operate, in line with the ergonomics and could happily combine fitness and entertainment. It is an amphibious ship applicable to park or amusement park, which not only travels in water, but also on ground (Wu *et al.*, 2004). This study specifically researches its working principle, internal structure and appearance shape, including the design of aquatic motion mechanism and ground motion mechanism. This research will be beneficial to solve the above problems about sightseeing amusement. It could provide one-stop service and could well meet the common need for sightseeing on ground and leisure in water, which makes the sightseeing amusement more smooth and more comfortable (Zhang, 2000). Meanwhile, it has simple structure, novel design,

convenient operation and low cost, extremely possessing fun and entertaining. In addition, it drives the boat trip through manpower with pedal way, which could have very good fitness effect, such as the exercise of strength in waist and lower limbs and endurance, as well as the whole body coordination.

LITERATURE REVIEW

Amphibious ship has excellent unimpeded performance, which could cross mountains and river, not restricted, so it could play an enormous role in the military, transportation, disaster rescue, exploration survey and other professional fields (Xiao, 2008). Amphibious ship was applied in the military field in the beginning, deriving from the military landing craft during WWII, after the development of transformation, usually applied for tourism and leisure (Wang *et al.*, 2004).

Currently, amphibious tourism projects are popular in the developed country, which have operated for many years in Brisbane of Australia, Singapore, Ottawa, Montreal, Toronto and Nova Scotia of Canada, New York, Washington, Miami, Philadelphia, George and many other cities of the United States. In 2001, 36 shipping experts including engineers who are from Australia, Italy, the United States, Germany, Britain and China gathered in Australia's gold coast. They constantly developed and updated the speed, performance and function of amphibious vehicle and after 5 years development, finally they created the Australia international amphibious cruise ship- "adventure duck" amphibious sightseeing ship, costing millions. Amphibious projects were further applied to tourism industry, used in Cairns, Brisbane and other famous tourist resorts.

In 2009, Qingdao Shengshifeiyang sea cruises co., LTD. (China Shengshi investment co., LTD., a wholly owned subsidiary), conforming to the trend of The Times, introduced the Australian "adventure duck" amphibious ship to Qingdao coast in China and applied it to carry out amphibious sightseeing tourism, filling the gaps in China's tourism market, which has opened up a new thought for China's tourism market.

In recent years, aiming at the shortcomings of the amphibious ship introduced from abroad and some suggestions and requirements of the masses of tourists, China Shengshi investment co., LTD. organizes domestic several military enterprise, purchase advanced vehicle technology in Australia and South Korea and set up the only officially certified "amphibious ship" research and development center and final assembly base, continuously to improve the amphibious ship, successively researching, designing and creating the second and third generation duck "adventure" amphibious ship with China's independent intellectual property rights and putting into daily operations, which is safer, more comfortable and more luxurious and is loved by tourists.

Because of its excellent unimpeded performance, amphibious ship has its unique operating advantages in the tourist cities or scenic spots which have the advantages of regional integration of tourism landscape, plentiful tourists and compound requirements within the waters. Amphibious ship must have huge development space and market prospects.

But the existing research also has certain problem, such as:

- This kind of large amphibious ship is expensive and its application scope is limited, not suitable for small lake waters in parks or amusement park, such as "adventure duck".
- It lacks the research on small mechanical amphibious ship, low degree of popularity.
- It lacks the characteristics of energy-saving and environmental protection and the fitness function.

STUDY METHODOLOGY

Confirm its shape characteristics: According to the vehicles and ships technique and industrial design theory, the author putts forward the research on amphibious ship for sightseeing amusement. Giving priority to ship and combining vehicle and ship is the overall guiding thought of ship design of amphibious ship for sightseeing amusement. To minimize the wave-making resistance, bow line adopts streamline, as shown in Fig. 1.

Confirm the overall design scheme: Through demonstration and simulation calculation, the author makes scheme screening to select the excellent one and finally determines the overall design scheme that the rudder is arranged front and the pedal drive is arranged



Fig. 1: Three-dimensional modeling of the amphibious ship for sightseeing amusement

in the middle. Such design that the center of gravity is low and the axial load distribution is reasonable is advantageous to the boat balance in water and climbing on ground. In particular, the rudder is arranged front, which changes the consistent practice that ships have always controlled the direction by stern rudder. It boldly adopts a front wheel to control the orientation. So, even if it sails in water, just as on land. Easily manipulating the handle of the direction just could drive freely, which not only avoids a lot of troubles on the operation, but also provides great convenience for drivers.

Study the aquatic motion mechanism and ground motion mechanism and the drive system:

Through argumentation and selecting the optimal scheme, ultimately it is determined that the aquatic motion mechanism consists of two propellers and a rudder; the ground motion mechanism consists of two rear wheels and a front wheel. To get the optimal design, the front wheel acts as a rudder in water, then connecting the front wheel and the handle of manipulating direction, so as to realize the steering. It could realize the movement by pedaling the pedal device with feet, transferring the power to the propellers and the rear wheels. In this way, the two manners of driving in water and on land, respectively share a set of transmission system, which is not only simple and reasonable, but also achieves the research goal of low cost.

Study the concrete structure and the design of all parts of the amphibious ship for sightseeing amusement:

According to the theory of mechanical design, after repeated research, finally it is determined the hull front end is equipped with a front wheel which is connected with the handle of manipulating the direction. The part of front-wheel hub does not set hole, so the front wheel could act as a rudder when sailing in water. The hull backend is equipped with the rear axle of which both ends are equipped with the rear wheels of which the insides are equipped with the propellers. Hull inside backend is equipped with two seats of which the front is the handle of manipulating direction, which makes the two persons who sit at the back all control direction, avoiding the fatigue of one person driving for a long time. Hull inside is also equipped with the pedal drive device which connects the rear axle through the chain. The front end of hull inside is equipped with two swivel chairs in order to make the two persons who sit

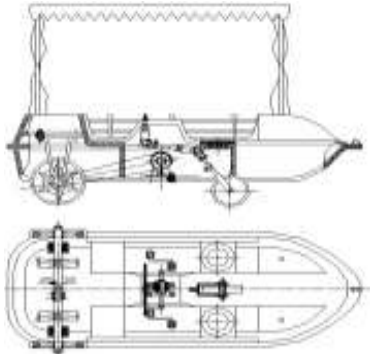


Fig. 2: General assembly drawing of the amphibious ship for sightseeing amusement (part)

in the front row change the sitting direction optionally and make the tourism freer and more comfortable, as shown in Fig. 2.

Study the humanized design of seats in the ship: The seat design should fully consider the man-machine engineering, because the correct sitting posture could reduce the energy consumption of the human body and eliminate fatigue (Jiang, 2013a). According to the theory of man-machine engineering, through scientific calculation, finally the following design is made:

Seat height: When putting a diameter of 350 mm, 60 kg half ball weight on the seat surface, it is measured to get the numerical value of seat height 360~480 mm. Meanwhile, in view of the thickness of life jacket, the numerical value of seat height takes 420 mm.

Seat width: At the intersection point of the seat central axis and seat surface or at the half of depth direction of seat surface, it is measured to get the numerical value of seat width 370~420 mm. The recommended numerical value is 400 mm, so the numerical value of seat width takes 400 mm.

Seat depth: At the height $g = 210$ mm of lazyback, it is measured to get the numerical value of seat depth 360~390 mm. when measured, it is not the stress state. The recommended numerical value is 380 mm, so the numerical value of seat depth takes 380 mm.

Lazyback angle: Research shows that when the angle β of seat surface and lazyback is $95^\circ\sim 115^\circ$, the intervertebral disc pressure significantly decreases, when leaning backward, human body feels most relaxed. So the numerical value of lazyback angle takes 110° .

Study the reasonable design of the hull and ceiling: The hull and ceiling uses glass fiber reinforced plastics which have high strength and light weight, resistant water and corrosion and are not afraid of exposed to the sun and rain, solid and practical. The ceiling is designed into the micro arch, the center slightly higher than the surrounding, which makes the ceiling will not save

water. Around the ceiling it does not need too much decoration, in order to realize the ideal effect of sightseeing while pedaling and widening vision. In addition, in the middle of the four pillars at the ceiling (in addition to the position of the front), it is equipped with the shading drape of waterproof material and the felt strip, which could be used to keep out, when meeting the rain or the dazzling direct sunlight, zipping up the shading drape of waterproof material; when not using, which could be attached to the pillars, which does not take up the space, but also plays a decoration role. The bow uses concave deck design, so as to facilitate people up and down the ship.

The ceiling is designed slightly higher, so as to avoid excessively bending down when people enter the cabin; the height of guardrail on either side of the boat was should be moderate, which not only plays a protective role, but also gives the arms effective support, such as to ease the fatigue caused by pedaling; it is equipped with high elastic rubber anti-collision fender around the hull. Any exposed portion of hull that has contact with people is all rounded transition, which is not only rich of affinity, but also could avoid collision (Jiang, 2013b).

SIGNIFICANCE AND PROSPECTS

Study and design on amphibious ship for sightseeing amusement will fill a void of tourism in our country. Because of its amphibious special function, it could widely apply to agriculture, health, public security and all fronts. Used as a means of transportation of tourism, it has more unique superiority.

In addition, the opening of market economy inevitably leads products to constantly update. Tourism appliances as the goods are no exception. The shift from unitary type to versatility is the modern economy of rapid development demand for industrial products. Therefore, the amphibious ship for sightseeing amusement will be popular with the whole society and the development prospect is good (West and Deng, 2010). According to preliminary investigation, people are very eager to the amphibious tourism appliance. It is believed that it is once available and it will be in short supply.

The amphibious ship for sightseeing amusement not only has the very high social benefits, but also its economic benefits will be considerable (Zhang, 2000). According to preliminary estimation, a single cost could be controlled in about RMB 9,000 Yuan and the lowest selling price could be set at RMB 12,000 Yuan. If establishing a amphibious ship company whose annual output is 5000 amphibious ships for sightseeing amusement, it not only could solve the employment problem of about 600 people, but also provide tax turnover of about RMB 4 million Yuan for the country every year.

CONCLUSION

This study is to design a mechanical amphibious ship of small type, filling the gap on the market. It is suitable for small lake waters and has high popularity degree. The two manners of driving in water and on land respectively share a set of transmission system, which is simple and unique. In addition, it drives the boat trip through manpower with pedal way, which is energy-saving and has environmental protection and very good fitness effect. In particular, the rudder is arranged front, which changes the consistent practice that ships have always controlled the direction by stern rudder. It boldly adopts a front wheel to control the orientation.

At the same time, the design of the amphibious ship for sightseeing amusement, of which the shape is beautiful; the structure is simple and reasonable; the technical content is high; manufacturability is good; the cost is low; the operation is convenient and the safety performance is good, is in line with the ergonomics, meets the demand of tourism, fitness and entertainment and achieves the double function of traveling in water and on ground.

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