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Optimization of air brake system using rotary compressor in Locomotives

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Abstract" Air brake system comprises the brake system using compressed air. For getting the pressurized air we use the compressor. Air brake system is used to stop the running train locomotive which contain high amount of kinetic energy. The pressurized air is provided by the different types of air compressors as per the requirement. The air brake system is used in present railway locomotives use the reciprocating compressor to provide the pressurized air to air brake system. The air pressurized by two compressors they are reciprocating and rotary compressors. There is a drawback in reciprocating compressor there is continuous contact of piston and cylinder. This introduces a significant amount of friction, which takes more power input to overcome this. Due to upward and downward movement, there are more chances of jerk on the coaches. Reciprocating compressors more expensive and require more maintenance. To overcome these drawbacks of reciprocating compressors, this can be replaced by rotary compressors. Rotary compressors use impellers (rotating part of compressor). . So maintenance cost can be saved. Due to continuous rotation of impeller, jerk on coatches will be controlled. Whereas rotary compressors are energy efficient with higher EER(energy efficiency ratio). In this way we can optimize the function of air brake system using rotary compressor.
Key Words: Air brake, compressor, Energy efficiency ratio, impeller.

I. INTRODUCTION

A moving train contains energy, known as kinetic energy, which needs to be removed from the train in order to cause it to stop. The simplest way of doing this is to convert the energy into heat. The conversion is usually done by applying a contact material to the rotating wheels or to discs attached to the axles. The material creates friction and converts the kinetic energy into heat. The wheels slow down and eventually the train stops. The material used for braking is normally in the form of a block or pad. The vast majority of the world's trains are equipped with braking systems which use compressed air as the force to push blocks on to wheels or pads on to discs

These systems are known as "air brakes" or "pneumatic brakes". The compressed air is transmitted along the train through a "brake pipe". Changing the level of air pressure in the pipe causes a change in the state of the brake on each vehicle. It can apply the brake, release it or hold it "on" after a partial application. The pump draws air from atmosphere and compresses it for use on the train. Its principal use is for the air brake system, although compressed air has a number of other usesontrains. Main reservoir is Storage tank used for store compressed air for braking and other pneumatic systems. The equalising reservoir overcomes the difficulties which can result from a long brake pipe. A long pipe will mean that small changes in pressure selected by the driver to get a low rate of braking will not be seen on his gauge until the change in pressure has stabilised along the whole train. At the ends of each vehicle, "angle cocks" are provided to allow the ends of the brake pipe hoses to be sealed when the vehicle is uncoupled. The cocks prevent the air being lost from the brake pipe. The movement of the piston contained inside the cylinder operates the brakes through links called rigging. The operation of the air brake on each vehicle relies on the difference in pressure between one side of the triple valve piston and the other. In order to ensure there is always a source of air available to operate the brake, an auxiliary reservoir is used. The operation of the brake on each vehicle is controlled by the triple valve.

II. LITERATURE SURVEY

Locomotive air compressor with motor supported by outside bearing Varney, et al. september 2010 09/593,559 wabtec corpora. The present invention provides an assembly for supporting a rotatable shaft member driven by a motor. The assembly comprises a base member, an upright support member connected to the base member and a bearing member mounted on the upright support member Such bearing member is connectable with the rotatable shaft member for supporting such rotatable shaft member thereby reducing extraneous vertical and horizontal movement of such rotatable shaft member while permitting such

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rotatable shaft member to rotate freely.

Pneumatic coupling having a latching mechanism and a bleed-off valve for attachment to an air brake hose Chew, august 16, 1988 07/082 ,401A brake hose coupling having a locking mechanism and a pressure relief valve for connecting a telemetry unit to the air brake pipe line of a railway train. The locking mechanism positively latches the brake hose coupling to the "glad hand" brake pipe hose coupling and causes the venting of the entrapped pneumatic pressure by the relief valve when the locking mechanism is unlatched.

BRAKE SYSTEM AND METHOD Hill, et al. june 17 2003 09/825,364The invention relates to a brake system for railway equipment. More particularly, the invention relates to brake devices and systems for pneumatically and manually actuating such devices on railroad train cars such as freight cars. The brake system can be integrated into modern trains without interfering with existing air brake systems. The brake system can be remotely operated, locally pneumatically operated and/or locally manually operated. Monitoring equipment for determining the status of the brakes from remote and local positions may also be provided. The invention may be configured to fit within the envelope of prior art handbrake systems

A. Experimental Setup

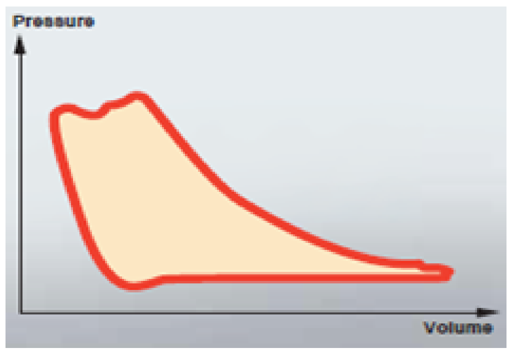

Fig 2.1:Actual pressure of reciprocating compressor

In addition, the valves cannot fully open and close without a minimal delay, which results in a pressure drop when the gas flows through the channels. The gas is also heated when fl owing into the cylinder as a consequence of this design.

Note that we assume polytropic compression and expansion.This is because some degree of cooling is usually attempted.

If no cooling were attempted n becomes γ.

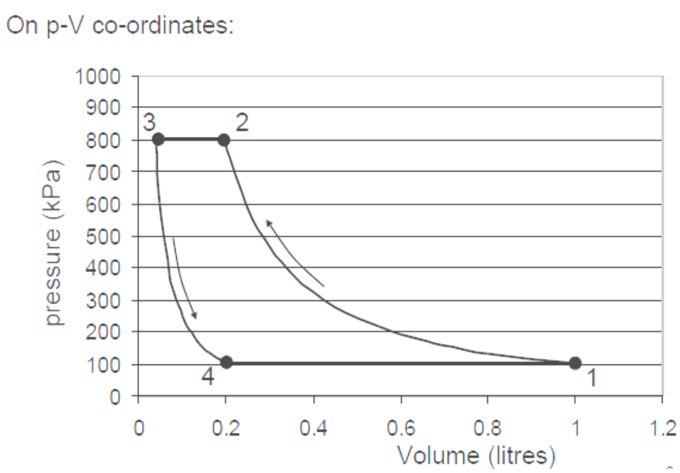

Fig 2.2:Pressure rise with 1l cylinder

There are various type of compressors in rotatory but in this experiment we have taken the centrifugal compressor.

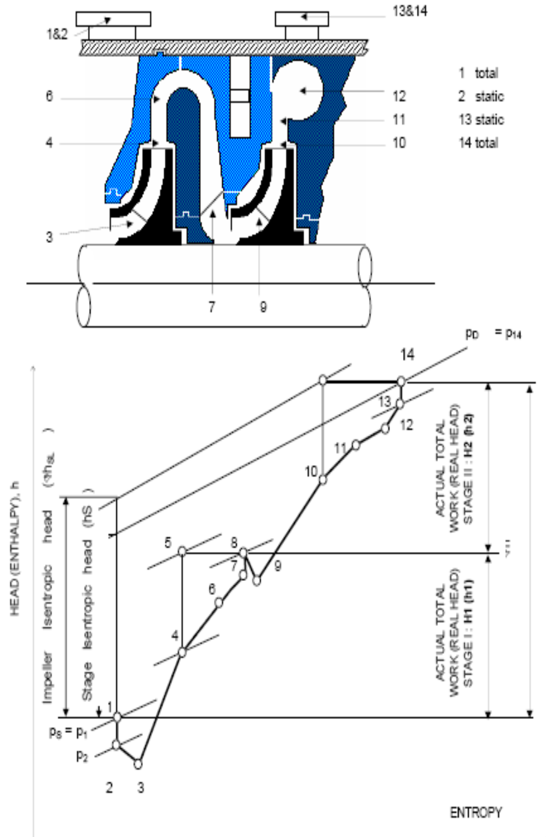

Fig: 2.3 Centrifugal Compression

T-S Chart for Compression

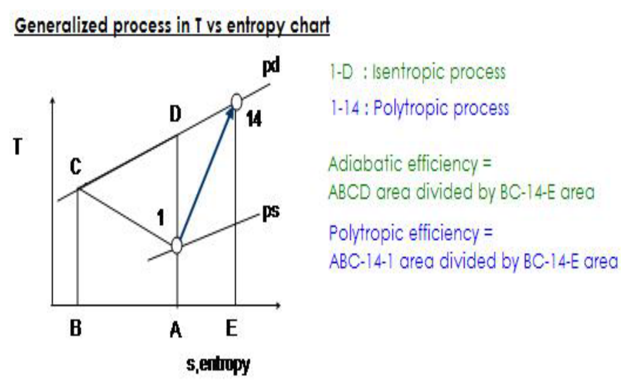

Fig: 2.4 Generalized process in Temp Vs Entropy

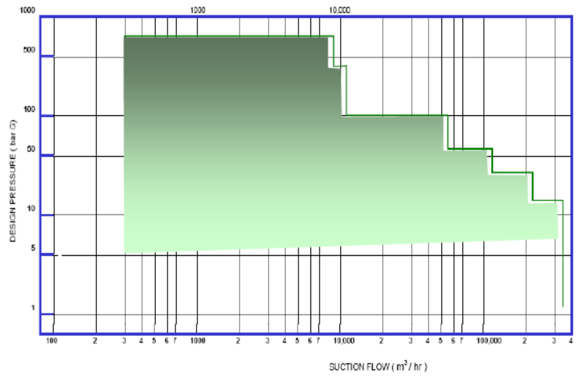

Fig: 2.5 Operating Range of Centrifugal Compressor

Power supplied	50Hz 220-240 V
Discharge capacity	50 PSI
Line power consumption	2.5
Volume	Less

Specifications of Rotary Compressor

To improve efficiency, some or all stages cool the air before it enters the next stage. For discussion purposes, the operating explanation has been simplified in an effort to remain within scope. The pressure capabilities of a centrifugal compressor are dictated by aerodynamic design of the internal components, ambient conditions, rotating speed and cooling of the air between stages.

The relationships between flow, pressure and power for a centrifugal compressor are normally expressed using a performance curve based on specified ambient conditions, cooling water and applied internal components.

The performance curve is made up of two parts: the pressure-flow curve and the power-flow curve. The pressure-flow curve has pressure on the vertical axis and flow on the horizontal axis. The power-flow curve has power on the vertical axis and flow on the horizontal axis. The flow values for each horizontal axis align so each pressure-flow curve has a matching power-flow curve. Notice how the natural curve moves up and to the right as ambient temperature decreases

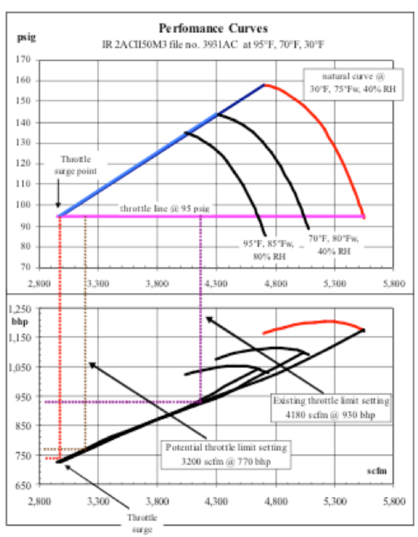

Fig: 2.6 Centrifugal Compressor Performance Curves

III. RESULTS & DISCUSION

A. Rotary compressor s are continuous flow of air equipment while reciprocating compressors are intermittent due to clearance volume

B. Reciprocating compressors are suitable for high pressure and low discharge of compressed air while rotary compressors are suitable for low pressure and high discharge.

C. Balancing is easy in the case of rotary compressor better than reciprocating compressor

D. Rotary compressor operates at higher speeds while reciprocating compressor operates at low speeds

E. In Reciprocating compressor the air that is delivered is generally contaminated with lubricants and rotary compressor the air is relatively pure.

F. In Reciprocating compressor adiabatic process can be achieved at low speed and rotary compressor adiabatic process achieved at high speed.

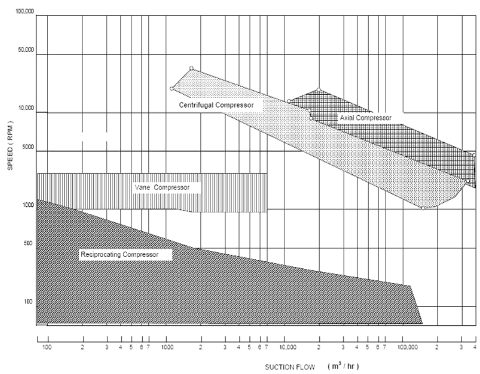

Fig: 2.7 comparison of compressors speed

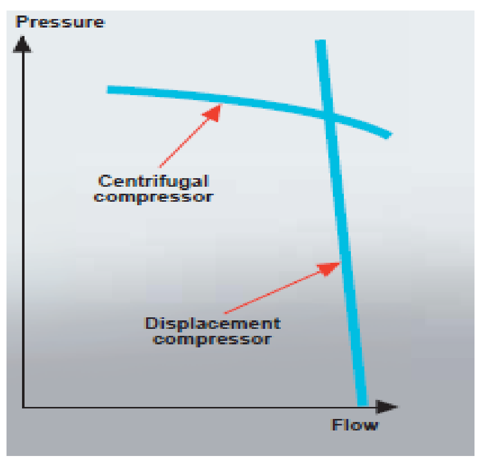

Fig: 2.8 Comparision of pressure vs flow graph

REFERENCES

[1] Indian railway compressor manual
[2] Atlas Copco Compressed Air Manual 7th edition
[3] Applied thermodynamics: Dr. R. Yadav
[4] http://www.airbestpractices.com/system-assessments/compressor-controls/air-system-pressure-influences-compressor-power-part-2-influe
[5] IS 10431:1994: Measurement of airflow of compressors and exhausters by nozzles.