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Design and Development of Hydro-Pnumatic System

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Abstract: *Our hydro-pneumatic lifting machine works on both pneumatic and hydraulic system. We give pneumatic pressure as a input to Dutta pump. It increases hydraulic pressure with the help pneumatic pressure. This hydraulic pressure output is use in single acting cylinder to lift any components and many other applications.*

Keywords: *hydraulic system,pneumaticsystem,dutta pump.*

I. Introduction

A hydraulic drive system is a drive or transmission system that uses pressurized hydraulic fluid to power hydraulic machinery. The term hydrostatic refers to the transfer of energy from flow and pressure, not from the kinetic energy of the flow.

Principle: Pascal's law is the basis of hydraulic drive systems. As the pressure in the system is the same, the force that the fluid gives to the surroundings is therefore equal to pressure × area. In such a way, a small piston feels a small force and a large piston feels a large force. The same principle applies for a hydraulic pump with a small swept volume that asks for a small torque, combined with a hydraulic motor with a large swept volume that gives a large torque. In such a way a transmission with a certain ratio can be built

Following equipments are used in hydraulic system:

- Hydraulic filter
- Oil tank
- Pressure relief valve
- Non return valve
- Needle valve
- Single acting cylinder
- Male stud coupling
- Dowty seal
- Swivel elbow
- Hose adaptor
- Swivel branch Tee
- Swivel run Tee
- Gauge adapter
- Filler breather
- Level indicator
- Hose pipe

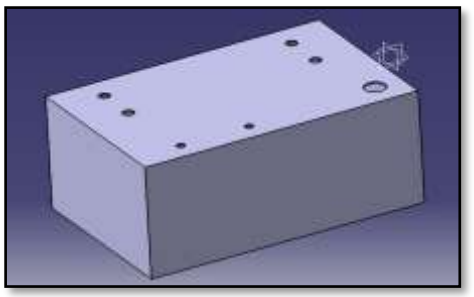
Advantages of hydraulic system:

i. Liquid does not absorb any of the supplied energy.
ii. Capable of moving much higher loads and providing much higher forces due to the incompressibility.
iii. The hydraulic working fluid is basically incompressible, leading to a minimum of spring action. When hydraulic fluid flow is stopped, the slightest motion of the load releases the pressure on the load; there is no need to "bleed off" pressurized air to release the pressure on the load.
iv. Highly responsive compared to pneumatics.
v. Supply more power than pneumatics.
vi. Can also do many purposes at one time: lubrication, cooling and power transmission.

measuring devices. In recent year's technical development in other fields such as optics, acoustics and electromagnetism have resulted not only in improved sensitive designs but also in new flow measuring concepts Wang and Ronald (2014). = Recently, flow meters have proven to be an excellent device for measuring

flow in any water application domain. In irrigation fields flow meters are required for measuring the water needed to supplement the insufficient rainfall. Flow meters also serves as

II. Selection of pump



1. Plate thickness- 3mm
2. Material-MS
3. Discharge of pump-3.5 lpm
4. Maximum discharge-3*3.5=11.49 lpm
5. Volume of tank

V=l*b*h

=400*250*200*

=20000000 mm^3

=0.02m^3

=0.02*10^3 lit=20 lit

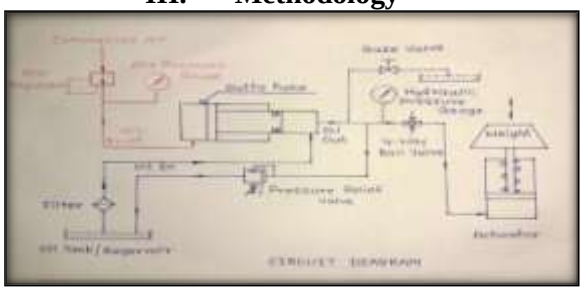
2.Following Equipment is Selected Based on the System Output Pressure

(Our maximum pressure is 125 bar)

Table No. 3.4.1 Hydro-pneumatic component list

1)	Filler breather	FSB05 ID-26mm OD-50mm
2)	Level indicator	LG603 (Hydro line)-3″
3)	Pressure relief valve	DPRH06S200 UPTO 200 bar

III. Methodology



i. Abovefigure shows the working of hydro-pneumatic lifting machine.
ii. It consist of air regulator, air pressure gauge, Dutta pump, Gate valve, pressure relief valve, ball valve, single acting cylinder, filter etc.
iii. When we connected air compressor pressurized pipe to inlet of hydro-pneumatic pump
iv. Compressed air passes to dutta pump through air regulator and air pressure gauge. Air regulator is used to regulate the compressed air and air pressure gauge used to indicate air pressure.
v. At the same time oil passes to dutta pump through filter. The filter is remove dust particle which is present in oil.
vi. Dutta pump increases the oil pressure with the help of compressed air. Then pressurized oil pass through NRV.
vii. If the required pressure is less than the available pressure then gate valve is used to reduce excess pressures.
viii. Pressure relief valve is used to reduce back pressure.

ix. The four way ball valve used to distribute the connection of pressurized oil.
x. After the four way ball valve pressurized oil is passes to single acting cylinder through inlet port.
xi. Single acting cylinder used to lift the load by using pressurized oil.
xii. When we released pressure relief valve again hydraulic oil comes to return to the tank and single acting cylinder to comes its original position.

5.1. Model Diagram of Hydro-Pneumatic Machine

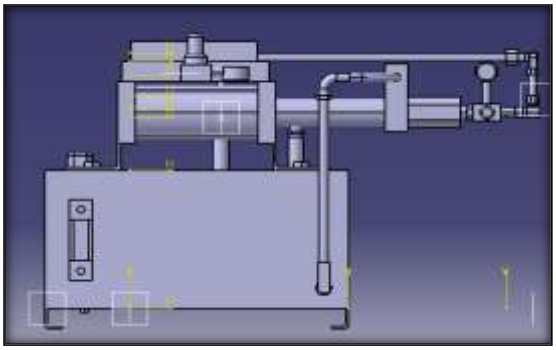


Figure No. 5.1.1 Front view of hydro pneumatic lifting machine

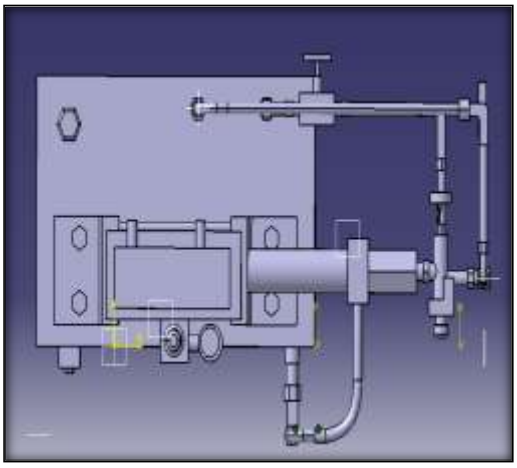


Figure No. 5.1.2 Top view of hydro pneumatic lifting machine

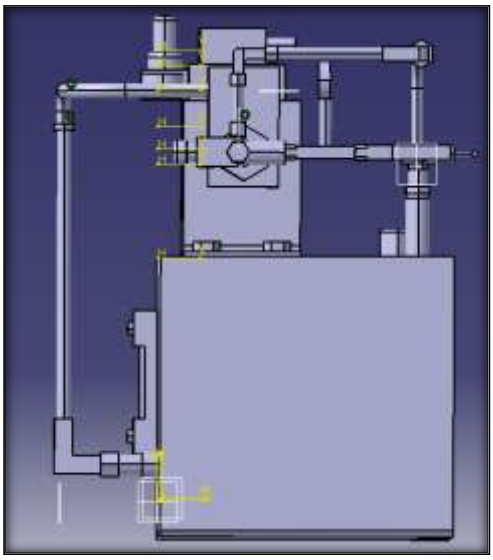


Figure No. 5.1.3 Side view of hydro pneumatic lifting machine

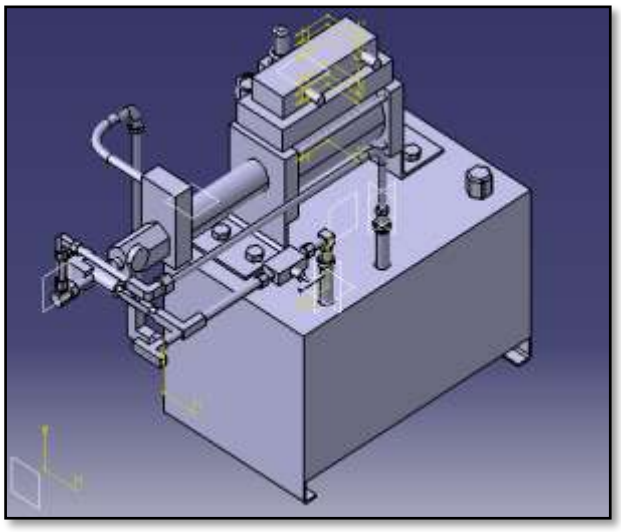


Figure No. 5.1.4 Isometric view hydro pneumatic lifting machine

IV. Result and Performance Analysis

Sr. No.	Parameter	Hydraulic system	Pneumatic system	Hydro-pneumatic system
1	Medium	In hydraulic system oil is used as working medium.	In pneumatic system pressurized air used as medium.	In Hydro-pneumatic system both air and oil is used.
2	Operation cost	High operation cost.	Medium operation cost.	Less operation cost required.
3	Operation time	High operation time required.	Medium operation time required.	Less operation time required.
4	Maintenance time	More maintenance required.	-	It required less maintenance time than the hydraulic system.
5	Life of system	15 years (hydraulic jack)	5 to 10 years (pneumatic jack)	-
6	Breakdown time	It required more breakdown time.	It required medium breakdown time.	It required less breakdown time.
7	Productivity	Hydraulic system have less productivity.	Pneumatic system have medium productivity.	Hydro-pneumatic system have more productivity.
8	Load carrying capacity	More time required to lift the load	Less time required to lift the load.	Lift high load but time required is very less.

V. Discussion

Hydro-pneumatic system is more effective than hydraulic and pneumatic system. Hydro-pneumatic pump (dutta pump) is the heart of this system. This system works on combination of both hydraulic and pneumatic system. In this system pneumatic pressure is used as a input to increased hydraulic pressure.It reduced the maintenance time and operation cost of Hydro-pneumatic system. It minimize the breakdown time due to this increased productivity. It actuate quickly and easy to handle. Hydro-pneumatic system required less starting time as compare to hydraulic and pneumatic system. Heavy load easily and quickly lifted by this system.

VI. Conclusion

The lifting machine was developed after studying the pneumatic system, hydraulic system and hydro-pneumatic system is more effective the pneumatic and cost efficient than hydraulic system. The system has shown noticeable improvement in various sector like operation time and cost of operation. It is observation that operation time is reduced from 8 to 10 hours for lifting the any heavy machine while maintenance is carried out and cost of operation is reduced approximately by 80%. The further advantages of the system has covered the safely of operator and make operation more convenient, improve dimensional and positional accuracy of lifting

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