

Air Cushion Mobility System

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ABSTRACT

In any industry we use various material handling system. Most of them required high power and energy but in Air Cushion Mobility System requires less power and effort to move considerable heavy load. An air cushion mobility system is any system that employs a cushion of air the load from the ground. Air casters are systems which use air pressure to facilitate the movement materials in the industry. It uses continuous air pressure to create a cushion of air upon which the load platform floats. An air caster is a pneumatic lifting device used to move heavy loads on flat, nonporous surfaces. Its operation is similar to a hovercraft, as it uses a thin layer of air as a way to float a very small distance off the ground. Compressed air enters an airbag shaped like a torus, and when the bag is filled it creates an airtight seal with the ground, and forces more air into the centre of torus, eventually causing the air to flow over the bag and to raise the load above the ground.

I. INTRODUCTION

The most common method of moving heavy load across factory floors are cranes, trolleys, belt conveyors, rollers conveyors. All these method have their requires cranes that the infrastructure be forced to supports the load and in many case electric power and also there was a problem statement about the transfer of material handling in industries using pneumatics. It was decided to use air caster so as to transfer industrial goods from one place to another. The design details related to construct and working and other related things are discussed in forthcoming chapter Air casters are systems which use air pressure to facilitate the movement materials in the industry. It uses continuous air pressure to create a cushion of air upon which the load platform floats. An air caster is a pneumatic lifting device used to move heavy loads on flat, nonporous surfaces. Its operation is similar to a hovercraft, as it uses a thin layer of air as a way to float a very small distance off the ground. Compressed air enters an airbag shaped like a torus, and when the bag is filled it creates an airtight seal with the ground, and forces more air into the centre of torus, eventually causing the air to flow over the bag and to raise the load above the ground. The compressed air is forced under the airbag, pushing it and the load less than a millimeter off the ground.

The benefits of Air Cushion Mobility System are felt because of the "Force Equation" one parts of "Force Equation" state that "the force required to move a load over a surface is the product of weight x the coefficient of friction". The resistance to movement is a dramatically reduce when the load is floated on an "air cushion". Air because of its easy available and general characteristics is an ideal fluid to use for reducing friction drag between load and supporting surface. Since air buoyancy is omni-directional there are no directional restraints and air cushion mobility system also allow very accurate positioning of the load.

II. Literature review

1. The air caster was invented in the late 1950's by British Hovercraft Corporation who after inventing the hovercraft went on to produce the BHC Hover pad. Air Casters and the related engineering in fluid film technology are manufactured by many different

companies worldwide such as Air Caster Corp, Aero Go, Aeris and Hovair. Globally there is Solving in Sweden, Vertex and Airofilm Systems in the Netherlands.

2. R. C. Wolf worked on air caster mechanism at first they designed the air caster and attached to the rectangular platform with the help of high pressure pipe with the help of nozzle then filling compress air filled into the caster that's why the name is air caster. This air caster used for material handling purpose the purpose design concept allowed the development of device for solving the problem such as material handling.
3. W. O. Parker work on improving air caster design and related mechanics a structure approach towards stress analysis the linkage and design of air caster totally base on stress and strain analysis. This paper provides machine designer and researcher with structure design approach towards material handling equipment.

III. Methodology

Air cushion are systems which use air pressure to facilitate the movement of scenery. Confusingly, there is commonly referred to as "air casters" which we will refer to as "air casters", use continuous air pressure to create a cushion of air upon which the load platform floats, allowing it to be moved with nearly zero friction.

I. What is an air bearing?

The fluid film of the bearing is achieved by supplying a flow of air through the bearing face and into the bearing gap. This is typically accomplished through an orifice or a porous media that restricts or meters the flow of air into the gap. The restriction is designed such that, although the air is constantly escaping from the bearing gap, the flow of pressurized air through the restriction is sufficient to match the flow through the gap. It is the restriction through the gap, that maintains the pressure under the bearing and supports the working load. Air Caster's air bearings-powered movers are available in both aluminum and steel. The lighter weight aluminum structures are more portable, while the steel units are normally bolted or attached to the machine or fixture to be moved.



Air Caster

Air casters are a means of making scenery move by floating it on a thin cushion of air. The operating principle is similar to that of a hovercraft: a plenum of air under the load is maintained at a higher pressure than the external air. Air continuously escapes from the plenum, lifting the load ever-so-slightly off the ground. A typical air caster design uses an air bladder, frequently shaped like a torus (a donut). When air is not being supplied to the air caster, the bladder is empty, and the load rests on some other support. When air is applied, the bladder inflates and presses against the ground, as in Figure 3.2 This seals off the area inside the torus. The air pressure is then applied to the plenum inside the torus. Once the plenum reaches a sufficiently high pressure, it can lift the load off the ground, as in Figure 3.3. A thin layer of air constantly escapes from under the bladder on all edges. The load can be easily moved on this layer of air.



Fig: Air Bearing bag

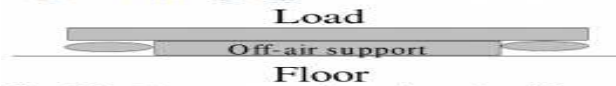


Fig. 3.1 Air caster, section view, air off



Fig.3.2 Air caster, section view, air on

Once the air casters have lifted a load, it can be moved around with surprisingly little force required. Thousands of pounds of load may be moved with only a few pounds of force. The air casters also have the convenient “zero-throw” property: changing direction of movement is not difficult. As is blindingly obvious from the name, air casters operate on air. They require a continuous flow of air while being operated, though usually not at an especially high pressure. A 10,000 pound-capacity caster may consume around 75 CFM of air, supplied at an operating pressure of only 25 psi or so — it is a high-volume but low-pressure device. Larger air casters, of course, will require proportionately larger volumes, and sometimes slightly higher pressures as well. Noise is always a concern with an air caster system. Compressors and blowers are inherently noisy devices, and hearing one of them operating generally doesn't fit too well into a show. Fortunately, they can often be placed offstage, with hoses run to the air casters. It is important to keep the hoses close to the same length, since radically different lengths may cause a pressure differential that can cause one side of the unit to float higher than the other, limiting efficiency. Alternatively, a pressurized air tank could be used to supply the air rather than a compressor. Another concern with air casters is their need for a smooth, non-porous floor

surface. This can be a problem in the theater since the average stage may not be suitably smooth, may very well be out of level, and likely has some sort of traps or pockets through which air can flow. The floor can be prepared to make it smooth and tolerable for air casters. This is typically done by applying a surface of vinyl or some other plastic sheeting, or smooth sided Masonite, with the joints carefully sealed.

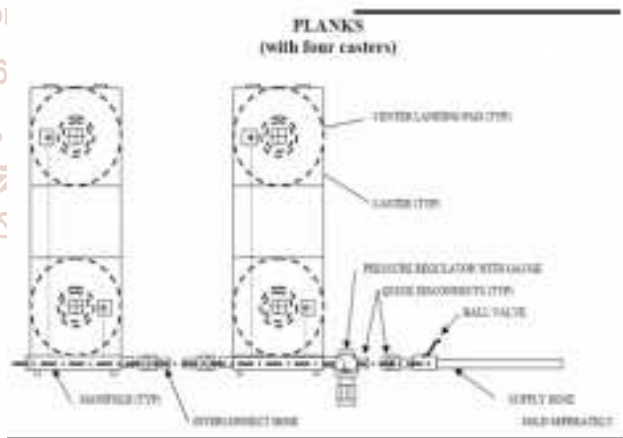


Air Caster

PARTS AND COMPONENTS

1. 1" × 1" square Aluminum pipe.
2. 2mm Aluminum sheet.
3. 3mm MDF sheet.
4. 4mm thick acrylic sheet.
5. 3/16 nut and bolt.
6. Screws.
7. Pipe Fittings.
8. Pneumatic pipes.
9. Rexine material.
10. Nozzles.
11. Control valve.

OUR DESIGN



Fabrication of Model

The project named “Air Caster” is constructed with various materials like

- 1" × 2" square Aluminum pipe
- 2mm Aluminum sheet.
- 4mm acrylic sheet.
- 3/16 mm bolts.
- Tubes.

First of all a base frame of square aluminum pipe is constructed having dimensions 25" × 25" at the inner edge with aluminum support and are fixed which supports air caster. Air caster have a nozzle from air intake which spreads air through vents horizontally at the angle of 120° as there are 3 vents



Fig.3.1 Air caster air bags

IV. Operation of Air Bearings

Casters when energized with a compressed air supply, the following sequence of events takes place

1. The circular reinforced rubber bellows inflates and fills the gap between the mounting plate and the floor.
2. As the pressure increases, the mounting plate and its landing pads, lifts off the floor
3. When the pressure in the bellows is higher than the counter pressure of the load, the air flows out from the bellows forming a thin air film on which the load floats practically friction-free.

V. Advantages, disadvantages and limitations

Advantages:-

1. Can be worked for very high loading.
2. Virtually works on even surfaces.
3. High in construction.
4. Maintenance free work
5. Instead of the wheels air bags are used for the movement of the lift.
6. Because air casters are virtually friction-free, the force required to move them is very low
7. Air casters are also omni-directional, meaning they move with equal ease in any direction.
8. Air casters are lightweight and easily positioned under a load.
9. Big components of large weight can be moved just a little force.

Disadvantages:-

1. No self propulsion.
2. Requires larger pressure for wide area.
3. No self compressor. Clean & Plane surface area required

Limitations:-

1. Air casters require a smooth, nonporous surface in order to maintain lift and operate properly.
2. Cracks and other surface defects can interrupt the proper flow of air, causing the air cushion to dissipate and thus lose its ability to lift. This limits their application to fields like manufacturing, where such surfaces are abundant.

3. Also necessary is connection to a system which provides compressed air, as well as a power supply.

VI. Applications

1. It can be used in the industry for material handling where heavy load materials are to be moved.
2. It can use to be found in the workshop too for carrying the materials from one place to other.
3. It can be stopped at any instant, so it can also use in multistoried building.
4. Automobile industry.
5. Various industries.
6. Air craft industries and in ship building. Air Caster used in automobile industries, so to find out proper application of mechanism we can use this model.

VII. Conclusion

This developed model of "Air Caster" has set standards in the field of lifting devices for loading and unloading of the industrial goods and materials. In concluding statements it can be claimed that this project "Air Caster" is successful and exhibits expected result this model which also results in saving time. We have compared the analyzed result obtained from experimental considering variations further modification suggested is true and considering the probable implementation plays the project could do wonders in industries and industrial market. The problem statement thus put forward was solved and work successful convenient out.

VIII. Future Scope This Project Can Be Modified In Following Points

1. Capacity of this project can be increased by increasing the supply of the air from the compressor.
2. Air caster casters can be enlarged for accumulating the large amount of air.
3. Instead of rexine, rubber can be implemented.
4. Scissor lift mechanism can be implemented by which load can be lifted at certain height. This project can be successively used in the industries like air craft industries, ship building for lifting of the heavy materials, their loading and unloading. Since this scissor lift is having air casters instead of wheels for their movement this has no limitation over its movement as it can be moved in any direction.

IX. References:-

- [1] www.aerofilmsystems.com/Air-casters
- [2] seminarprojects.com/s/air-caster-levitation
- [3] www.google.co.in/patents/US6585069
- [4] www.intellicaster.com/about.htm
- [5] www.intellicaster.com/floorcond.htm
- [6] seminarprojects.com/s/air-casters-levitationpdf
- [7] seminarprojects.com/.../seminar-pdf-airlevitation-using-air