A Literature Review on Cushioning Mechanism for Improving Working Life of Piston Cylinder Assembly

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Abstract— The piston cylinder assembly is extensively used in different applications including reciprocating pumps, Compressors, Reciprocating actuators and engines of vehicles. The most frequently encountered problem is generally arises with this all above equipment's are damage occurs of piston or cylinder. Because of such a kind of damage engine life, pump life, actuators life or compressor life becomes shorter and also sometimes premature failure of piston-cylinder is noticed. Due to these engine or pump will not able to work for long time period. In this paper represented the solution of avoiding likewise problem for piston-cylinder assembly, reduces the chances of premature failure of parts and improve working life cycle of engine, compressors and pumps. One of the most widely used mechanism in hydraulic system named as cushioning mechanism provide the solution of above cases. This type of mechanism is provided at the end of piston and cylinder where hammer blow is generated during the working motion. With the help of cushioning mechanism piston speed is to be reduced at the end of each stroke. At the end result piston make contact with cylinder comparatively very low speed. Speed reduction at the end of stroke of piston, which can reduce the thrust force, which is generated on the cylinder reduced as well. In this paper represent the end portion of piston and cylinder is displayed for improving working life cycle of piston and cylinder assembly. In addition with this mechanism reduction in vibration during end of stroke is also to be achieved.

Key words: Piston, Cylinder, Actuators, Cushioning Mechanism, Life cycle, Hammer blow, Vibration

I. INTRODUCTION

The successful development of piston cylinder assembly widely used for huge area of applications like as reciprocating compressors, pumps, actuators, engines etc.

We already aware about that is damaging of piston or cylinder walls because of end of stroke piston strikes & provide a jerk on cylinder wall. We can consider this as hammer blow effect. Due to this piston and cylinder undergoes the effect of thrust and damage. We cannot neglect the vibrations generated because of this thrust. At the end of this problem working life of piston and cylinder is reduced and sometimes premature failures occur.

This problem ultimately generates more maintenance, more replacement of piston and cylinder and delay in work.

For resolving this problem here shows solution of cushioning mechanism for improving working life cycle of piston and cylinder assembly. Also gives additional advantage of reduction in vibrations at the end of each strokes.

Some form of cushioning is normally required to reduce the rate of travel of a cylinder before the piston strikes the end cover. Reducing the piston velocity at the end of its travel lowers the stresses on the cylinder while reducing vibration on the structure of which it is part. Efficient cushioning is usually necessary in applications in which precision is a must.

Basically this problem can be solved in three ways and that are by means of simple impact cushioning, by pneumatic cushioning or by fitting of shock absorbers.
Here I introduce a working reality of piston cylinder with cushioning mechanism and provide exact difference with & without cushioning.

II. PISTON CYLINDER ASSEMBLY WITH AND WITHOUT CUSHIONING MECHANISM

A. Without cushioning mechanism:

In general piston and cylinder are available without any special provision for reducing thrust at the end of each stroke. Generalize figure of piston cylinder is shown in below fig.1.

As given below normally piston cylinder assembly is used in most of all area of applications and it consist only normal configuration as outer side there is one hollow cylinder and inner side there is a piston. Outer side cylinder is fixed and inner side piston is moving to and forth either way up and down or side by side movements.

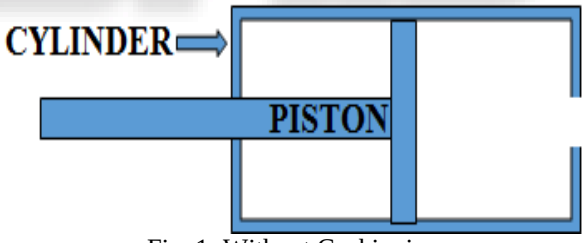

Fig. 1: Without Cushioning

In above fig. 1 simple piston cylinder assembly is indicated without any special arrangement.

In this concept when force is given to the left side piston can move toward the right side at the end of stroke piston strikes on cylinder. Due to this thrust is exerted on cylinder wall and piston also. Same effect of thrust at the other side of piston also in backward stroke. This reduces ultimately the life of piston and cylinder both. Vibration is also generated and over all working life cycle is reduced. To improve over all working life cycle of assembly and overcome the thrust effect on cylinder wall, reduce vibration effect there is one solution which we can called as cushioning mechanism.

In this cushioning mechanism end of the cylinder and piston design should be change. This design itself work as cushion means softer than the previous working condition as indicated in normal case.

B. With cushioning mechanism:

With the help of cushioning type cylinder at the end of stroke we can overcome the problem in normal case and we can improve working life cycle and reduce thrust generated at end of each stroke.

The conceptual Figure of cushioning mechanism is as given below in Fig. 2.

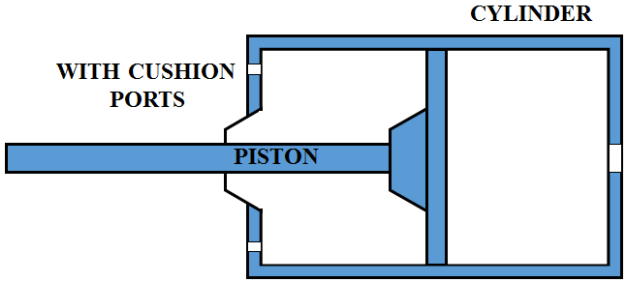

Fig. 2: With Cushioning Mechanism

The conceptual figure of cushioning mechanism is indicated in above Fig. 2.

In this case at the piston end side one more area is attached and opposite cavity is provided at cylinder wall.

By providing such a kind of shape in case of pneumatic or hydraulic system all the fluid cannot expelled out spontaneously.

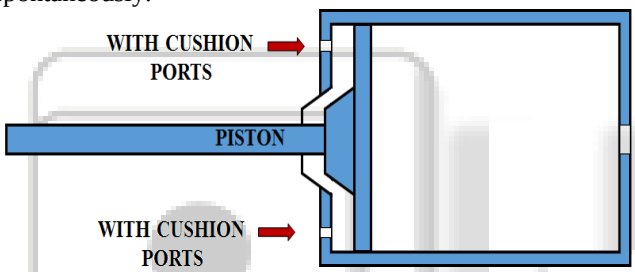

Fig. 3: with Cushioning end position

As indicated in Figure No. 3 the end position of piston.

When at the end of the stroke of piston all fluid cannot expelled out from cylinder because of closing of main exhaust hole the remain fluid come out from the small holes provided in cylinder named as cushion ports. Due to this speed of piston is reduced at the end of stroke, because of slow outlet from the cylinder. This effect create a cushion effect on piston and cylinder both. So there is drastically reduction speed of piston at the end, which ultimately reduces thrust on the piston and cylinder wall.

By applying this vibration at the end of stroke, noise from the piston at the end of stroke, damage of piston and cylinder considerably reduced and improve working life cycle of piston and cylinder. We can say this will improve reliability of assembly for long time.

III. Advantages of Cushioning Mechanism

- More efficient than preset cushioning.
- Higher working cycle times.
- Smooth running of piston inside cylinder
- Very fewer vibrations.
- Less noise with the help of this mechanism
- Reduce maintenance cost.
- Decrease the end thrust in between piston and cylinder wall.

IV. Application Area of Cylinder with Caushioning Mechanism

- In automobile engines.
- In hydraulic systems.
- In pneumatic systems.
- In reciprocating pumps.
- In reciprocating compressors.

V. Conclusion

From this it is concluded that without cushioning mechanism there are more thrust forces generated on the cylinder wall and piston wall, also increase vibration and noise at the end of each stroke, but by applying cushioning mechanism there will be higher working cycle time, smooth running of reciprocating system, very fewer vibrations, less noise and reduction in maintenance cost can be achieve.

Future Scope

In future this kind of mechanism can be analyses and compare the thrust force effect on piston and cylinder wall assembly on with and without cushioning mechanism arrangement. If analysis shows correct result than we can proceed for actual case and compare performance in normal atmospheric condition by experimentally.

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