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DESIGN AND FABRICATION OF AIRBOAT

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ABSTRACT

The word airboat comprises of the two words namely Air and Boat . Boat is a means of transport of goods , people etc by means of water . Thus the boat which runs on the water surface by means of the propelling force derived from the air is called an airboat .The cons of the water propelled boat are that they require high fuel to run the motor which in turn runs the propeller . This costs high to the boatsmen which are having poor standard of living . Moreover the dirts present in the water stream also hinders the operation . The other factors which effects the performances are density of water , drag experienced by the boat and so on.This paper aims at design and fabrication of airboat which reduces the fuel cost ,friction and problems associated with density of the liquid over which the boat is moving. This paper states about the fabrication of an airboat model that comprises of a propeller fan powered by the 12 V dc supply and works on the principle of Newton's third law .A rudder to change the direction of the boat due to effect of pressure difference across its blade and air tube which floats over the liquid . It reduces the friction and takes care of the buoyancy effects.

Keywords: Airboat, propelling force ,friction ,rudder , buoyancy , Newton's third law.

I. INTRODUCTION

During floods it has been found that the navy rescue team meet with many circumstances where they cannot use their conventional water motor boats due to submerged obstacles at unprecedented depths. Therefore designing an airboat which overcomes all these obstacles and have a rescue capability deemed a national necessity.

The paper deals with the fabrication of the model of an electric propelled airboat. The airboat comprises of a 3 blade propeller .The propeller is runned by a 12 V dc supply .The propeller provides the necessary thrust to the airboat and works on the principle of Newton's third law of motion. The rudder is provided for steering (direction changing) and stability. Air filled tube(of 20 to 25 psi)is placed at the bottom which takes care of the buyoncy and friction effect.

II PRINCIPLE OF OPERATION

The principle of working of the airboat can be studied under following aspect :-

Mechanical Aspect :-When looking from the mechanical point of view , making of

airboat involves the concept of Fluid Mechanics .The forces acting on an Airboat are :-

→ Weight .
→ Byuount Force .
→ Thrust
→ Drag (Air Resistance).

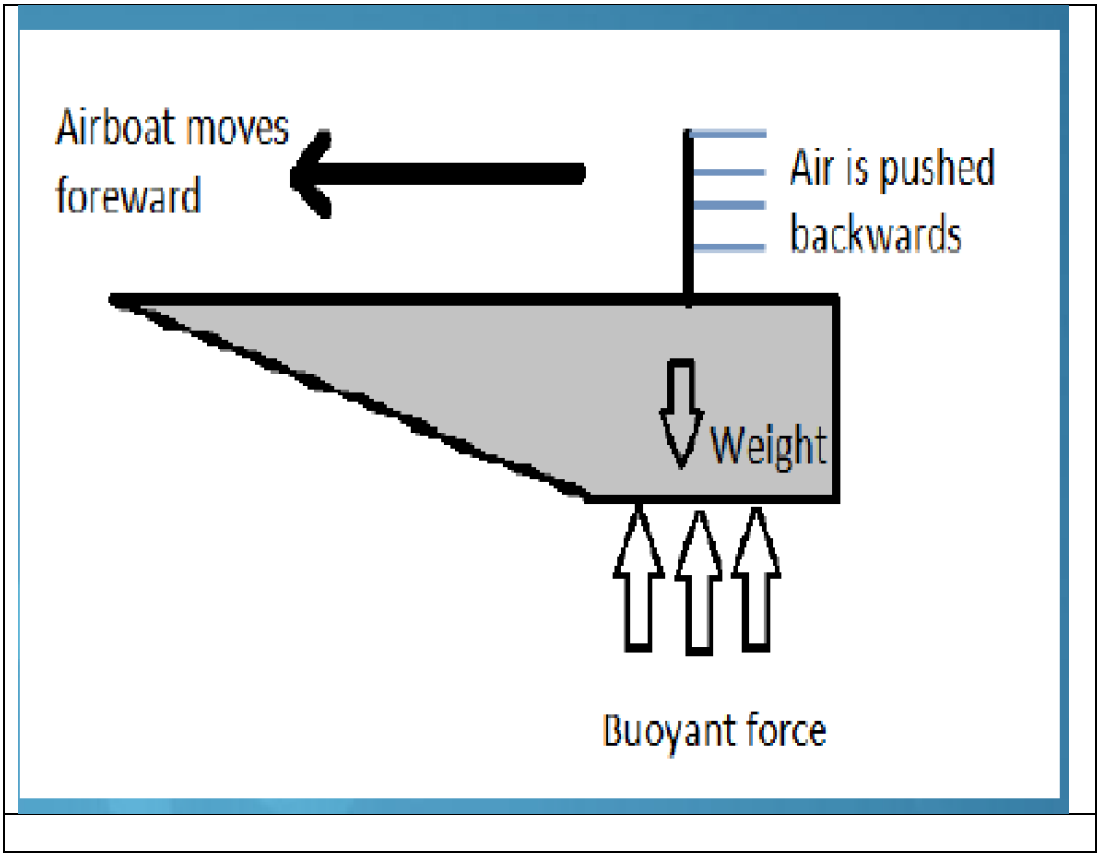


Figure 1 :- Forces acting on Airboat

1.)Weight force :- This is the force exerted by the boat on the water surface by virtue of the gravity of the earth . This is also called as the gravity force .The weight force includes the weight of the material by which the boat is made as well as the payload it carries .

2.)Buoyant Force :- A submerged body in a liquid experiences an upward force due to the fluid pressure . This upward force exerted by the liquid on the body is called as the Buoyant force . The magnitude of this buoyant force is given by the ***Archimede's Principle*** , which is stated as follows :-

" A body immersed in a fluid is buoyed or lifted up by a force equal to the weight of the fluid displaced by the body . The body apparently loses as much of its weight as the weight of the fluid displaced by it . A floating body displaces volume of fluid just sufficient to balance its weight ."

Thus Buoyant Force (F_b) = weight of the water displaced by the boat .

Condition of Equilibrium :-

At this point ,it will be very useful to understand under which condition the body (in our case boat) will remain in the floating condition when it goes into water .Before we find this required condition , it becomes of prime importance to see all the possible conditions when a body (in our case boat) is acted upon by the weight force and the buoyant force .Depending upon the ratio of the weight W of a body and the buoyant force F_b , three cases are possible :-

i. $W > F_b$:- the body tends to move downwards and eventually sinks .
ii. $W = F_b$:- the body floats and is only partially submerged .
iii. $W < F_b$:- the body is lifted upwards and rises to the surface .

In case of an airboat Case (ii) has to be achived .

i.e Weight of the body = Buoyant Force

$W = F_b$

3.) Thrust Force :-The word thrust literally means to push forward . Thus is case of an airboat , thrust is the force which propells the boat in the forward direction . Generation of thrust is based on the Newton's 3rd law of motion , which states :

" *To every action there is an equal and opposite reaction.*"

4.) Drag Force :- It is the resistance offered by the air when the boat moves in the forward direction .

III PARTS OF AIRBOAT MODEL

1. Base of the boat
2. Propeller.
3. Rudder.
4. Electrical connections.

1. Base of the boat :

The base of the boat is one of the most important construction as all the other accessories will be mounted on it . It should be taken into consideration that the base should be so heavy that it sinks neither it should be so light in weight that it is not able to maintain the stability.In the present model making of the airboat the following materials are used tyre tube , ply wood ,zip locks The steps involved are :

1.) Cut thetyre tube to bring it into required size. Figure 2(b)
2.) Drill holes and tie the tube by means of either zip locks or wires Figure 2(c).
3.) Filling of air in the tube . Figure 2(d)
4.) Base after filling of air .Figure 2(e)
5.) Figure 2(f) shows the top of the base on which other mountings will be mounted . Tube will remain in contact with the water surface.

a : Tyre Tube

b : Cutting of the tyre tube

c: Drilling holes and tieing it with zip locks of wires

d : Filling of air in the tube

e: Base after filling of air

f: Top of base where other accessories can be mounted.

Figure 2 : Steps of base making

2. **The Propelling mechanism :** In order to move the airboat in the forward direction , a thrust force is required. This thrust is generated by means of a propeller. There can be different types of propeller which can be used as per the acceleration required in by the boat . It can be two blade propeller , three blade propeller or the

four blade propeller. Here , in this model four blade propeller is used which gives a reasonable acceleration as required (figure 3). The suitable scale ration of the blade can be taken for the prototype.

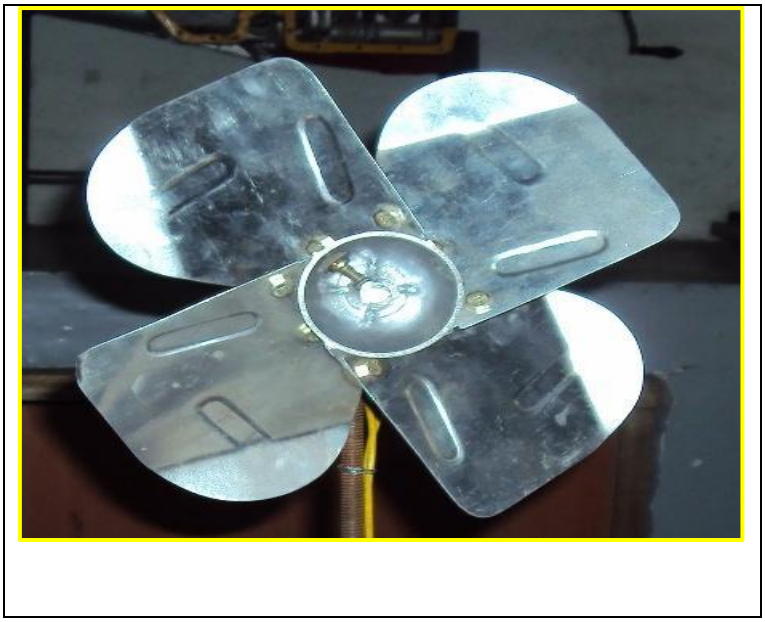
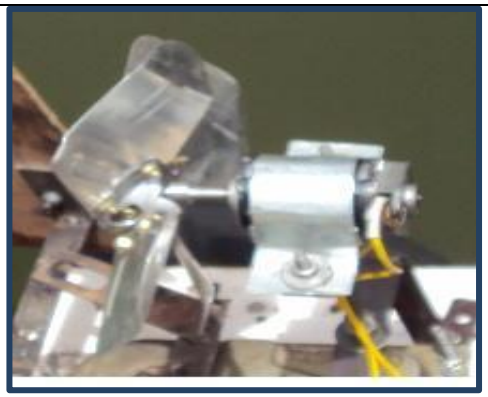


Figure 3 : Propeller fan used in the model

The propeller fan can be powered by means of IC engine , aircraft engine , motor etc. Taking consideration of pollution of the environment the use of electric motor is preferred (figure 4) . Here in this model making a dc motor operated with 12 V dc supply is used for the demonstration purpose. Reasonable performance was obtained by the motor and the required velocity and the acceleration were achieved.

a : 12 V dc motor



b : connecting of propeller to motor

c : Rear view of motor

d : Battery

Figure 4 : DC motor,its connection and battery

3.)Rudder :

In order to provide steering capability to the boat the air around the boat has to be manoeuvered. For this purpose rudder is used .A rudder is a primary control surface used to steer a ship ,boat ,submarine , hovercraft ,aircraft or other vehicle that moves through a fluid medium(generally air or water).To steer an airboat there must be substantial air traveling over the rudder. An idling engine does not provide sufficient steering except for a near-stationary boat. Even though it feels unnatural, it is an important concept in airboating that one must use engine power to steer around obstacles. When the operator lifts his or her foot from the acclerator, almost all steering ability is lost.

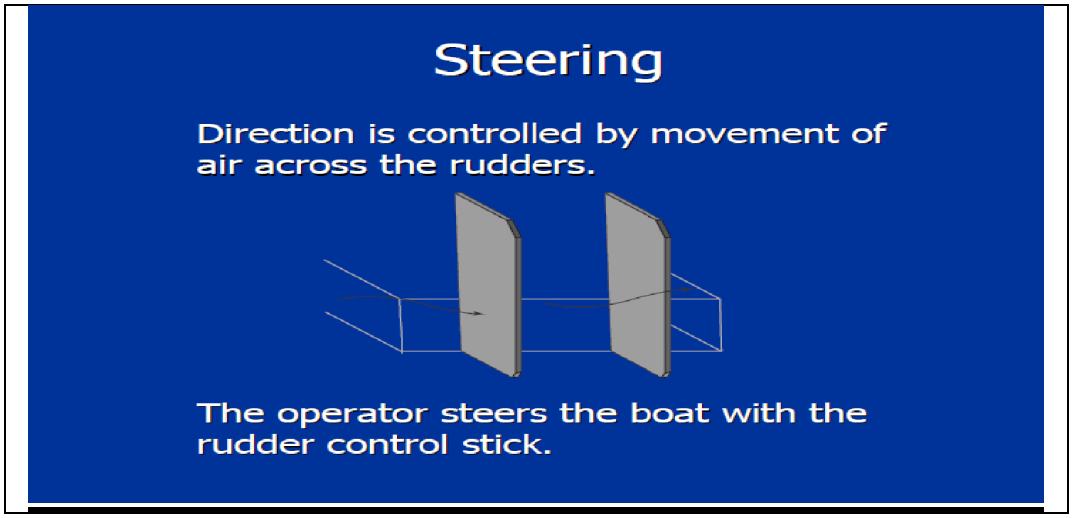


Figure 5 : principle of controlling rudder mechanism

In the present model making of airboat for making rudder the plywood is used for the purpose . A suitable blade angle is provided to the rudder to tear the air and provide the

necessary steering. The power to the rudder is provided by a steering motor which can move the rudder in both direction.

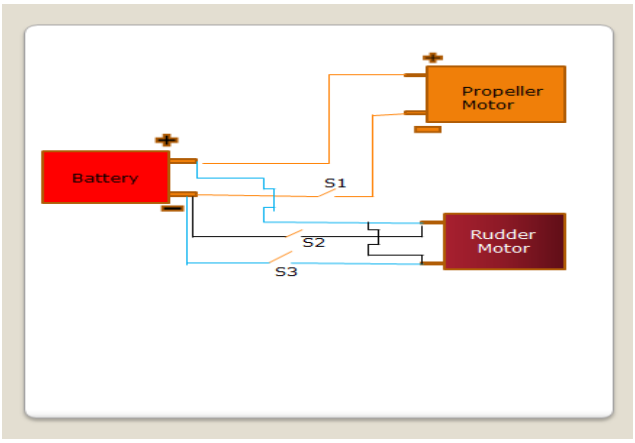
a : plywood plates for rudder

b : Rudder installation

c : Complete rudder installation

Figure 6 : Rudder and its installation

4.Electrical connections for propeller and rudder motor :



a : Electrical connection for propeller and rudder

b: top view of the final model

Figure 7

The simple electrical connections are done for operating the propeller motor and rudder motor. It is shown in the figure 7. The connections are done such that the propeller motor and the rudder motor can be operated simultaneously. And the finally the model is ready for the operation .

IV CONCLUSION :

From the present paper it can be concluded that an airboat can be designed and fabricated which can run over fluid medium such as water or muddy areas by using the force of air. For this propeller ,motor ,base setup and rudder is required. The system works on the principle of Newton's third law of motion and Archimedes Principle . This boat can run at a reasonable acceleration with proper steering capability. This boat can be used in water transportation and in case of natural calamities such as floods etc. The airboat which will be a great asset for the nation.

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