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TECHNOLOGY UPGRADATION IN AIR BRAKE SYSTEM OF HEAVY COMMERCIAL VEHICLE

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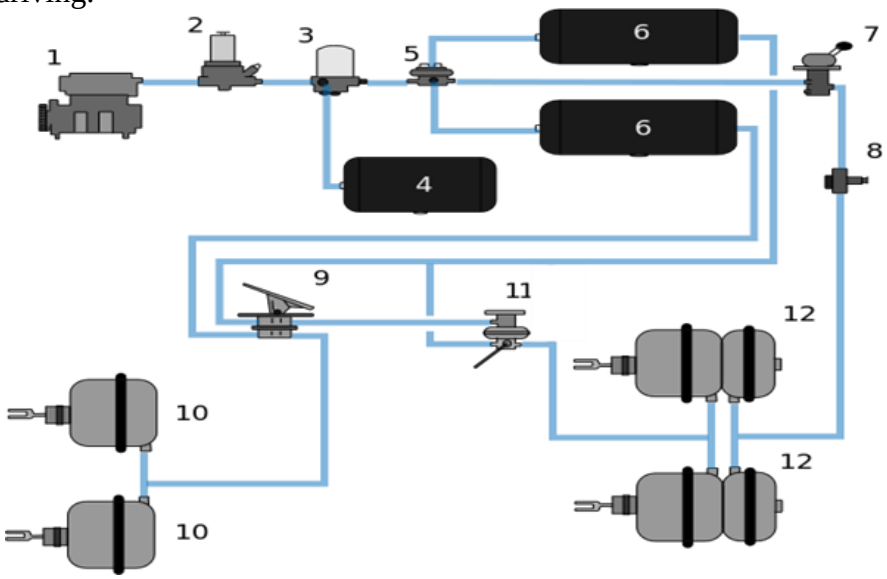
Abstract
Most of the accidents in four wheeled vehicles occurs due to failure of braking systems. Manual method of applying brakes as it leads to accidents the linkages of braking systems, road conditions, uncontrollable speed of the vehicle and manual operation of braking systems are thereason of accidents. It is necessary to control brakes automatically through electronics devices to reduce accident problems. In this research paper we design an effective methodology for automatic control of braking system to avoid accidents. We used Arduino, relays, IR transmitter, and IR receiver for the effective function of braking control system. This complete system can be fixed on the dashboard of a vehicle and effectively used for automatic control of braking system. Vehicle accidents are everywhere in recent years. This is because of increase in population of vehicles, due to its high demand. A system must be designed to reduce the accidents.. The technology of pneumatics plays a mainrole in the field of automation and modern machine shops.. IR sensor fixed on the front end of the vehicle detects the presence of the obstacle. The use of pneumatic system can be useful in automation due to its simplicity and ease of operation. The past experiment results show that the control method can be improve the braking performance of a vehicle. So, the objective is to develops a system based on automatic control of vehicle. So design "Pneumatic Braking System". Generally, we see a pneumatic controlled braking system within the heavy loaded vehicles. In today's world technology is upgraded day by day with the assistance of advance braking system in pneumatic controlled braking systems we willmake it work more effectively. Generally, we see heavy loaded vehicles travels long distance So as to induce safe driving, braking system should be advance, braking distance are minimum. Automatic controlled air braking system of ABS is advancement in air braking system Although improvements like high bandwidth is additionally required Bioactivated valves gives accuracy to the brakes and also work on heavy reservoir toform it less heavy are to be improvement also driver cannot control the air which is triggered at the time of applying brakes to form systems more advance a special style of drain valve called as drain cock can augment to the reservoir tank. Within the air braking system, we see that brakes are not frequently used as compressor takes power from the engine so at that time high pressurized air is release to atmosphere so by stopping the compressor the power can be reduced and energy can be conserved this mechanism can be achieved with the help of engaging and disengaging of the air brakes. Braking by wire with multifunction's used in the commercial vehicles under the name of electro pneumatic braking system. advancement in braking systems required so there will be less accidents and this advancement are often done by improvements. And a braking are advance given that it gives effectively good response.

Keywords: Heavy Commercial Vehicle, Braking, Air Brake

Introduction

Brake plays important role within the vehicle as engine. An engine requires to run the engine it also needs brakes since we used hydraulic brakes but what about heavy vehicles, in heavy vehicles we use Pneumatic air brakes for the effective braking. Generally, a pneumatic brake or air brake is a kind of mechanical System in which compressed liquid fluid from hydraulic brake is replaced from compressed air which applying pressure to the master piston cylinder connected to the brake pads for the deceleration of vehicle.

In this paper, we are studying about the advancement in the pneumatic braking system. In the present study about pneumatics breaks the breaks are used to avoid collision between two vehicles and reduce accidents and reduce the damage of vehicles from collisions and also protect the people from injury. the vehicle accidents mainly depend upon the driver inability to press the brake pedal at the right time and rash driving etc. for this type of accidents can be controlled and somehow we can reduce by attaching the sensors to the breaks and the break will be automatically done is known as the automatic pneumatic braking system. An automated collision avoidance system is one such system that is reducing accidents. This pneumatic break can be controlled electrically. The main objective of this system is to avoid the collisions of the vehicles. The main purpose was designed to develop of a command system based on the electronically controlled automotive bumper activation system is called "automatic pneumatic braking system". The automatic pneumatic braking consists of IR transmitter, Receiver circuit, command unit, solenoid valve, pneumatic bumper system. The IR sensor senses the obstacle. When the obstacle is come closer the vehicle wheels the control signal is given to the bumper and break activation system. this bumper activation system is activated when the speed 30-50 km per hour. Speed was sensed by proximity sensor and that can be transfer to the control unit and the pneumatic bumper activation system. In collision mitigation system, the sensors detect the possibility of collision but will not take the immediate action. Road accidents are the most unwanted thing that happens to road user. Sometimes this accident proves to be fatal. The major source of vehicle accidents are occurred due to the human error. These accidents are mostly caused due to the delay of driver to press the brakes pedal. The main purpose of this paper is to design the system which will resolve such accidents by the continuously keeping the record of the distance between two vehicles. In Intelligent Battery Sensor (IBS), ultrasonic sensor senses the imminent collision with another vehicle, person or the IR Sensor is detect the obstacle and the microprocessor in the system start the brakes can be applied to the wheel and it will slow down the vehicle or bring it to stop if needed. The main reason for writing this paper is to implement a braking system using IR sensor and to proposal a vehicle with less human attention to the driving.



Components of Air Brake System

1. Air Compressor
2. Oil Separator (Optional in domestic)
3. Air Dryer
4. Purge Tank
5. Multi Protection Valve6(i) Primary Tank
6. 6(ii) Secondary Tank
7. Hand Brake Valve
8. Quick Release Valve

9. Dual Brake Valve
10. Brake Chambers
11. Relay Valve
12. Spring Brake Actuator

Whenever the vehicle is moving in a highway or traffic less area the application of brake is not that much frequent, in that time the compressor send high pressure to the atmosphere as required amount volume of air is already available in the reservoir. As a result, soundof releasing air come from the heavy loaded vehicles. Brakes are applied by pushing down the brake pedal which is also known as foot valvemore pressure can apply by pushing harder the vehicle. Release the breaks let some air get out from the system so that the air pressure canbe reduced from the system. There are also large vehicles which have emergency braking system in which compressed air holds back with the help of spring.so, if pressure lost brakes will engage itself and vehicle will stop

Literature

Pneumatic Braking system –In Electro-pneumatic braking system law of pneumatic used for apply the brakes. When any obstacle sensed in the path by sensors. it will apply instant brake in seconds so driver can protect from the major accidents. So, there is a pneumatic braking circuit with IR sensors perform these operations. Automatic braking systems in two wheelers is very useful and provide extra safety to the two wheelers, So the purpose of the project is to perform required task in small time with adding some in automobiles. The circuit can stop the vehicle within seconds running at a high speed. Automatic brake with the electro-pneumatic system will provide more safety to the two-wheelers. The main aim of the project is made to perform the required task in shortest time and to add some innovation in the automobile Industry.

2.1 Designing and testing an advanced pneumatic Braking System for Heavy Vehicles -Generally we see poor braking systems in heavy vehicles at time of emergency, Compare to other vehicles and generally problems created in pneumatic brake actuators which limits the control bandwidth of their ABS And also the algorithm thatused do not achieve the max braking force throughout the stop. So according to the research paper the pneumatic air braking system which used for heavy vehicleswill be improve by placing high band width brake actuators the braking control algorithm is change with wheel slip regulator with little change of mode with the help of combined actuator and slip controlled surface friction can be reduced from 10% to 27%

Several slip control algorithms have been derived for passenger cars,19–22 but only a few works have focused on heavy vehicles. Akey23 simulated a fuzzy logic wheel slip controller specifically for commercial vehicles. The algorithm produced 15% better braking distances than finite-state ABS in a Monte-Carlo simulationanalysis. However, details of the simulation were sparse, and no indication of experimental validation was given. A sliding mode slip controller was designed for a rigid commercial vehicle with conventional air-over-hydraulic brakes by Kawabe et al.24 Full-scale vehicle tests showed that the control error was relatively small, but because the focus on the reducing chattering, the sliding controller was not compared to conventional ABS'

The binary-actuated valves and sliding mode controller were tested on a HiL rig that included the ECU, pneumatic brake system and prototype valves, along with a simulation model of the rest of the vehicle. These tests showed reductions in stopping distance of 10% and 27% over conventional ABS on smooth and rough, high friction surfaces, respectively. Reductions in stopping distance of 23% and 25% were also observed on low friction, smooth and rough roads, respectively.

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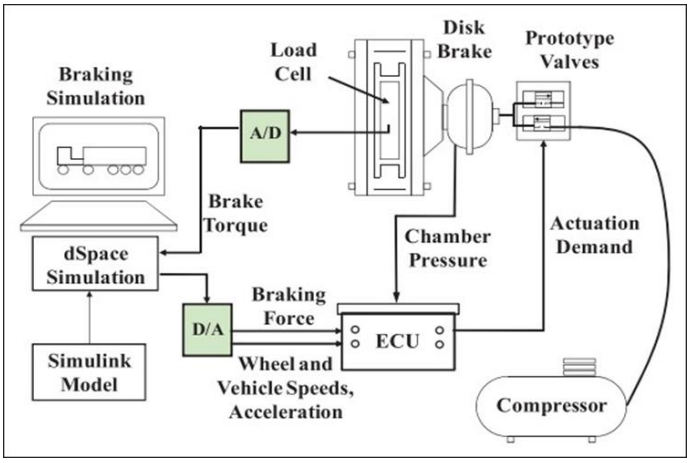
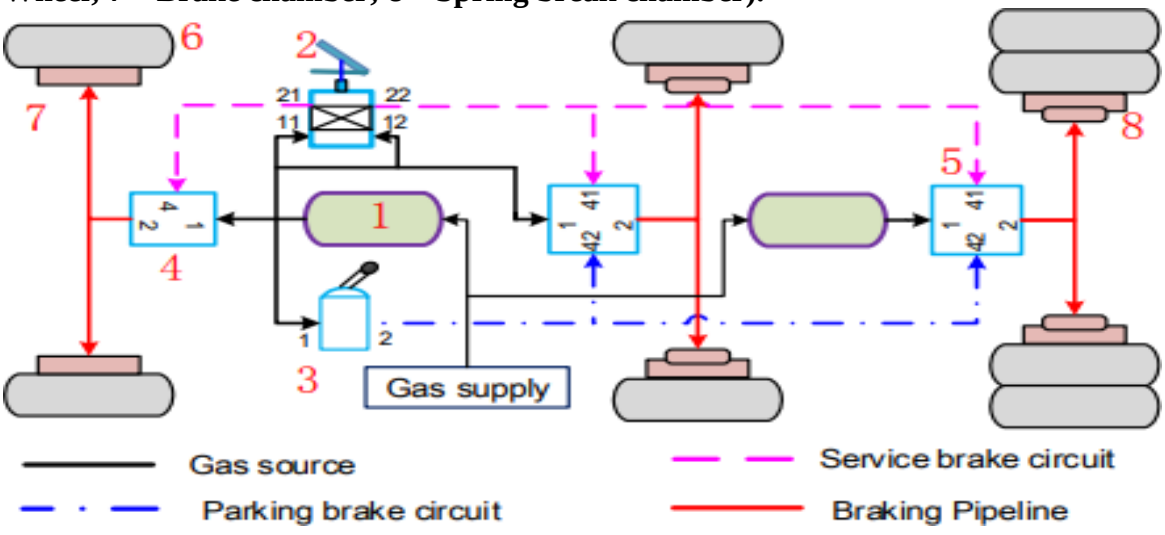


2.2 An experimental study on hysteresis characteristic of a pneumatic braking system for the multi axle heavy vehicle in emergency braking situations-Hysteresis is a property of the PBS, which with little question encompasses a significant impact on braking performance. The hysteresis characteristics can be divided into two types they are one is system level and component level. Most of the literatures are focused on the trade valves, brake pipelines, and other sub-assemblies.

However, subassemblies in a very loop are connected to every other and affect each other; analysis of individual subassembly seems to be insufficient. In terms of the system level, Selvaraj and He established simulation models of the PBS on two-axle vehicles using AMEsim (Advanced Modelling Environment for performing Simulation of engineering systems) and MWorks, respectively. Additionally, sensors aren't easily placed or replaced on subassemblies after the vehicle is totally assembled. Hence, a test bench for studying hysteresis characteristics of PBS for MHV is critical.

In the below figure PBS in an MHV are showed. The system consists of service brake circuit and emergency brake circuit. Usually, double circuits are employed within the service brake circuit, only for avoiding the braking failure just in case one amongst the 2 circuits has stochastic fault. Each circuit within the system mainly consists of gas reservoirs, control valves, brake chambers and brakes. The gas source of the entire vehicle is provided by compressor and stored during a main reservoir with large capacity additionally as several normal ones with relatively small capacity. Control valves mainly comprise a emergency valve and a treadle valve located within the cab, several relay valves, and delay relay valves arranged within the rear axle of the chassis. Drum brakes, which might offer more powerfulbraking force compared to disc brakes, are widely utilized in MHVs.

Schematic diagram of a pneumatic braking system(PBS) on a multi-axle heavy vehicle (MHV), 1 gas reservoir; 2—Treadle valve; 3—Hand brakevalve; 4—Relay valve; 5—Delay relay valve;6—Wheel; 7—Brake chamber; 8—Spring break chamber).



2.3 Vehicle braking force distribution with electronic pneumatic braking and hierarchical structure for commercial vehicle – You **w**ill be seen wire braking system within the commercial vehicles that allow no. of multifunction works, which can improve braking comfort and safety of business vehicle. The design of braking force distribution control method has drawn rather more attention. Considering structure characteristics of electronic pneumatic braking system, control method with a three-layer hierarchical data structure is proposed. The primary layer presents an estimation method towards vehicle mass and Centre of gravity combining Kalman filter with recursive least square. The second layer is developed by designing a hard and fast relationship between the foot pedal displacement and vehicle braking deceleration. Whereas the third layer decides the braking force between front and rear axles. In line with the strategy of deceleration control which might be achieved with the graceful axle load transfer during a way of linear matrix inequality. The research shows that control method can enhance the performance of electronic pneumatic braking system.

2.4 A study on automatic bumper system - During this system controlling is completed by IR sensor with the assistance of IR sensorpneumatic bumper actuate brake will applied. When the obstacle is there in front of vehicle then the IR sensor sense and that signal transfer to the solenoid valve is actuated. solenoid valve having a two output and one input. Input is connected to the compressor and the output is connected to the pneumatic cylinder and the bumper will go further which comes back by the gas. When the obstacle comes before of car the IR sensor unit will command to the control unit and control unit will cut the facility off motor by this rotation of wheel decreases and brake will applied. In this project they are mainly focused on the reduce accident problem by means of providing the sensor arrangement in bumper. The aim is to style and develop a bearing system based an intelligent. Electronically controlled automotive bumper activation system is named automatic pneumatic bumper. This technique is consisting of IR transmitter and receiver circuit, control unit, pneumatic bumper system. The IR sensor is employed to detect the obstacle.

2.4 Merits

- Air pressure is quick to act and hence air brakes are immediate
- Air brakes can effectively stop loads of over 14 tons
- A little feather would apply the same pressure
- Air does not corrode the metals, so the life of pneumatic brake is more
- Air is available everywhere in atmosphere so the brake can never run out of its operating
- Force is limited by air pressure and cylinder diameter
- The speeds and forces are infinitely variable
- Can apply a lot of force from a small and light package
- Easy to control
- Simple in design and control
- Storage of compressed air is easy
- low in cost as compared to other systems

2.5 Application

- Air brakes on busses and trucks
- Air compressors
- Air engines for pneumatically powered vehicles
- Compressed air engine and compressed air vehicles
- Lego pneumatics can be used to build pneumatics models
- Pneumatics actuator
- Pneumatics bladder
- Pneumatics cylinder
- Pneumatics tools
- Pneumatics tire
- Pneumatics motor

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2.6. ADVANCEMENT IN PNEUMATIC BRAKING SYSTEM: Pneumatic braking system is used in heavy vehicles earlier but our innovation is pneumatic braking system is used in mini cars and auto and vehicles and with IR Sensor which will sense the object near by the vehicle and pneumatic brake will activate and vehicle will be come to rest position and IR sensor works on program and reduce the cause of accident and improve the safety to the passenger. Pneumatic braking system is using in heavy vehicles and not used in mini vehicles so our innovation is using a Pneumatic braking system in mini vehicles by connecting of IR sensor to the bumper of the vehicle and pneumatic brake system is fixed to vehicle in place of hydraulic or another brake system and reduce size of components of pneumatic braking system and coding was stored in board and air will take from the environment and air filter will filter the air and send it to the compressor and then to reservoir than when we apply brake in very short period of time the brake will work and vehicle will stop and when any obstacles come suddenly and sensor will detect and pneumatic brakes activation take place and vehicle will stopand reduce the number of accident.

2.7 WORKING OF PNEUMATIC BRAKING SYSTEM - Brake system is based upon a design Air patented by George Westinghouse on March -5 year1872. The Westinghouse Air Brake Company (WABCO) was systematic organized to manufacture and sell Westinghouse invention which has been universallyadopted.

The air compressor operated by the engine forces air at a pressure of 9-10 km/sec, through the water and oil separator to the air reservoir. The air pressure in the reservoir is indicated by the pressure gauge. The reservoir contains required compressed air for several braking operations. From the reservoir the air is enter into the brake valve. As long as brake pedal is not pressed,brake valves stop the passage of air to brake chambers and there is no braking effect.

When the brake pedal is depressed, the brake valves change its position and compressed air is admitted into the wheel brakechambers. In the chambers the air acts upon flexible diaphragms, and then the pushes out the rods connected with the leversof the brake gear cams. The cams move and separate the shoes then breaking the wheels.

When the brake pedal is released, the supply of compressed air is stop to the brake chambers and which connected to the atmosphere. The pressure in the chambers drops, then brake shoes are returned to their initial position and the wheels run free. The brake valve is connected with a servo mechanism and which maintain the braking force on the shoes is proportionalto the force applied on the pedal. the valve imparts a relative reaction to the movement of the pedal so that the driver can knowns the degree of the brake application.


Quick Release Valve


Spring Brake Actuator


Hand Control Valve


Dual Brake Valve


Double Check Valve


New Generation Dryer

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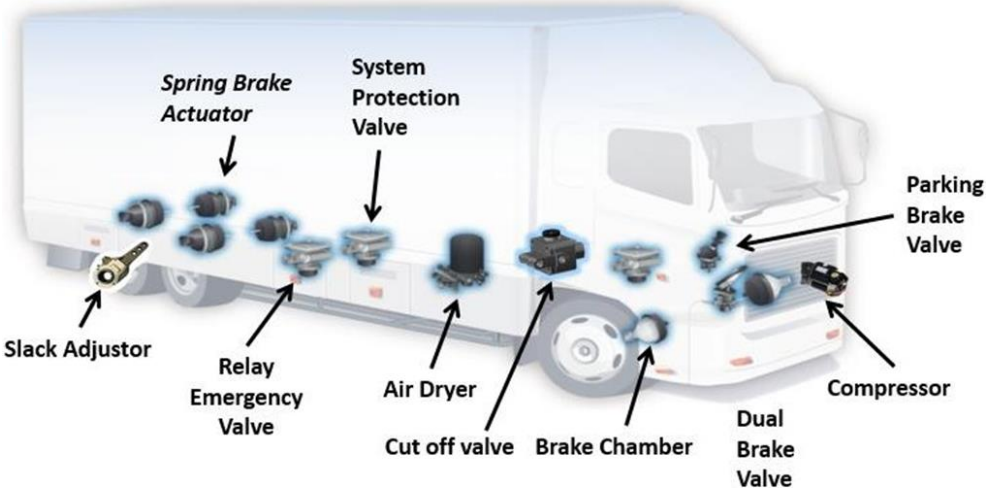

Air Dryer

- remove moisture, dirt, carbon and oil from the compressed air.
- To control the air brake system pressure (Unloader function)
- External purge allows the trapped dirt and condensate to be expelled and the desiccant to be regenerated with clean & dry air.
- TIV (optional) for tyre inflation purpose.
- To protect system from excess pressure build up

Application

- Commercial vehicles / Cranes

Feature

- Dual governor system
- Global patented for higher pressure (CO-CI > ~2 bar) difference setting
- Improved fuel efficiency (As per ARAI report - 2% approx. Test standard IS 11921 -1993)
- High performance cartridge
- Desiccant volume-600cc ,Drying performance @DT=18°C –188 L/cycle
- High Oil removal ratio (%) - 98%
- Easy replaceable with spin on cartridge

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Specification

#	Parameter	Specification
1	Max Operating Pressure	12 bar
2	Operating pressure	8.5 bar
3	Fluid used	Compressed air
4	Applicable temperature range	-40°C to +80°C
6	Weight	3.7 Kg
7	Dimensions	275 X 156 X 145 mm
8	Governor type	Dual governing system
9	Blow off pressure(Safety)	10.5 bar Min.
10	Exhaust noise level	≤ 72dB (A)

Multi Protection Valve

a. To supply air to four separate circuits
b. To protect individual circuits from air loss in the event of failure in any bake circuit
c. Preventing back flow of compressed air into upstream by means of non-return valves

Application

d. Commercial vehicles.

Feature

e. Series charging, Filling sequence 21/22□23/24
f. Unique orifice valve design for Bypass/High retaining pressure.
g. Bleed back feature (optional) provides additional safety in case of any one or both service brake failure.

DU 3 Unit

- To remove moisture, dirt, carbon and oil from the compressed air.
- To control the air brake system pressure (Unloader function)
- Integrated purge allows the trapped dirt and condensate to be expelled and the desiccant to be regenerated with clean, dry air.
- Integrated MPV to supply air to four separate circuits

Application

- Commercial vehicles /Cranes

Feature

Dual governor system
Global patented for higher pressure (CO-CI > ~2 bar) difference setting
Improved fuel efficiency (As per ARAI repot - 2% approx. Test standard IS 11921 -1993)
High performance cartridge
Desiccant volume-600cc ,Drying performance @Dp=18°C –
-188 L/cycle
High Oil removal ratio (%) - 98%
Easy replaceable with spin on cartridge
Unique orifice valve design for Bypass/High retaining pressure.
36% Lesser weight than competitor

Brake Chamber

To provide the input force to actuate the vehicle's foundation brake.

Application

Commercial vehicles / Cranes

Feature

- Flat output characteristics 10 to 45 mm
- Ensuring full return of slack adjusters in 0.3 sec to avoid wheel

Grabbing

Relay Valve

- To do relay function there by reducing reaction time
- Applicable for long wheelbase rear axle

Application

- Commercial vehicles.
- Off -Road vehicle

Feature

- Less Exhaust time.
- Ease in mounting
- Crack off pressure≤ 0.3 bar

High response at low pressure

Hand Control Valve - Auto Return

- To apply parking brakes by releasing the air pressure from spring side of actuators
- Mechanical braking force by expansion of power spring in the actuators.
- Return stroke controlled automatically

Application

- Commercial vehicles.
- Off-Road vehicle

Feature

- Gradual brake application in case of emergency.
- With plastic Finish and gives premium look on Cabin.
- Handy Knob following AIS 047.
- Boot design eliminated.
- Reduce exhaust noise

Other Componnts Description

- **Air Compressor:** -Air compressor is a device which converts compressed airinto power. By using gear or belts compressor is connected to the engine
- **Air Compressor Governor**: -The governor is a device maintain required compressed air in required limits.
- **Air Dryer**: -Air dryer is used to take the moisture out from the air, so the water moisture will not be in the air storage tanks. if moisture in the air thatwill caused to brake failure.
- **Air Storage**: -The function of the air reservoir is to store the compressed air so that there will always be an ample supply available for immediate use in brake operation. It stores and provides the sufficient compressed air to permitbrake applications even after the engine has stopped and just restarted. It alsoprovides a space when the air is heated during compression might cool, and oiland water vapours condense.
- **Brake Pedal**: -brake pedal is used to apply the brakes , applying by pushing down the brake pedal. How much harder you push down on the pedal; the more air pressure is applied from the storage tanks into the brake chambers.
- **Dirt collector:** -It is placed in the brake pipeline at a point from where abranch is taken off to the triple valve.
- **Triple valve:**-Application and release of brakes where brake pipe pressure has to be reduced and increased respectively with the help of driver's brake valve during these operations the triple valve is used

Conclusion

I found that timing for the braking systems for various vehicles is different. ABS play major role within the controlling of car ABS can protect vehicles from the slippery road. The simplicity of pneumatic braking systems prove that its operation is straightforward and also IR sensors perform well with this. Centrally located and electrically powered compressors that powers cylinders and other pneumatic devices through solenoid valves can provide power during a cheaper way with more safety and more flexibility. There's a negligible maintenance and even have long lifetime of pneumatic actuators throughout the life cycle. Since heavy vehicles carries huge load with its pneumatic systems provide spring effect withit so when brakes applied there'll be a less jamming of disc within the vehicle. Supported pure pneumatic ABS control and optimum control theory, the optimization of the control strategy for regenerative braking with ABS is proposed. The optimization is devised to create better use of electrical motor torque when the frictional braking system comes under ABS control. The difference within the supply pressure and also the steady state pressure within the brake chamber is strongly associated with the severity of the leak. Behind the designing of this method, our main aim is to boost the technique of prevention of accidents and also reducing the hazard from accidents like damage of auto, injury of humans, etc. The appliancesof pneumatics produce smooth operation. By using more techniques, they'll be modified and developed per the applications.

By implementing this project, we will reduce cost of high-end cars by giving similar reasonably safety. A pneumatic braking system for an eight-axle vehicle is introduced. So as to accurately study the hysteresis effect of the system in emergency brakingsituation, a test bench is made. Not only the delay time of every loop such as each axle but also the interval of every subassembly during a single loop is detected in real time.

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