Fabrication Of High Speed Indication And Automatic Pneumatic Braking System

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***Abstract*— As for the Indian road transport scenario is concerned, accidents are becoming a day to day cause an attempt has been made in this project to reduce such mishaps. In our project a high speed indication is given and automatic braking is applied by cutting off the fuel supply to the engine when the setup speed is exceeded. In our project, we have used solenoid valve and an operational amplifier circuit using LM324IC. The alternations to be made to implement this project in the vehicles are also discussed.**

***Keywords*— High speed indication, Automobile braking system, Automatic vehicle identification, Adaptive cruise control, Solenoid Valve.**

I. Introduction

In this fast moving world accidents are becoming proportional to high speed. In this project we are dealing with the speed limit taking into consideration, the wheel speed. A speed limit, the electronic gets closed. This makes the solenoid valve to close, which is placed before the carburettor. The fuel supply is cut off due to the action of a solenoid valve that in turn decreases the speed. As soon as speed decreases the op-amp circuit disables the supply to the solenoid valve, which makes it to open and allows the fuel flow in a regular manner to the engine. The rider while in action may drive in different speeds depending on his needs and his substance of mind. This may lead to negligence of visual indication of the speed that he is driving which in many incidents have proven to be a disaster. In our Automatic braking system the audible alarm is given to the rider against the high speed stop that he is brought to his senses from the deviation, the Automatic braking system enables the control limit and brings the vehicle to the safety limit.

Automatic braking is a technology for automobiles to sense an imminent collision with another vehicle, person or obstacle; or a danger such as a high speed approach to a stop sign and to respond with the braking system by either recharging the brakes or by applying the brakes to slow the vehicle without any driver input. Sensors to detect other vehicles or obstacles can include radar, video, infrared, ultrasonic or other technologies. GPS sensors can detect fixed dangers such as approaching stop signs through a location database. Using such systems to prevent crashes is problematic, so practical systems more often seek only to reduce crash speed in some situations. Every year, we find more and more road accidents due to increased traffic on the roads, and if you see the statistics, you will find that the casualties are more every year than that of 1970 Indo -Pak war. Experts say, increased motorist population, long working hours, stressful life, are the major cause. The factors are beyond one's control, but if we could alert the driver on the highway, could save the many prestigious lives. The fig. 1 shows the receiver block diagram.

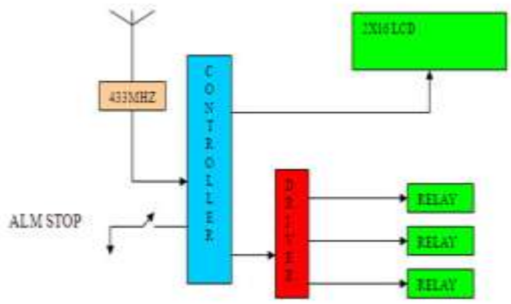

Fig. 1 Receiver Block diagram

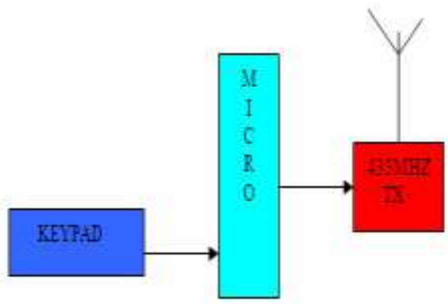

Fig. 2 Transmitter Block diagram

Fig. 2 shows the Transmitter Block diagram. Transmitter consists of a microcontroller and 433mhz transmitter module .Capacitor C1 and R2 gives the reset pulse to microcontroller reset pinX1 along with two 33 pf capacitors gives required the clock pulse to the microcontroller. Receiver consists of a microcontroller ic2 and 2×16 LCD device for display purpose. Capacitor C3 and R2 gives the required reset pulse to the reset pin1 of the microcontroller. Alternatively a reset switch is also provided to manually reset the microcontroller. Capacitor C4, C5 along with the crystal X1 gives the clock pulses to microcontroller, this serially received data is displayed on the LCD. Alarm switch connected to p1. 0 pin 13 will Data transmitted from the transmitter is received by the 433mhz receiver and output from this receiver is connected to pin 2 of the microcontroller ic2. This serially received data is displayed on the LCD. Alarm switch connected to p1. 0 pin 13 will switch off the alarm relay. Pin7, 8&9 of the microcontroller controls the operation of the relay.

These three relays are alarm relay, break relay and no horn relay. Transistor Q4 and Q5 are drivers for relay K3, a break relay. Whenever speed limit is above 80 km/hour break relay will be operated and break relay will operate and break will be applied. Whenever the vehicle is in no horn zone, no horn relay' normally close contact will open and driver will be prohibited to sound the horn. Whenever the vehicle receives any warning signal on his LCD an alarm will also sound which will be operated by the sound replay. The driver has an option to switch off the alarm after he sees the alarm message on the LCD. Limit 80, Limit 40, Limit 20 and No horn are the four keys connected to microcontroller pin 67, 8, 9. One side of the keys is connected to ground, so whenever any key is pressed, that particular pin of the microcontroller will become law and the microcontroller will detect key press. If no key is pressed all these pins will stay high. Data shifted out serially at the rate of 300bits per second. Output data from the pin 3 of the microcontroller is connected to the data in pin 2 of the 433mhx transmitter. The transmitter will transmit this data to air. The entire circuit is driven by 9v battery is 1 is a 5 v regulator which gives regulated 5v DC required for microcontroller and 433mhx transmitter module. Ld1 gives the visual indication whenever any key is pressed.

II. AUTOMATED HIGHWAY SYSTEMS

A major long-term element of Intelligent Transportation Systems research and development is automated highway Systems (AHS). The AHS program is a broad international effort "to provide the basis for, and transition to, the next major performance upgrade of the vehicle/highway system through the use of automated vehicle control technology". The detailed definition of the Automated Highway System is as follows.

The consensus in the AHS community is that AHS will evolve over a series of smaller steps in technology. The final step of full automation will not be a leap, but a logical consequence of previous development and deployment efforts. Each step in the technology will have its own benefits and be self-sustaining. Vehicle and infrastructure evolutions will be "synchronous" [**James 1994**].

[**Hapsburg 1991**] designed a fuzzy rule-based controller for lateral guidance of a vehicle. This system is based on human-type reasoning. The advantages of such a controller include flexibility in the choices of input/outputs, and on-line/off-line training capability. Their focus was achieving good tracking for a variety of roadway curves over a range of longitudinal vehicle speeds. Simulations to demonstrate its performance under parameter variations and external disturbances gave satisfactory results.

An alternative approach is presented in [**Lubin 1992**]. It concentrates the intelligence in the vehicle, using the visual sensing approach described in [**Kornhauser 1991**]. In this model, no infrastructure modification is needed, but considerable cost and complexity is added to each individual vehicle. With the current rate of technology improves, this system may become feasible for production purposes. During the last five years, the research on lateral vehicle control and lane changing maneuvers was extensive. For a (non comprehensive) list of publications on the subject, see [**PathDb 1996**].The concept requires inter-vehicle communication links to provide velocity and possibly acceleration information from the lead vehicle to each of the following vehicles, as well as the velocity and acceleration of the preceding vehicle in the platoon. [**Sheikholeslam 1989**] showed that inter-vehicle communications increases the stability of the platoon formation in the case of identical vehicle platoons.

It has also been shown that communicating the lead vehicle's information to other vehicles is not a requirement if we can tolerate degradation in the performance. This degradation is said to be not catastrophic [**Sheikholeslam 1991**]. Recent research on longitudinal control includes vehicle follower control design for heavy-duty vehicles [**Yanakiev 1996**], adaptive control of a nonlinear platoon model [**Spooner 1996**], automatic braking systems and their effects on capacity [**Hedrick 1996**], advanced control techniques [**Kachroo 1995**], and adaptive traction control [**Lee 1996**]. Again, a relatively comprehensive list of publications on longitudinal vehicle control can be found at [**PathDb 1996**].Microwave radar sensors perform very well in fog and heavy rain, but they are very expensive. Laser radar systems are low-cost, but cannot handle low visibility conditions [**Yanagisawa 1992**]. To facilitate lane changes at a range of relative speeds, the vehicle must be equipped with sensors that locate vehicles on the side with a longitudinal range of about 30m. Infrared and laser range finding techniques may prove to be useful in this area.

Besides headway and side sensor information, longitudinal and lateral velocity and acceleration, yaw rate, front steering angle, and lateral deviation data are needed to obtain a robust combined lateral and longitudinal control. All of these except the last one can be obtained using on-board accelerometers and encoders. For vehicle position sensing, there are two alternatives: magnetic markers [**Lee 1995**], and vision systems [**Pomerlau 1996**]. Recent research done on vision systems showed significant promise, however these systems are more expensive than magnetic markers which, in turn, require infrastructure deployment as well as on-board sensors.

Operation and conversion is done by connecting the fuel supply system with the Op-amp Circuit and Solenoid Valve. Base plate of 1000mm length and 300mm width made up of mild steel is used for fixing up all the parts. Engine of the following specifications:

Engine	: Spark ignition.
Type	: Two stroke single cylinder Air cooled engine.
Intake System	: Normal aspiration with Reed valve.
Bore	: 50mm.
Stroke	: 49mm.
Cubic capacity	: 75cc.

H. Performance

Horse Power	: 2.5 kW.
Torque	: 4.3 NM.

The engine is welded to the base plate. Wheel of 550 mm diameter is connected to the engine with the help of a chain drive. Op-amp circuit is designed by LM324 IC which gives the control signal to the solenoid valve. The engine voltage is given to the input of the op-amp comparator circuit which is variable upon the speed of the vehicle.. An Indication panel is fitted along with the base plate. The Indication panel consists of the Bulb, Alarm and Comparator circuit. When the rider has reached the set speed limit the bulb glows and the alarm rings to indicate a caution for the rider. If the speed is not reduced then the presented valve, the op-amp gives the 230V input supply to the solenoid valve it gets magnetized and closes, thus stopping the fuel flow to the engine. This reduces the speed of the engine to a safety limit.

III. COMPONENTS AND DESCRIPTION

The following are the parts required for the High Speed Indication and Automatic Pneumatic Braking System

- Engine,
- Solenoid valve,
- Speedometer,
- Carburetor,
- OP-AMP IC,
- Indication panel.
- Wheel arrangement,
- Power supply.

A. Engine Construction

In this project we use spark ignition engine of the type two stroke single cylinder of Cubic capacity 75 cc. The engine has a piston that moves up and down in the cylinder. A cylinder is a long round air pocket somewhat like a tin can with a bottom cut out. Cylinder has a piston which is slightly smaller in size than the cylinder the piston is a metal plug that slides up and down in the cylinder Bore diameter and stroke length of the engine are 50mm and 49mm respectively. Internal combustion engines are those heat engines that burn their fuel in the engine cylinder. The engine which gives power to propel the automobile vehicle is a petrol burning internal combustion engine. Petrol is a liquid fuel and is called by the name gasoline in America.

B. Solenoid Valve (or) Cut off Valve

Solenoid valves come in a variety of sizes and materials in order to integrate within many fluid management systems. The body of the valve should be made of a material that is compatible with the system media to prevent premature failure of the valve, or contamination of the media. The most important components to consider when selecting a solenoid valve are the seal, coil, and the ports of the valve.The control valve is used to control the flow of fuel to air mixture is called cut off valve or solenoid valve. This solenoid cut off valve is controlled by the electronic control unit which is attached in the control panel itself. Fig.3 show the simple Solenoid valve (cut off valve).

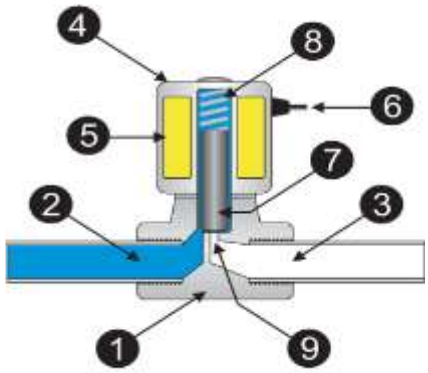

Fig 3 Solenoid valve (cut-off valve)

1. Valve body
2. Inlet port
3. Outlet port
4. Coil/Solenoid
5. Coil windings
6. Lead wires
7. Plunger
8. Spring
9. Orifice

1). Types of Solenoid Valve

Solenoid valves are devices that use a solenoid to control valve activation. Actuation methods include electric, electro-hydraulic, electro pneumatic, and pneumatic. Unpowered states include normally open and normally closed. In a tandem center solenoid valve, the pressure and tank ports are connected while the service ports are blanked. This allows the system unloading while still providing isolation of the service lines. In a float center solenoid valve, the supply pressure port is closed. All other ports are interconnected. This allows the supply to be shut off while enabling the load to move or free wheel with flow available to other services. Solenoid valves include ball and butterfly valves. Ball valves provide tight shut-off and characterizable control. They have the high range ability due to the design of the regulating element, without the complications of side loads typical of butterfly or globe valves. Butterfly valves control the flow of gas or liquid by means of a disk, which turns on a diametrical axis inside a pipe or by two semicircular plates hinged on a common spindle, which permits flow in only one direction. They are normally used as throttling valves to control flow. Butterfly valves are solenoid valves that offer a rotary stem movement of 90 degrees or less, in a compact design. Unlike ball valves, butterfly valves do not have any pockets in which fluids may become trapped when the valve is closed.

Solenoid valves generally have two ports. The ports can come with either inside or outside threaded ports. In a tandem center solenoid valve, the pressure and tank ports are connected while the service ports are blanked. This allows system unloading while still providing isolation of the service lines. In a float center solenoid valve, the supply pressure port is closed. All others ports are interconnected. This allows the supply to be shut off while enabling the load to move or free wheel with flow available to other services.

Solenoid valves generally have two ports: an inlet and an outlet port. There are several types of solenoid valves that include three or more ports.

- **Three-way solenoids** are used to operate single-acting actuators, such as diaphragm actuators. They are designed to only send air to one chamber of an actuator. Three way solenoids are used to interrupt or override an instrument signal for double-acting actuators with a pneumatic positioner.
- **Four-way solenoids** provide a positive two directional action. They can be used instead of positioners to provide on-off operation of double-acting valves. When the solenoid is de-energized, it sends the full air supply to one side of the actuator and exhausts the other side to the atmosphere.

Fig. 4 shows the line diagram of High speed indication and automatic braking system. Fig. 5 shows the fabricated model of High speed indication and automatic braking system.

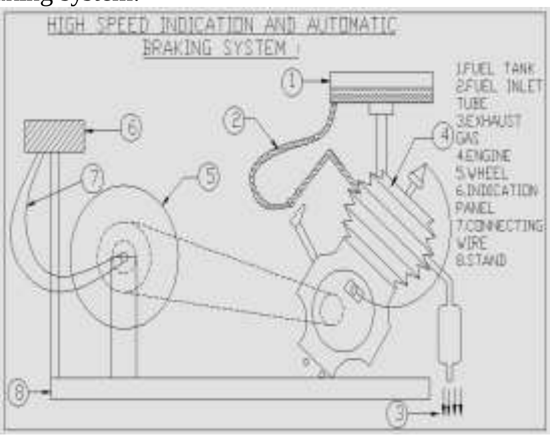

Fig.4 High speed indication and automatic braking system (Line diagram)

Fig. 5 Fabricated High speed indication and automatic braking system

Fig. 6 Fabricated High speed indication and automatic braking system with LM324 IC pin diagram

A comparator is a device which is used to sense when a varying signal reaches some threshold value and this comparator output is used to drive logic circuit. The OPAMP is used to construct comparator. Fig. 6 shows the fabricated model of High speed indication and automatic braking system with LM324 IC pin diagram.

In Abnormal condition the voltages applied to the non-inverting terminal (+ ive from engine voltage) is high when compared to the inverting terminal voltages (- ive from engine voltage). At that time, the OP-AMP output is +Vsat. (I.e. +12 Volt). The transistor and relay are in **"ON"** condition. This circuit can be used to sense and differentiate between different colors. This project demonstrates the principle and operation of a simple color sensor using LDR. The circuit is divided into three parts: Detector (LDR), Comparator and Output. This circuit is based on LM324 IC whose pin diagram has been shown below (Fig. 7)

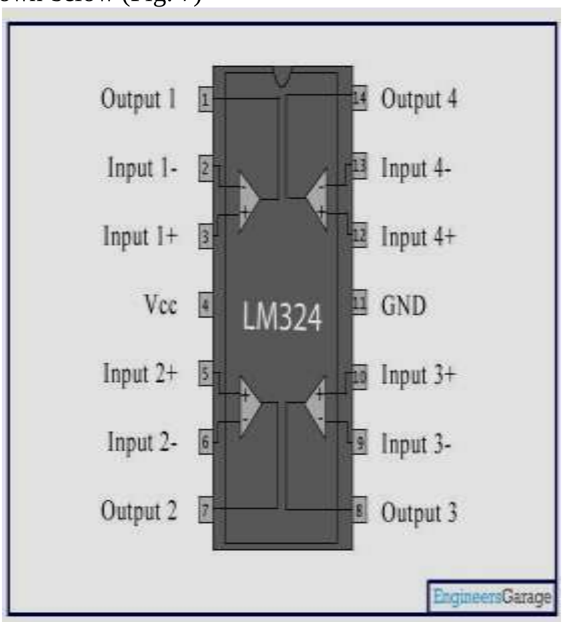

Fig. 7 LM324 IC pin diagram

IV. AIR BRAKE

A. Introduction

Air brakes use compressed air to make the brakes work. Air brakes stop large and heavy vehicles. Safely; but the brakes must be maintained and used correctly. Air brakes are three different braking systems: service brake, parking brake and emergency brake systems. The emergency brake system uses parts of the service and parking brake systems to stop the vehicle if the service brake system fails.

B. Air brake system parts

The air brake system consists of the following parts.

1). Air compressor pumps

Air compressor pumps air into the air storage tanks (reservoirs). It is connected to the engine through gears or a v-belt. The compressor may be air cooled or cooled by the engine cooling system. It may have its own oil supply or it may be lubricated by engine oil. If the compressor has its own oil supply, check the oil level during the pre-trip inspection.

2). Air compressor governor

Air compressor governor controls when the air compressor pumps air into the air storage tanks. When air tank pressure rises to the cut-out level (around 125 pounds per square inch-psi), the governor stops the compressor from pumping air. When the tank pressure falls to the cut-in pressure (around 100 psi), the governor allows the compressor to start pumping again.

3). Air storage tanks

Air storage tanks hold compressed air. The number and size of the tanks vary between vehicles. The tanks will hold enough air to allow the brakes to be used several times even if the compressor stops working. Air tank drains allow you to drain water and compressor oil that may accumulate in the tanks. Water and oil tend to collect in the bottom of the air tank and are bad for the air brake system. The tank must be drained completely to remove all moisture. Otherwise, water can freeze in cold weather and cause brake failure. Each air tank is equipped with a drain valve in the bottom. Fig 8 shows the air storage tank.

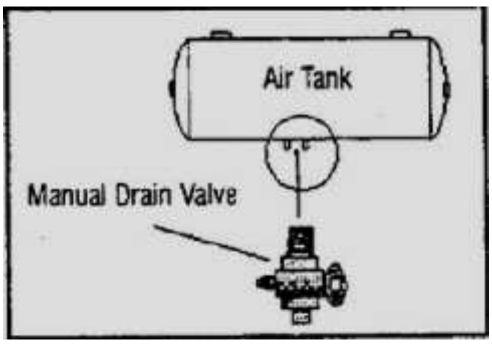

Fig. 8 Air storage tank

4). Brake pedal

Brake pedal applies air pressure and puts on the brakes. Pushing the pedal down harder applies more pressure. Letting it up reduces the air pressure and releases the brakes. Releasing the brakes lets compressed air out of the system and reduces air pressure in the tanks. The air pressure must be made up by the air compressor. Pressing and releasing the pedal unnecessarily can let out air faster than the compressor can replace it. If the pressure gets too low, the brakes may lock up.

5). Foundation brakes

Foundation brakes are used at each wheel. The most common type is the scam drum brake. Refer to the diagram. Brake drums are located on each end of the vehicle's axles. The wheels are bolted to the drums. The braking mechanism is inside the drum. To stop, the brake shoes and linings push against the inside of the drum.

6). Supply pressure gauges

Supply pressure gauges tell you how much pressure is in the air tanks. These gauges are on all air-braked vehicles.

7). Application pressure gauge

The application pressure gauge shows how much air pressure you are applying to the brakes. This gauge is not on all vehicles. If the applied pressure decreases when you are holding the same speed, it means that the brakes are fading. Slow down and use a lower gear. The need for increased pressure can also be caused by brakes that are out of adjustment, air leaks or mechanical problems.

8). Low air pressure warning

The low air pressure warning comes on air before the pressure in the tanks falls below 60 psi. This warning signal is required on all vehicles with air brakes. The warning is usually a red light. In some vehicles, a buzzer may also come on. Another type of warning is the wigwag. This device drops a mechanical arm into your view when the pressure in the system drops below 60 psi. An automatic wigwag will rise out of your view when the pressure goes above 60 psi. On large buses, the low pressure warning signal often comes on at 80-85 psi.

9). Stop light switch

Stop light switch turns on the brake lights when you put on the air brakes.

10). Front brake limiting valves

Front brake limiting valves were used in vehicles made before 1975 to reduce the chance of the front wheels skidding on slippery surfaces. Actually, the limiting valves reduce the stopping power of the vehicle. The control is usually marked "normal" and "slippery." When you put the control in the slippery position, the limiting valve cuts the air pressure to the front brakes by half. Many vehicles have automatic front wheel limiting valves. These valves reduce air to the front brakes except when the brakes are put on very hard (60 psi or more application pressure). These valves cannot be controlled by the driver.

11). spring brakes

Spring brakes are used for emergency and parking brakes. Emergency and parking brakes must be held by a mechanical force because air pressure can leak away. When driving, powerful springs are held back by air pressure. If the air pressure is removed, the springs put on the brakes. A parking brake control in the cab allows the driver to let the air out of the spring brakes. This lets the springs put on the brakes.

A leak in the air brake system which causes all air to be lost will also cause the springs to put on the brakes. Tractor and straight truck spring brakes will come on fully when air pressure drops to a range of 20 to 40 psi.

12). Parking brake controls

Parking brake controls in newer vehicles with air brakes, you put on the parking brakes with a diamond-shaped, yellow, push-pull control knob. You pull the knob out to put on the parking brakes (spring brakes) and you push the knob in to release them. On older vehicles, parking brakes may be controlled by a lever.

13). Dual air brake systems

Most new heavy-duty vehicles use dual air brake systems for safety. A dual air brake system has two separate air brake systems which use a single set of controls. Each system has its own air tank, hoses, lines, etc. One system operates the regular brakes on the rear axle or axles

C. Basics of pneumatic brakes

The basic principle of compressed air supply and distribution - the main air supply consists of the following.

1). Compressed air supply

All pneumatic or compressed air brakes act by pressing the brake blocks or pads against the wheels or brake discs by means of compressed air. The braking force can be regulated by altering the air pressure. Each locomotive or motor coach is equipped with a compressor driven by an electric motor.

2). Distribution - the main air supply pipe

On passenger trains composed of a locomotive and carriages or motor coaches, the compressed air is distributed over the whole length of the train by the main air supply line serving the following purposes:

- Supplying the drivers brake valve on a driving trailer
- Supplying auxiliaries on passenger carriages with compressed air (door operating gear, pneumatic suspension, additional brake filling on electro-pneumatic brake systems, etc.)

3). Continuous compressed air brake

Compressed air brakes for train movements at speeds above 50 km/h are required to be continuous in design.

V. TECHNICAL SPECIFICATIONS

A. Introduction

The technical specification of the High speed indication and automatic braking system is shown below.

B. Technical specifications

Engine	: spark ignition.
Type	: Four stroke single Cylinder air cooled engine.
Intake system	: normal aspiration with Reed valve
Bore	: 50 mm.
Stroke	: 49 mm.
Cubic capacity	: 75 cc.
Carburetor	: SPACO.

C. Performance

Horsepower	: 2.5 kW.
Torque	: 4.3 NM.
Clutch	: Centrifugally operated Single plate friction clutch
Transmission	: Geared type.
Primary transmission	: Chain drive
Ignition system	: Magneto ignition system
Brake	: Internally expanding drum Type.

D. Advantages and Disadvantages

1). Advantages

Air brakes are *Advantages* used as an alternative to hydraulic brakes which are used on lighter vehicles such as automobiles. Hydraulic brakes use a fluid (hydraulic fluid) to transfer pressure from the brake pedal to the brake shoe to stop the vehicle. Air brakes have several advantages for large multitrailer vehicles.

- The supply of air is unlimited, so the brake system can never run out of its operating fluid, as hydraulic brakes can. Minor leaks do not result in brake failures.
- Air brakes are effective even with considerable leakage, so an air brake system can be designed with sufficient "fail-safe" capacity to stop the vehicle safely even when leaking.
- No cost
- As an operating medium, air costs nothing and is always available.
- No leaking problem
- Very minor leaks are not critical (the compressor continually supplies more air pressure).
- No pressure drop and faster air transmit. Air brake lines have large inside diameter. (Hydraulic brakes are not very suitable for long wheelbase trucks).
- Suitable for connection with trailer.
- Source of energy operates various equipment on the vehicle (Door control etc.).

2). Disadvantages

- Air compressor (bigger load on the engine) bigger possibility to freeze up on you (winter time + humidity), more components involves must/should empty the air reservoir after each day/trip, regular adjustment/lub of the S cam required (do not trust the self adjustment system if equipped) if ABS, more and touchy, looser feel of the pedal. If you lose the air you are going nowhere, if you have a leak, there is no visible sign only audible.

3). Applications

- The automatic braking system can be used in both light moving vehicles such as two wheelers as well as in heavy moving vehicles such as buses and trucks etc.
- The automatic braking system is flexible enough to be used in any type of breaking system such as mechanical, hydraulic, vacuum and air brakes.
- The automatic braking system can be implemented in institutional vehicles, taxis, driving school vehicles, etc. Solenoid valves are used in a wide variety of industries. They are used in machinery, devices, and equipment such as refrigerators and automatic faucets.
- Solenoid valves are commonly used in central heating systems to control the thermostat to regulate the flow of

heated water to the heating element. They are also used in automatic irrigation sprinkler systems, air control, fluid control, and in pharmacology experiments.

VI .CONCLUSION

The project adventured by us is the one that is flexible for all vehicles. Speed control by engine arrangement is complicated; we have done the project with simple in construction by lower expenses.

This is one of the feasible project considering the cost and simplicity of wheel arrangement. If the engine arrangement is used gear, clutch comes into action for controlling the speed, hence the setup becomes bulky and complex for which we have done using wheel arrangement.

Tests had been carried out for checking the condition of wheel arrangement with fuel supply control using solenoid valve, to control the speed.

In future this project can be modified by using the same solenoid valve set up in the muffler and based on engine speed considering various speed ratios.

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