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Abstract — at present the company suffering from the transportation & material handling problem. The company uses the manual crane for the transportation of machine components. The problem is that when the machine components are transported by the crane, parts of it are displaced from its original places so that the accuracy of the CNC machine will not be stable. Now our solution is that we used air caster for the transportation of machine components of CNC Machines. An Air film technology is a "relatively new" concept which offers a different way of moving heavy machines. The principle of air film technology is to cause loads to float on a floor surface using compressed air as the only power source. Air caster is developed for taking the advantages of pneumatic lifting. An air caster is a pneumatic lifting device used to move heavy loads on flat, non-porous 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. The present work includes design and modelling of 100 kg air caster. The components of air caster like base plate, load landing plate form, air bag, supporting rings. Also the part drawing of components of Air Caster have been prepared using Creo.

Keywords- Material handling, air bearing bag, air, and compressor.

I. INTRODUCTION

Material handling consists short-distance movement within the building or between a building and a transportation vehicle. It uses a wide range of manual, semi-automated, and automated equipment's. It also includes consideration of the protection, storage, and control of materials throughout their manufacturing, warehousing, distribution, consumption, and disposal. Material handling can be used to generate time and place utility through the handling, storage, and control of material, as distinct from manufacturing, which generates form utility by changing the shape, form, and makeup of material.

The company is suffering from the material handling problem. They currently use manual crane for transportation of CNC machine, but the major problem associated with the crane is that there might be chances of damaging CNC machine and floor. The handling of manual crane is also difficult and required high attention.

II. METHODOLOGY

An Air Caster is a pneumatic lifting device which is used to move heavy loads on flat and non-porous surfaces. The operation of air caster is similar to a hovercraft, as it utilizes a thin layer of air as a way to float a very small distance off the ground. Compressed air enters in an airbag shaped like a torus and when the bag is completely filled with air, it creates an air-tight seal with the ground and forces more amount of air into the center of torus (air bag), eventually causing the air to flow over the bag and to raise the load above the ground.

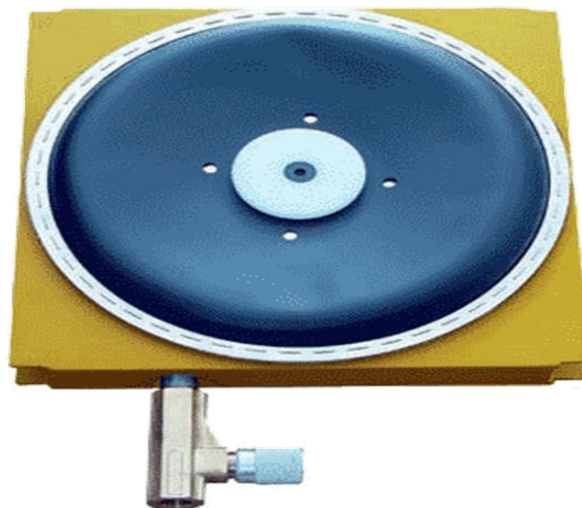


Fig.2.1 Air Caster (Bottom View)

III. AIM AND OBJECTIVE

To develop a flexible material handling equipment for transportation of the CNC machine by the application of small effort. To reduce the material handling cost for company. To develop such material handling equipment which does not damage the floor of company, To carried out the design, part modelling, and development of air caster for 100 kg (approx.)

IV. WORKING PRINCIPLE

Step-1 Initial Position



Fig.4.1 Initial Position

In the first step, the load is placed on the air caster. In this position, the landing pad of air caster is in contact with the floor surface. When the load is applied on the air caster, due to weight of the load the air bag of air caster may be crushed therefore the landing pad is provided to protect the air bag from being crushed by weight of load applied to the air caster.

Step-2 Air filling and Air bag inflation



Fig.4.2 Air filling and Air bag inflation

In the second step, air is start supply from the air compressor to the air bag of the air caster through the hose pipe. Due to the air supplied to the air bag through compressor, air bag start inflates. After this, due to air bag is inflates the load is start rising from the floor surface. Inflated air bag creating seal again the floor surface area under the air caster.

Step 3 Air Escapes and Air film formation



Fig.4.3 Air Escapes and Air film formation

In the step 2, seal creates between the air bag of air caster. In the chamber when the pressure of the air which is supplied through the air compressor is sufficient to offset the load's weight, Air slowly and evenly escape between the floor and transporter base. Due to this the thin air film has been created. This air film gives a nearly frictionless transportation of the load applied on the air caster.

V. DESIGN

(1) Thickness of Base Plate:

$$l = 950 \text{ mm}$$

$$b = 950 \text{ mm}$$

$$w = 100 \text{ kg} = 981 \text{ N}$$

$$M_{\max} = \frac{wl^2}{8}$$

$$= 116.493 \times 10^3 \text{ N mm}$$

$$I = \frac{bt^3}{12}$$

$$= 79.16 \text{ t}^3 \text{ mm}^4$$

$$[\sigma_b] = 155 \text{ Mpa}$$

$$[\sigma_b] = \left(\frac{M_{\max}}{I} \right) \times \left(\frac{t}{2} \right)$$

$$t = 2.17 \text{ mm}$$

So, thickness of base plate is 3 mm.

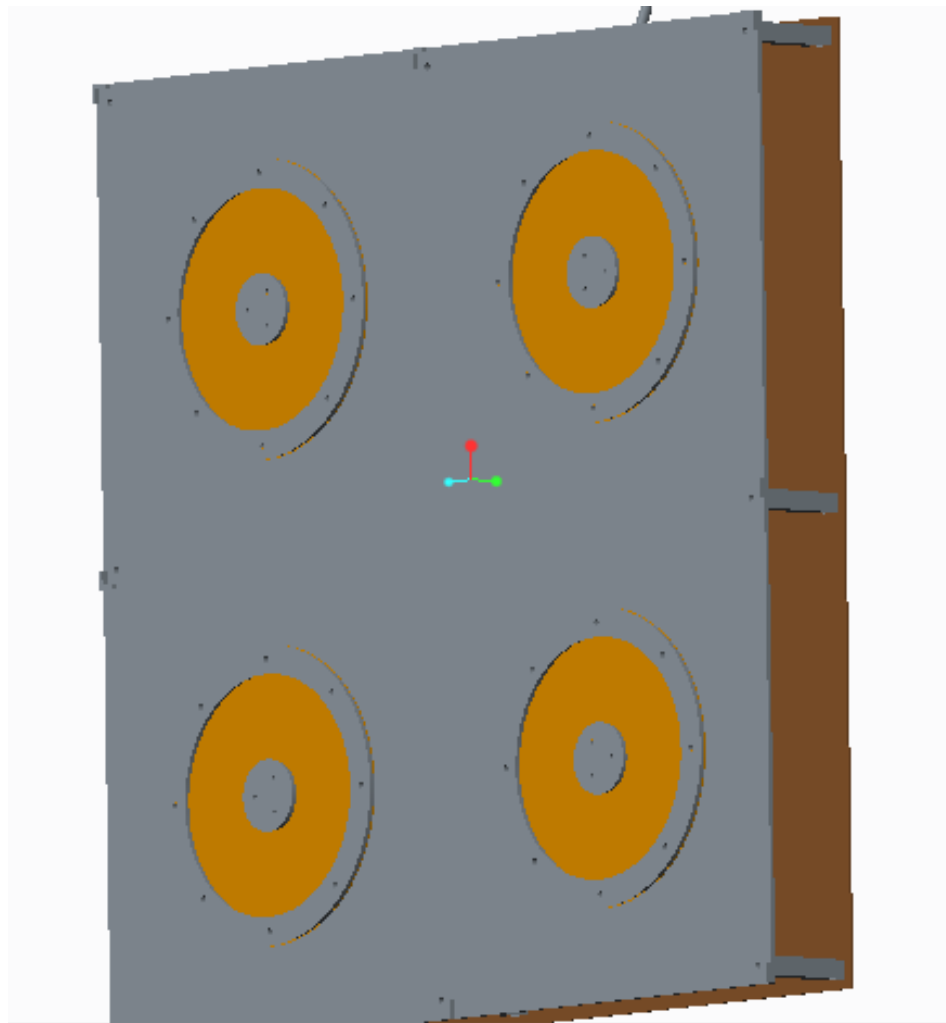


Fig.5.1 3D Model

(2) Pressure:

$$P = \frac{W_T}{A}$$

$$= \frac{1226.25}{\frac{\pi}{4} \times (40)^2} = 0.975 \text{ N/mm}^2$$

$$= 9.75 \text{ bar}$$

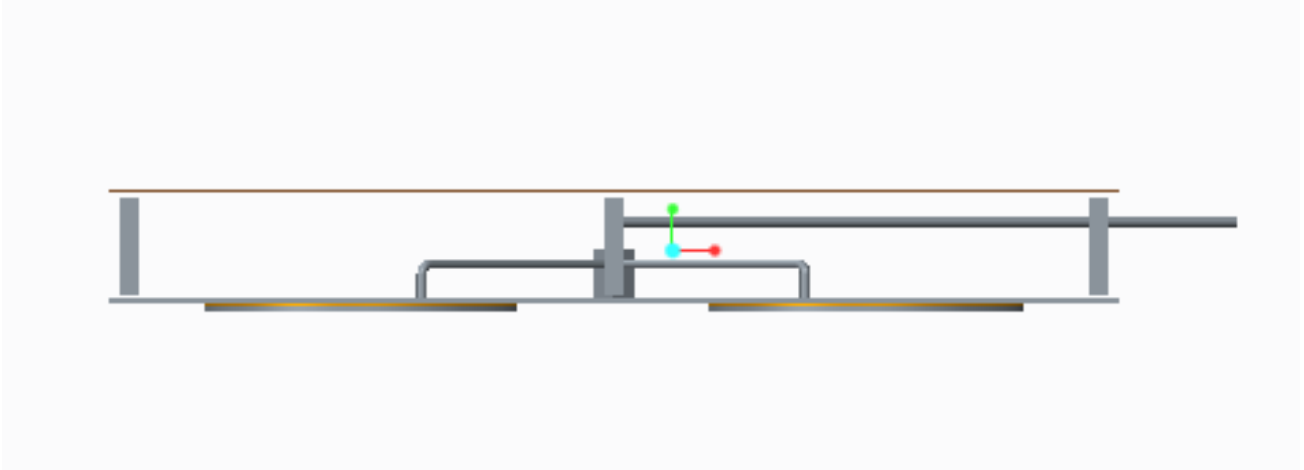


Fig.5.1 3D Model-Side View

VI. RESULT

R No.	S	Pressure [bar]	Self-weight [kg]	Lifting weight [kg]	Total weight [kg]
1		10-12	25	100-125	125-150

VII. TESTING & VARIFICATION

We test air caster to measure its performance. The main component required for testing is air compressor which is provided by the company. So we have tested our machine in the industry. The pressure required for the lifting total load is approximately 10 to 12 bar. The company have compressor with maximum capacity 10 bar. So air caster lifts the total 125 to 150 kg load in which 25 kg self-weight & 100 to 125 kg lifting weight. Our machine has more capacity to lift the load but the company's compressor does not sufficient to produced high pressure to lift heavy load which required for our machine.



The pressure requires for lifting the heavy load with maximum capacity 250 to 450 kg is approximately 15 to 18 bar. So that our machine is performed well during the test.

VIII. CONCLUSION

The main aim of our project is to design and development of flexible material handling equipment – Air Caster. Air Caster makes the material handling accurate compared to crane used in Industry. It makes transportation of CNC machine easy and reduces chances of damage drastically. Thus, Air Caster is beneficial to industry. In future, if frame is provided than we can use Air Caster for different dimensions of CNC machine.

IX. REFERENCE

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