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Hydraulic Gauge/Valve Testing Machine

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***Abstract*: We are going to make a machine for valve industry and make it multipurpose & should be used as valve testing & pressure gauge testing. The machine is simple to maintain easy to operate. Hence, we tried our hands on "Hydraulically operated valve cum pressure gauge testing." Hydraulically operated valve cum pressure gauge testing device is a calibration and testing equipment specially meant for calibration of different types of pressure gauges for its truth ness and valve for its reliability.**

***Keywords*: hydraulic gauge.**

1. Introduction

Hydraulically operated valve cum pressure gauge cum valve testing device is a calibration and testing equipment specially meant for calibration of different types of pressure gauges for its truth ness and valve for its reliability. In its simple form it consists of following different components: -

Main cylinder: It is the vertical cylinder of thick cross section wall designed enough to with stand the bursting pressure safely. it is smoothly finished from inside by honing and lapping process enough up to mirror finishing. The plunger type of piston reciprocates inside the cylinder vertically with the application of lever.

Lever: It is the heart of valve cum pressure gauge testing machine because it provides power for the operation of the piston in the cylinder. The lever mechanism is as shown according to the following principle: -

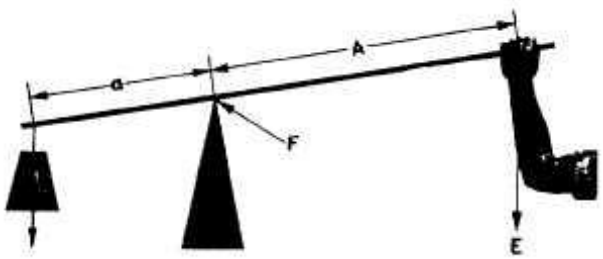

Fig. 1. Lever

You will find that all levers have three basic parts: the fulcrum (F), a force or effort (E), and a resistance (R). Look at the lever in figure 1. You see the pivotal point (fulcrum) (F); the effort (E), which is applied at a distance (A) from the fulcrum; and a resistance (R), which acts at a distance (a) from the fulcrum. Distances A and a are the arms of the lever.

A. Classes of Levers

The location of the fulcrum (the fixed or pivot point) in relation to the resistance (or weight) and the effort determines the lever class.

First Class: In the first class (fig. 1), the fulcrum is located between the effort and the resistance. As mentioned earlier, the seesaw is a good example of a first-class lever. The amount of weight and the distance from the fulcrum can be varied to suit the need. Notice that the sailor in figure 1 applies effort on the handles of the oars. An oar is another good example. The oarlock is the fulcrum, and the water is the resistance. In this case, as in figure 1, the force is applied on one side of the fulcrum and the resistance to be overcome is applied to the opposite side; hence, this is a first-class lever. Crowbars, shears, and pliers are common examples of this class of levers.

Second Class: The second class of lever has the fulcrum at one end, the effort applied at the other end, and the resistance somewhere between those points. The If you apply 50 pounds of effort to the handles of a wheelbarrow 4 feet from the fulcrum (wheel), you can lift 200 pounds of weight 1 foot from the fulcrum. If the load were placed farther away from the wheel, would it be easier or harder to lift? Levers of the first and second class are commonly used to help in overcoming big resistances with a relatively small effort.

Third Class: Sometimes you will want to speed up the movement of the resistance even though you have to use a large amount of effort. Levers that help you accomplish this are in the third class of levers.

2. Working

As the piston of the power cylinder is operated using the lever operating mechanism, due to the advantage of leverage the piston is reciprocated inside the vertical cylinder. During the upward motion of the piston, the partial vacuum is created inside the cylinder to fill up this vacuum non-return valve installed at the bottom of the cylinder will open towards the inside in the cylinder and the water is sucked in the cylinder. During downward motion of the piston the massive pressure is exerted on the surface of the water. As the water is in inflexible it's pressure will increase. as the pressure of water exceeds the spring tension of the non-return valve no2 and valve no3 which opens out of the cylinder, it will open and pressurized water is allowed to flow in the header pipe on which the valves and the pressure gauge to be calibrate ted are installed. This high-pressure water will enter the valve and pressure gauges and will check the valve for its leak testing or reliability against the leak and will check whether both the pressure gauges (one being

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standard and the other to be tested) are working as our sample gauge is proper, we have to check whether the other to be tested is showing same pressure or not. If it is showing same pressure then it is O.K. unless it is faulty. In the same fashion the valve is tested for its reliability of leak proofing.

Here the piston will pressurize the water in the pipe on the either-sides of the cylinder maximum up to the pressure of 25 bar and will test the leakage of the valve and will calibrate the pressure gauge.

3. Valves

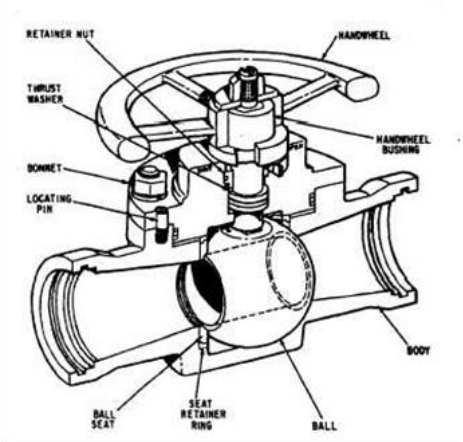

Fig. 2. Valve

It is all but impossible to design a practical fluid power system without some means of controlling the volume and pressure of the fluid and directing the flow of fluid to the operating units. This is accomplished by the incorporation of different types of valves. A valve is defined as any device by which the flow of fluid may be started, stopped, or regulated by a movable part that opens or obstructs passage. As applied in fluid power systems, valves are used for controlling the flow, the pressure, and the direction of the fluid flow. Valves must be accurate in the control of fluid flow and pressure and the sequence of operation. Leakage between the valve element and the valve seat is reduced to a negligible quantity by precision-machined surfaces, resulting in carefully controlled clearances. This is one of the very important reasons for minimizing contamination in fluid power systems. Contamination causes valves to stick, plugs small orifices, and causes abrasions of the valve seating surfaces, which results in leakage between the valve element and valve seat when the valve is in the closed position. Any of these can result in inefficient operation or complete stoppage of the equipment. Valves may be controlled manually, electrically, pneumatically, mechanically, hydraulically, or by combinations of two or more of these methods. Factors that determine the method of control include the purpose of the valve, the design and purpose of the system, the location of the valve within the system, and the availability of the source of power. The different types of valves used in fluid power systems, their classification, and their application are discussed in this chapter control. Some valves have multiple functions that fall into more than one classification.

Flow control valves are used to regulate the flow of fluids in fluid-power systems. Control of flow in fluid-power systems is important because the rate of movement of fluid-powered machines depends on the rate of flow of the pressurized fluid. These valves may be manually, hydraulically, electrically, or pneumatically operated. Some of the different types of flow control valves are discussed in the following paragraphs. Ball valves, as the name implies, are stop valves that use a ball to stop or start a flow of fluid.

4. Pressure Measurement

Since static fluid pressure is determined by the fluid density and depth, the depth or height difference of a given liquid is commonly used for pressure measurement:

The fact that the liquid levels are the same in these three manometers shows that the pressure in the glass manifold above them is uniform. This is under static conditions with no air flow through the system so that all parts of it are at atmospheric pressure. The fact that open liquids will seek a common level is the principle behind liquid levels for construction purposes.

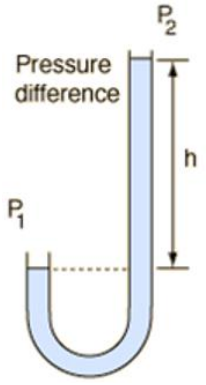

Fig. 3.

The flow in this system is from left to right, driven by a high-pressure air supply. The system is said to have a positive gauge pressure exerted by the air supply. This pressure acts to push the manometer levels down, so the minimum height The fact that the center manometer has a higher level under these conditions of rapid air flow indicates that the pressure has been lowered in the constriction by the Bernoulli effect. Note that the liquid level in the righthand tube is slightly higher than the left tube, indicating that the pressure there is slightly less than that at the left-hand tube. This is indicative of the normal pressure drop in a flowing fluid from Poiseuille's law since the diameters of the top tube are the same at the left and right tubes. in the left manometer indicates that it is subjected to the highest pressure.

1) Pressure calculation

There are many physical situations where pressure is the most important variable. If you are peeling an apple, then pressure is the key variable: if the knife is sharp, then the area of contact is small and you can peel with less force exerted on the blade. If you must get an injection, then pressure is the most important variable in getting the needle through your skin: it is better to have a sharp needle than a dull one since the smaller area of contact implies that less force is required to push the

needle through the skin.

When you deal with the pressure of a liquid at rest, the medium is treated as a continuous distribution of matter. But when you deal with a gas pressure, it must be approached as an average pressure from molecular collisions with the walls.

Pressure in a fluid can be seen to be a measure of energy per unit volume by means of the definition of work. This energy is related to other forms of fluid energy by the Bernoulli equation.

$$P = \frac{Force}{Area} = \frac{F}{A} = \frac{F \cdot d}{A \cdot d} = \frac{W}{V} = \frac{Energy}{Volume}$$

5. Gauge Pressure

Does the flat tire on your automobile have zero air pressure? If it is completely flat, it still has the atmospheric pressure air in it. To be sure, it has zero useful pressure in it, and your tire gauge would read zero pounds per square inch. Most gauges read the excess of pressure over atmospheric pressure and this excess is called "gauge pressure". While a useful measurement for many practical purposes, it must be converted to absolute pressure for applications like the ideal gas law.

Since a partial vacuum will be below atmospheric pressure, the phrase "negative pressure" is often used. Certainly, there is no such thing as a negative absolute pressure, but small decreases in pressure are commonly used to entrain fluids in sprayers, in carburetors for automobiles, and many other applications. In the case of respiration, we say that the lungs produce a negative pressure of about -4 mmHg to take in air, which of course means a 4 mmHg decrease from the surrounding atmospheric pressure.

$$P_{gauge} = P_{absolute} - P_{atmosphere}$$

Fig. 4.

When a system is at atmospheric pressure like the left image above, the gauge pressure is said to be zero. In this image, the system has been opened so that it is at equilibrium with the atmosphere. In the right image, the system has been closed and the plunger pushed down until the pressure reads about 15 lb/in2. This implies that the absolute pressure has been approximately doubled by compressing the gas to half its volume (ideal gas law). Standard atmospheric pressure in these U.S. common units is 14.7 lb/in^2, so this must be added to the gauge pressure above to get the absolute pressure.

6. Advantages

Following are the different advantages of hydraulically operated valve cum Pressure gauge testing machine:

1) It required no power for its' operation being manually operated.
2) Its efficiency is more as for the less operation of lever the pressure developed is too large of the order of 10 bar and more.
3) It has greater mechanical advantage.
4) It is portable and can be conveyed to any remote place.
5) It required very little maintenance as compared to the power-driven units hence its running cost is negligible.

Following are the disadvantages:

- The continuity of pressure output is less smooth.
- It may cause fatigue to the operator.
- Less control over the required range of pressure value.

7. Maintenance

No equipment in the universe is 100% maintenance free equipment, either it may be human or machine. Our equipment being compact one requires following maintenance: -

Due to continuous use the piston 'O' ring may get worn out. It is required to replace if worn out or broken.

- The linkage pins are to be replaced if worn out.
- The air conveying pipes if leaking is to be replaced.
- The leakage of air may be due to the leakage from the nipples or connectors, then it may be replaced.
- It is required to color the equipment periodically.
- Nut bolts and screw should be replaced periodically.
- The broken strips or the linkages should be welded or replaced as per the

Sometimes the spool of the non-return valve may not be engaging the spool may jammed due to thread particles or any foreign material may clog it. Hence it may be cleaned

8. Conclusion, Testing and Safety

By having trial on our project "Lever Operated Hydraulically Opened Valve Cum Pressure Gauge Testing Machine," we came to the following conclusions:

Testing, trial was done on the machine, the performance and the efficiency of the machine is satisfactory. We can inflate the receiver tank in 2 minutes up to maximum pressure of 25 bar.

The operating Water pressure of the HYDRAULIC system is 4.5 kg/cm^2.

The maximum advancement of the piston in the cylinder is at the range of 1.5"/sec.

The pressure gauge to be tested is installed and checked whether it's pressure and pressure of the calibrated standard pressure gauge is same or not.

In the similar fashion valve is tested for leakage under high pressure.

Maintenance and Safety Precaution:

A good workman has the knowledge and the skill to avoid injuries to himself his work makes and to prevent his job and or equipment. He is operating from being damaged. A careful and intelligent operation of the machine will enable to handle the m/c efficiently and safety. The main source of accident and injuries in a work area are usually carelessness negligence ignorance and absence of attention. However, any machine needs careful and regular maintenance because it's moving parts are subjected to wear and tear.

Our machine partly being the electrical appliance, have to take the following

Safety precaution:

1) Do not touch the operating mechanism when the lever operated hydraulic valve testing machine is in operation or it may cause injury to the operator.
2) Do not operate the lever the center of gravity of the operated is adjusted or he may fall down while operation of the hydraulic unit.
3) Always calibrate pressure gauges for its proper functioning or it may spoil the system or accident may occur.

9. Future Scope

Since old age man is always trying to gain more and more luxurious. Man is always trying to develop more and more modified technique with increasing the aesthetic look and economic consideration. Hence there is always more and more scope towards whatever he might have created of course after having the experience of the presently manufactured things. But being the diploma Engineers and having the ability to think and plan. But due to some time constraints, and also due to lack of funds, we only have thought and put in the report the following future modifications:

It can be modified to work hand operated by increasing the height of the table and can be made gymkhana exercise equipment, such that while having exercise the pumping of air can be done.

It can be modified to operate by having jumping and jogging platform such that by receiving the energy of the impact load due to jumping can be utilized to pump the air in the cylinder through the linkage mechanism.

It can be made power operated by replacing the foot compressor by the electric motor operated reciprocating compressor coupled to the receiver tank.

Thus, in future there are so many modifications, which we can make to survive the huge global world of competition.

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