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Design of Cargo Load Lifiter

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Abstract: Cost efficiency is the need of the hour with increasing constraints of time and man-hours in service oriented departments of various organizations. The airline industry very closely resembles this need with the ground support playing a vital role in carrying our crucial operations and maintenance service. In accordance with the need for quality in service, there was a need to optimize the equipments being used so as to minimize the time. One such equipment i.e. Cargo load lifter has been in use for long duration. Our project deals with an in depth analysis of this system to identify of this problem areas and enhance and overall performance. A detail analysis of all its components was carried out and the shortcomings were identified. To overcome these shortcomings various options were looked into for instance the pump being used were of higher rating were required in the system leading to poor performance in terms of speed variations of the lifter platform. We have focused all the on these problem areas and carried out an in-depth study of all the pumps currently being used in similar functions and conditions. Of all the available options the most suitable and viable in terms of cost effectiveness and performance have been identified and suggested. The project aims at serving the ground support department of Indian airlines, Chennai to accomplish its aim of serving to grow and growing to serve. The cargo lift loader is used for loading and off loading the cargo of weight more than 40kgs to 2 tone capacities which cannot be loaded manually or by the normal bulk freight loader. Its maximum lifting capacity is 2 tones. This lifter can be used for Boeing 737 and Airbus 319 and 320 types of aircraft both the front and rear cargo deck of the flight. It is tow able equipment.

Key words: Ground support playing · Were looked into for instance · Lifter can be used

INTRODUCTION

Basic Concept: The main principle behind the cargo lift loader is PASCAL's law, which is the pressure exerted on a confined liquid is transmitted undiminished in all directions and at right angles to confined surfaces. This concept is mainly used in applications where large loads are transferred with a smooth movement at a very less time [1].

Introduction to Hydraulics

Pascal's Law: The pressure exerted on a confined liquid is transmitted undiminished in all directions and at right angles to confined surfaces.

Fluid Power: Fluid power is use of a confined fluid flowing under pressure to transmit power from one location to another. It is one of three commonly used methods of transmitting power in an industrial setting; the others are electrical and mechanical power transmission: Electrical power transmission uses an electric current flowing through a wire to transmit power. Its main advantage is its ability to transmit power over large distance very quickly. The most obvious example is use of electricity to transmit power from the power plant to our homes [2].

Cargo Lift Loader: The cargo lift loader is used for loading and off loading the cargo of weight more than 40kgs to 2 tone capacities which cannot be loaded manually or by the normal bulk freight loader. Its maximum lifting capacity is 2 tones. This lifter can be used for Boeing 737 and Airbus 319 and 320 types of aircraft both the front and rear cargo deck of the flight. It is tow able

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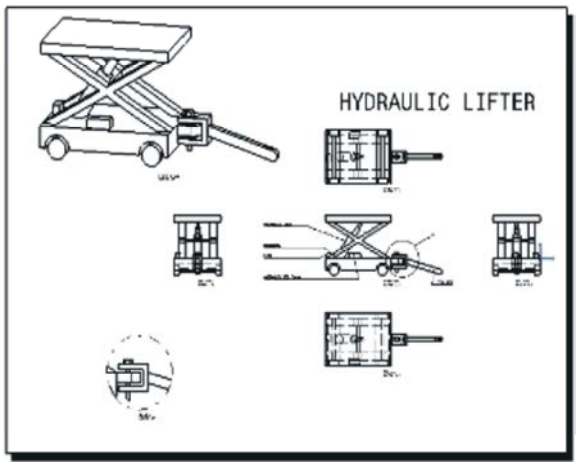
equipment. It consists of hydraulic oil tank, hydraulic hand pump (piston type) and one platform, Single cylinder telescopic jack, scissors for side support and to lift the platform. The Hydraulic oil that is used in the hydraulic system is AW 46

This equipment is small in size and is easier to maintain than the bulk freight loader. The loading and off loading of the luggage can be done with absolute ease and the loader can be moved easily of from the tarmac area due to its small size [3].

Designing of the Cargo Lift Loader: The design of the cargo lift loader was adapted from the FMC commander. FMC Commander is a bigger version of the lift loader which can carry up to 20 tons. The design of the cargo lift loader is as follows [4].



Getting the Material Required: The material mostly was given to us from the company. The majority of the material was retrieved from the company's scrap area. Our team was provided with 75 and 100 mild steel channels for the basic frame construction of the base fame and the top platform. Thick mild steel plates and tubular structures which support both the mobile and stationary components of the loader were also provided at the company. Standard equipments like rollers, wheels, bearings and the angle plates were also obtained. The material retrieved from the scrap area was rusted so proper cleaning had to be done using grade papers. Material such as the telescopic jack, the oil reservoir tank, flexible hoses and valves to install the hydraulic system was also provided at the company. The tools that were required were also provided [5].

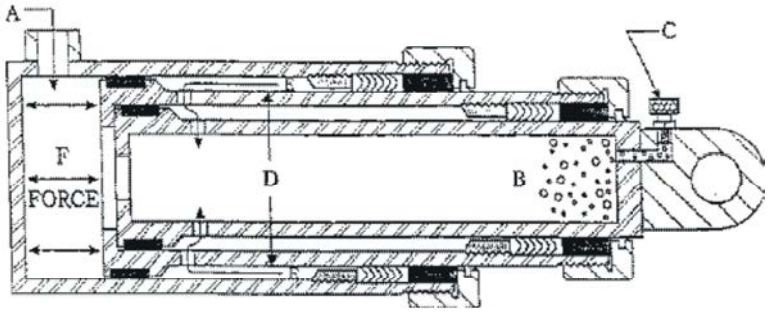
Material Selection: The frame work is completely done with mild steel. Mild steel is a hard metal which has great strength and has a high load withstanding ability. It is also easy to machine. It has high yield strength than plain carbon steels. The minimum yield strength of mild steel is 276 N\mm^2 and the tensile strength is 414 N\mm^2. The term 'mild steel' is also applied commercially to carbon steels not covered by standard specifications. Carbon content of this steel may vary from quite low levels up to approximately 0.3%. Generally, commercial 'mild steel' can be expected to be readily weld able and have reasonable cold bending properties [6].

Working of Cargo Load Lifter: The hand pump is been operated manually with the help of the handle bar. Due to the reciprocating motion of the cylinder in the hand pump, pressurized flow of the hydraulic oil from the oil reservoir to the telescopic jack takes place. An increase in pressure occurs in the telescopic jack thereby forcing the inner cylinder in the jack to move forward. Since the jack is been mounted on the center plate of the scissors, the scissors are also forced to move upwards or come to a closing position. Since the scissors are hinged on rear side, both to the top platform and the base frame and rollers are installed on the other side which rolls inside the channels of the top platform and the base frame, the scissors move towards the rear side of the loader. This movement brings the scissors to a closing position thereby raising the top platform to the required height. Stoppers are welded inside the channel to stop the rollers from rolling when the adequate height is attained. Chocks are placed under the wheel before the operation takes place in order to stabilize the equipment when the loading or off loading process takes place.

Once the operation of loading or unloading is done, the relief valve which is installed on the oil reservoir is opened; the pressure in the telescopic jack is reduced. Due to the self weight of the top platform, the telescopic jack is reduced to its initial position. This will lower the top platform to the initial sitting position. Once the platform is back to the initial position the relief valve is put back in the closed position.

Hydraulic System: The hydraulic system is designed in a very simple manner. It mainly consists of a single cylinder reciprocating hand pump, an oil reservoir, a single cylinder telescopic jack, flexible hoses, T-joint, hydraulic oil, connectors and a relief valve. The various components are explained as follows.

Single Cylinder Telescopic Jack:



Telescopic Hydraulic Cylinder Single Acting

- Steel externally threaded gland caps.
- Urethane wiper in gland cap.
- Homogenous alternating hytrel and nylon sets.
- Glass filled nylon gland bearing rings.
- Glass filled nylon piston bearing rings.

Telescopic Cylinder: They extend in stages; each stage consists of a sleeve that fits inside of the previous stage. This cylinder is a two stage, but standard modes are available with up to fine stages. The cylinder is kept at 30 degrees angle for lifting the platform.

Telescopic Hydraulic Cylinders are engineered to achieve truer and smoother operation in heavy duty applications. The welded type construction, incorporates a generous lap between stages for more stability and rigidity, allows the cylinders to have a higher stress and side-loading threshold. The use of extra wide internal bronze bearings will reduce the friction surface for the telescopic cylinders to operate. This wider bearing surface aids in the prevention of side-loading, which ultimately causes scoring within the tube and sends damaging metal particles throughout the hydraulic system. The sealing system used is stacked V-packing rings or single lip "U-cups" m. The packing is compatible with standard hydraulic oils. The telescopic cylinders are pressure tested and designed to operate at a maximum of 2,000 PSI.

Hydraulic Hose: Hydraulic hose is specifically designed to convey hydraulic fluid to or among hydraulic components, valves, actuators and tools. It is typically flexible and often reinforced. Hydraulic systems frequently operate at high or very high pressures; multiple layers and several reinforcement designs are employed in the design of hydraulic hose. Hydraulic hose is used in wide variety of industrial hydraulic systems. Dimensions, performance specifications, construction options and features are all important parameters to consider when searching for hydraulic hose.

Important dimensions for the selection of hydraulic hose include the design units, inside diameter, outside diameter and minimum bend radius. Design units can be English such as inches or fractions of an inch, or metric such as millimeters or centimeters. The inside diameter refers to the inside of the hose or liner. The outside diameter is often a nominal specification for hoses of corrugated or pleated construction. Minimum bend radius is based on a combination of acceptable hose cross-section deformation and mechanical bending limit of any reinforcement. Important performance specifications to consider when searching for hydraulic hose include working pressure, maximum vacuum and temperature range. The working pressure is the maximum service design pressure. Maximum rated vacuum is most frequently given in inches or mm of mercury referenced below one standard atmosphere. The temperature range is the full required range of ambient operating temperature.

Construction options for hydraulic hose include reinforced, coiled, corrugated or convoluted, articulated and multi-element. Reinforced hose is constructed with some element of reinforcement; styles include textile braid, wire braid, wire helix and many other designs in many ply or layer configurations. Coiled hose is coiled for flexibility and elasticity; this feature often makes it expandable and easy to store. Corrugated hose contains corrugations, pleats, or spiral convolutions to increase flexibility and capacity for compression and elongation. Articulated hose is rigid hose sections that are constructed with "joints" that can be swiveled, positioned, or articulated; often used in cases where hose discharge must be aimed, such as coolant delivery to a work piece. A multi-element hydraulic hose is constructed of more than one hose formed or adhered together in a flat, ribbon, or bundled configuration. Additional features to consider include integral end connections, anti-static, lay flat, crush proof, flame resistant and explosion-proof.

Hydraulic hose has a finite service life, which can be reduced by many factors including: frequency and

amplitude of pressure fluctuations, exposing the hose to pressure spikes above the maximum recommended working pressure, operation outside of the recommended temperature range, flexing the hose to less than the minimum specified bend radius and twisting, pulling, kinking, crushing or abrasion of the hose.

Hydraulic Oil: Hydraulic oil is the medium which is used to increase the pressure in the hydraulic system. The hydraulic equipment is one type of fluid machine requiring hydraulic oil for operation. Since the hydraulic pumps and valves are operated at high pressure and high speed, together with a variety of factors involved, such as materials used for equipment, operating temperature and atmosphere, hydraulic oil used is required to have the following properties:

Having adequate viscosity which does not change with temperature.

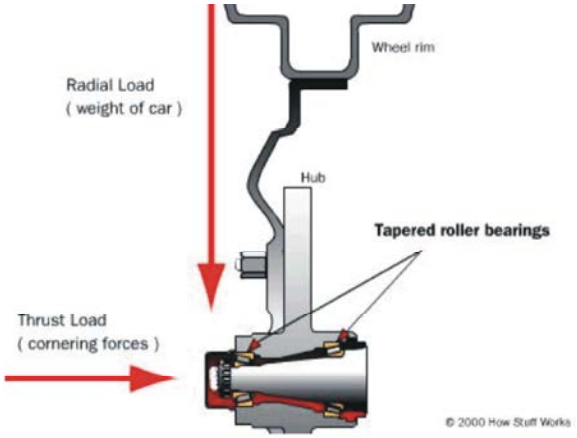
Maintaining fluidity at low temperature. Not deteriorate easily when used under high temperature.

Having good oxidation stability.
Having good shearing stability.
Having rust proof capability.
Not corrode (wear away by chemical action) fiber and paint.
Not compressible.
Having good anti-foaming tendency.
Having fire resistance.

The hydraulic oil used in the hydraulic system is AW-46 which has the above mentioned properties.

Taper Roller Bearing:

Bearings are typically capable of dealing with two kinds of loading condition; radial load and thrust load. Depending on the type of application the bearing is used in, it may experience radial load only, thrust load only or a combination of both. A classic example of the car wheel been loaded is shown below.



Tapered roller bearings are designed to support large radial and large thrust loads. These loads can take the form of constant loads or shock loads. Tapered roller bearings are used in many car hubs, where they are usually mounted in pairs facing opposite directions. This gives them the ability to take thrust loads in both directions. The cutaway taper roller on the left shows the specially designed tapered rollers and demonstrates their angular mounting which gives their dual load ability.

CONCLUSION

From the setup understand that lift the loads using hydraulic systems upto 50kg number of times without any damage of the materials. The operating systems of the machine is very simple, since using hydraulics only not pneumatics. This systems also be withstand high pressure and temperature.

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