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BONAFIDE CERTIFICATE

Certified that this project report **"PNEUMATIC REGENERATIVE BRAKING SYSTEM** "is the bonafide work of "**M.BHARATH (513413114003), B.DANIEL RAJKUMAR (513413114006), K.RAJASEKAR (513413114027) and S.SATHISH KUMAR (513413114037)**" who carried out the project work under my supervision.

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INTERNAL EXAMINER **EXTERNAL EXAMINER**

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LIST OF FIGURES

ABSTRACT

Regenerative braking is the effective method of braking that stores the energy lost in braking as a form of energy, usually electrical energy.Tesla motors was the first company to innovate this feature and successfully commercialize it. There are many ongoing researches in this topic.

Our project comes with the idea of storing the energy in the form of compressed air(pneumatic energy).we are using the back pressure created inside the silencer to effectively brake the bike by controlling the exhaust pressure based on braking requirement

We have successfully implemented the above idea and tested it.we have also developed a working model to simultaneously save the air compressed during braking.

திட்ட சுருக்கம்

மறுசுழற்சி நிறுத்தற்கருவி என்பது தேய்மான நிறுத்தற்க் கருவியில் வீணாகும் ஆற்றலாக சேமிக்கும் முறை ஆகும். இதனை டெஸ்லா மோட்டார்ஸ் லிமிடெட் என்ற நிறுவனம் அறிமுகம் செய்தது மட்டுமின்றி தாங்கள் தயாரிக்கும் வாகனங்களில் வெற்றிகரமாகவும் வணிகரீதியாகவும் உபயோகபடுத்துகிறது. இந்த மறுசுழற்சி நிறுத்தற்கருவி பற்றி பல ஆராய்ச்சிகள் நடைபெற்று கொண்டிருக்கிறது. எங்கள் திட்டமானது வீணாகும் ஆற்றலை உயர் அழுத்த காற்றாக (வாயுவான ஆற்றலாக) சேமிக்கலாம் என்ற கருத்தை கொண்டது.

நாங்கள் வாகன ஒலி கட்டுப்படுத்தும் கருவியிலிருந்து உருவாக்கப்படும் மமின் அழுத்தம் விரையடாகாமல் வாகனத்தை நிறுத்த மறுசுழற்சி நிறுத்தற்க் கருவியை பயன்படுத்துகிறோம்.

நாங்கள் இதனை வெற்றிகரமாக செயல்படுத்தி இந்த ஆற்றலை மேற்கண்ட முறையில் சோதித்து பார்த்துள்ளோம். மேலும் நாங்கள் உயர்அழுத்த காற்றை சேமிக்க ஒரு வழிமுறையை உருவாக்கியுள்ளோம்.

Chapter 1

INTRODUCTION

1.1. Overview of Regenerative brakes

A regenerative brake is an energy recovery mechanism which slows a vehicle or object by converting its kinetic energy into a form which can be either used immediately or stored until needed. This contrasts with conventional braking systems, where the excess kinetic energy is converted to unwanted and wasted heat by friction in the brakes. In addition to improving the overall efficiency of the vehicle, regeneration can greatly extend the life of the braking system as its parts do not wear as quickly.

Regenerative braking is not by itself sufficient as the sole means of safely bringing a vehicle to a standstill, or slowing it as required; it must be used in conjunction with friction-based braking.

- The regenerative braking effect drops off at lower speeds, and cannot bring a vehicle to a complete halt reasonably quickly.
- A regenerative brake does not immobilise a stationary vehicle; physical locking is required, for example to prevent vehicles from rolling down hills.
- Many road vehicles with regenerative braking do not have drive motors on all wheels (as in a two-wheel drive car); regenerative braking is normally only applicable to wheels with motors. For safety, the ability to brake all wheels is required.
- The regenerative braking effect available is limited, and insufficient in many cases, particularly in emergency situations.
- The friction brake is a necessary back-up in the event of failure of the regenerative brake.

Regenerative and friction braking must both be used, creating the need to control them to produce the required total braking. The GM EV-1 was the first commercial car to do this. In 1997 and 1998 engineers Abraham Farag and Loren Majersik were issued two patents for this brake-by-wire technology.

Early applications commonly suffered from a serious safety hazard: in many early electric vehicles with regenerative braking, the same controller positions were used to apply power and to apply the regenerative brake, with the functions

being swapped by a separate manual switch. This led to a number of serious accidents when drivers accidentally accelerated when intending to brake, such as the runaway train accident in Wädenswil, Switzerland in 1948, which killed twenty-one people.

1.2. History

A Flybrid Systems kinetic energy recovery system

The first of these systems to be revealed was the Flybrid. This system weighs 24 kg and has an energy capacity of 400 kJ after allowing for internal losses. A maximum power boost of 60 kW (81.6 PS, 80.4 HP) for 6.67 seconds is available. The 240 mm diameter flywheel weighs 5.0 kg and revolves at up to 64,500 rpm. Maximum torque is 18 Nm.The system occupies a volume of 13 litres.

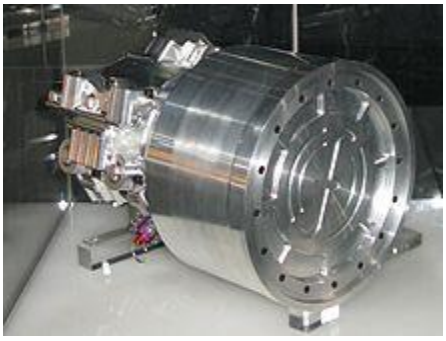

Figure 1.1.Flybrid system kinetic energy recovery

Two minor incidents have been reported during testing of KERS systems in 2008. The first occurred when the Red Bull Racing team tested their KERS battery for the first time in July: it malfunctioned and caused a fire scare that led to the team's factory being evacuated. The second was less than a week later when a BMW Sauber mechanic was given an electric shock when he touched Christian Klien's KERS-equipped car during a test at the Jerez circuit

1.3. Applications

1.3.1. Motorcycles

KTM racing boss Harald Bartol has revealed that the factory raced with a secret kinetic energy recovery system (KERS) fitted to Tommy Koyama's motorcycle during the 2008 season-ending 125cc Valencian Grand Prix. This was against the rules, so they were banned from doing it afterwards.

1.3.2. Bicycles

Regenerative braking is also possible on a non-electric bicycle. The EPA, working with students from the University of Michigan, developed the hydraulic Regenerative Brake Launch Assist (RBLA).

1.3.3. Races

Automobile Club de l'Ouest, the organizer behind the annual 24 Hours of Le Mans event and the Le Mans Series is currently "studying specific rules for LMP1 that will be equipped with a kinetic energy recovery system."Peugeot was the first manufacturer to unveil a fully functioning LMP1 car in the form of the 908 HY at the 2008 Autosport 1000 km race at Silverstone.

1.3.4.Railway Wagon Braking System

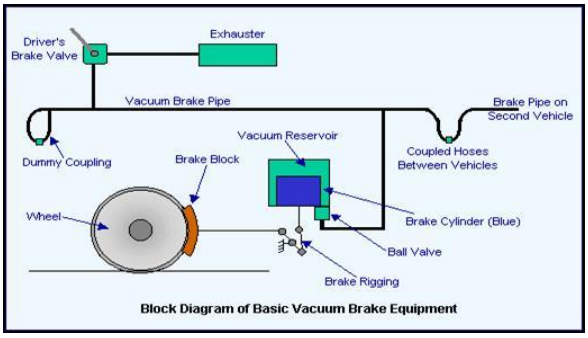

Figure 1.2. Railway Wagon Braking System

Chapter 2

LIST OF COMPONENTS

2.1. Solenoid Ball Valve

A solenoid valve is an electromechanically operated valve. The valve is controlled by an electric current through a solenoid: in the case of a two-port valve the flow is switched on or off; in the case of a three-port valve, the outflow is switched between the two outlet ports. Multiple solenoid valves can be placed together on a manifold.

Solenoid valves are the most frequently used control elements in fluidics. Their tasks are to shut off, release, dose, distribute or mix fluids. They are found in many application areas. Solenoids offer fast and safe switching, high reliability, long service life, good medium compatibility of the materials used, low control power and compact design.

Besides the plunger-type actuator which is used most frequently, pivoted-armature actuators and rocker actuators are also used.

Figure 2.1. Solenoid Ball Valve

2.1.1. Types

Many variations are possible on the basic, one-way, one-solenoid valve described above:

- one- or two-solenoid valves;
- direct current or alternating current powered;
- different number of ways and positions;

2.1.2. Materials

The valve body must be compatible with the fluid; common materials are brass, stainless steel, aluminum, and plastic. The seals must be compatible with the fluid.

To simplify the sealing issues, the plugnut, core, springs, shading ring, and other components are often exposed to the fluid, so they must be compatible as well. The requirements present some special problems. The core tube needs to be non-magnetic to pass the solenoid's field through to the plugnut and the core. The plugnut and core need a material with good magnetic properties such as iron, but iron is prone to corrosion. Stainless steels can be used because they come in both magnetic and non-magnetic varieties. For example, a solenoid valve might use 304 stainless steel for the body, 305 stainless steel for the core tube, 302 stainless steel for the springs, and 430 F stainless steel (a magnetic stainless steel) for the core and plugnut.

2.2. Mild steel pipe

MS Pipes MS Pipe and MS Tube refers to Mild Steel Pipe or a Mild Steel Tubes Mild Steel (MS) pipes are manufactured using low carbon (less than 0.25%) steel. Due to low carbon content the pipes do not harden and are easy to use. As MS Pipes are made from mild steel they can easily be welded and formed in various shapes and sizes for pipelining and tubing purposes. These are generally used for drinking water supply i.e. Plumbing, Firefighting, HVAC but can also be used in various other Industrial and Engineering applications.

These pipes are usually coated with other metals/paints/varnish etc. to prevent it from rusting but extra care should be taken to prevent it under extreme conditions.MS Pipe Manufacture in India Jindal Pipes Ltd. (JPL) manufactures

high quality MS pipes in India. The raw material of MS Pipes i.e. MS Steel Coils has been procured from trusted Steel manufacturer i.e.

i.e. Steel Authority of India (SAIL), which is a public sector company and is the largest integrated iron and steel producer in India. At Jindal Pipes we provide our customers with exceptional product quality, services and flexibility of production rate to meet their schedule. We not only manufacture high quality products but also a trustworthy relationship with our customers. We manufacture MS Pipes in a various sizes, grades and specifications as per various national and international specifications (IS, BS API, ASTM, DIN). Jindal Pipes has been constantly executing need based demanding orders for MS Pipes to meet the requirement of sectors like, Agriculture, Oil and Gas, Public Health, Housing, Irrigation, Engineering etc.

The company is specialized in the manufacturing / exporting / supplying of all kinds of optimal quality MS Pepsin the market. The Mild Steel Pipes made available by the company are remarkable for their high tensile strength. While manufacturing of any kind of pipes, we ensure best quality products only through the most branded & renowned companies in the sector. As a result, we are identified as one of the stupendous Round Mild Steel Pipes Suppliers based in India. Moreover we provide a good rates services by linking the customers with the best companies which even adds to our set of providing all kinds of services to our clients. Besides, our MS Pipes are also accessible with our guarantee. We are one of the leading Manufacturer and Exporters of MS Pipes, Mild Steel Pipes from India. When it comes to Mild Steel Pipes and Products, Spark Electrodes is a name that comes to mind.

We offer the best quality Mild Steel Pipes& Tubes which are used widely and are demanded all over. Our range of Mild Steel Products comprises of MS Pipes, M S Sheets, MS Round Barest. We ensure that our range of Galvanized Mild Steel Products is made up of high quality material and under the best quality manufacturing conditions. We offer the Mild Steel Products at competitive prices.

Figure 2.2. Mild steel pipes

We are one of the trustworthy Mild Steel Products Suppliers from India. We are manufacturing steel tubes like MS Pipes, MS Black Pipes, and Mild Steel Pipes conforming to various national & international standards.

We are Exporting wide range of Mild Steel Tubes, Mild Steel Pipes, MS Pipes and Mild Steel Galvanized Pipes for various purposes. Apart from the following standard range of products we also manufacture customized products as per the requirement of the buyers. Leading manufacturers of manipulated MS Pipes. Mild Steel Pipes manufactured as per ASTM specification. Mild Steel Pipes Manufacturers Mild Steel Pipes Exporters Mild Steel Pipes Suppliers MS Pipes/ Mild Steel Pipes MS Pipes/ Mild Steel Pipes For Chemical, Textile and Petroleum Industries Purpose, Water, Gas, Air Steam, Sewage, Water Wells, Mechanical, General Engineering purpose.

Process piping and power piping are typically checked by pipe stress engineers to verify that the routing, nozzle loads, hangers, and supports are properly placed and selected such that allowable pipe stress is not exceeded under different loads such as sustained loads, operating loads, pressure testing loads, etc., as stipulated by the ASME B31, EN 13480 or any other applicable codes and standards. It is necessary to evaluate the mechanical behavior of the piping under regular loads (internal pressure and thermal stresses) as well under occasional and intermittent loading cases such as earthquake, high wind or special vibration, and water hammer. This evaluation is usually performed with the assistance of a specialized (finite element) pipe stress analysis computer programs such as CAEPIPE and CAESAR.

In cryogenic pipe supports, most steel become more brittle as the temperature decreases from normal operating conditions, so it is necessary to know the temperature distribution for cryogenic conditions.

Steel structures will have areas of high stress that may be caused by sharp corners in the design, or inclusions in the material.

2.3. Air Tank 20Liters

Air tank Air tank may refer to diving cylinder used by scuba divers to hold air and other breathing gases at high pressure underwater. Pneumatic pressure vessel for storing compressed air to operate pneumatic equipment such as braking systems, paint dispensers and paintball guns.

V Tanks Main article: Compressed air tank the tanks must be designed to safety standards appropriate for a pressure vessel, such as ISO 11439.The storage tank may be made of metal or composite materials. The fiber materials are considerably lighter than metals but generally more expensive. Metal tanks can withstand a large number of pressure cycles, but must be checked for corrosion periodically.

One company stores air in tanks at 4,500pounds per square inch (about 30 MPs) and hold nearly 3,200 cubic feet (around 90 cubic meters) of air. The tanks may be refilled at a service station equipped with heat exchangers, or in a few hours at home or in parking lots, plugging the car into the electrical grid via an on-board compressor.

The cost of driving such a car is typically projected to be around €0.75 per 100 km, with a complete refill at the "tank-station" at about US$3.

Figure2.3. Air tank

Compressed air energy storage (CAES) is a way to store energy generated at one time for use at another time using compressed air. At utility scale, energy generated during periods of low energy demand (off-peak) can be released to meet higher demand (peak load) periods.[1] Small scale systems have long been used in such applications as propulsion of mine locomotives. Large scale applications must conserve the heat energy associated with compressing air; dissipating heat lowers the energy efficiency of the storage system.

2.4. Relief Valve

The pressure relief valve (PRV) is a type of valve used to control or limit the pressure in a system or vessel which can build up for a process upset, instrument or equipment failure, or fire. The pressure is relieved by allowing the pressurized fluid to flow from an auxiliary passage out of the system.

The relief valve is designed or set to open at a predetermined set pressure to protect pressure vessels and other equipment from being subjected to pressures that exceed their design limits. When the set pressure is exceeded, the relief valve becomes the "path of least resistance" as the valve is forced open and a portion of the fluid is diverted through the auxiliary route. The diverted fluid (liquid, gas or liquid–gas mixture) is usually routed through a piping system known as aflame header or relief header to a central, elevated gas flare where it is usually burned and the resulting combustion gases are released to the atmosphere.

Figure 2.4. Relief Valve

As the fluid is diverted, the pressure inside the vessel will stop rising. Once it reaches the valve's reseating pressure, the valve will close. The blow down is usually stated as a percentage of set pressure and refers to how much the pressure needs to drop before the valve reseats. The blow down can vary from roughly 2–20%, and some valves have adjustable blow downs. In high-pressure gas systems, it is recommended that the outlet of the relief valve is in the open air. In systems where the outlet is connected to piping, the opening of a relief valve will give a pressure build up in the piping system downstream of the relief valve.

This often means that the relief valve will not re-seat once the set pressure is reached. For these systems often so called "differential" relief valves are used.

This means that the pressure is only working on an area that is much smaller than the openings area of the valve. If the valve is opened the pressure has to decrease enormously before the valve closes and also the outlet pressure of the valve can easily keep the valve open. Another consideration is that if other relief valves are connected to the outlet pipe system, they may open as the pressure in exhaust pipe system increases. This may cause undesired operation. In some cases, a so-called bypass valve acts as a relief valve by being used to return all or part of the fluid discharged by pumper gas compressor back to either a storage reservoir or the inlet of the pump or gas compressor.

This is done to protect the pump or gas compressor and any associated equipment from excessive pressure. The bypass valve and bypass path can be internal (an integral part of the pump or compressor) or external (installed as a component in the fluid path). Many fire engines have such relief valves to prevent the over pressurization of fire hoses. In other cases, equipment must be protected

against being subjected to an internal vacuum (i.e., low pressure) that is lower than the equipment can withstand. In such cases, vacuum relief valves are used to open at a predetermined low pressure limit and to admit air or an inert gas into the equipment so as control the amount of vacuum.

Technical terms In the petroleum refining, petrochemical and chemical manufacturing, natural gas processing and power generation industries, the term relief valves associated with the terms pressure relief valve (PRV), pressure safety valve (PSV) and safety valve: Pressure relief valve (PRV) or Pressure Release valve (PRV) or pressure safety valve (PSV): The difference is that PSVs have a manual lever to activate the valve in case of emergency. Most PRVs are spring operated. At lower pressures some use a diaphragm in place of a spring.

The oldest PRV designs use a weight to seal the valve.*.Set pressure: When the system pressure increases to this value, the PRV opens. The accuracy of the set pressure often follows guidelines set by the American Society of Mechanical Engineers (ASME).Relief valve (RV)

A valve used on a liquid service, which opens proportionally as the increasing pressure overcomes the spring pressure.*.Safety valve(SV): Used in gas service. Most SVs are full lift or snap acting, in that they pop completely open. Safety relief valve (SRV): A relief valve that can be used for gas or liquid service. However, the set pressure will usually only be accurate for one type of fluid at a time.*.Pilot-operated relief valve (POSRV, PORV]

A device that relieves by remote command from a pilot valve which is connected to the upstream system pressure. Low-pressure safety valve (LPSV): An automatic system that relieves by the static pressure of a gas. The relieving pressure is small and near the atmospheric pressure. Vacuum pressure safety valve (VPSV): An automatic system that relieves by the static pressure of a gas. The relieving pressure is small, negative and near the atmospheric pressure. Low and vacuum pressure safety valve (LVPSV): An automatic system that relieves by the static pressure of a gas. The relieving pressure is small, negative or positive, and near the atmospheric pressure. Pressure vacuum release valve (PVRV)

A combination of a vacuum pressure and a relief valve in one housing. Used on storage tanks for liquids to prevent implosion or over pressure. Snap acting: The opposite of modulating, refers to a valve that "pops" open. It snaps into full lift in milliseconds. Usually accomplished with a skirt on the disc so that the fluid

passing the seat suddenly affects a larger area and creates more lifting force. Modulating: Opens in proportion to the overpressure.

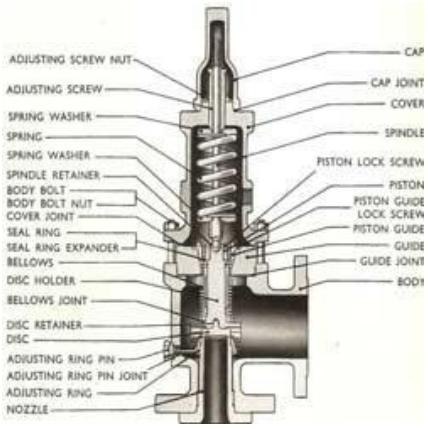

Figure 2.5. Structure of safety value

The primary purpose of a safety valve is the protection of life, property and environment. A safety valve is designed to open and relieve excess pressure from vessels or equipment and to reclose and prevent the further release of fluid after normal conditions have been restored.

A safety valve is a safety device and in many cases the last line of defense. It is important to ensure that the safety valve is capable to operate at all times and under all circumstances. A safety valve is not a process valve or pressure regulator and should not be misused as such. It should have to operate for one purpose only: overpressure protection.

2.5. Air Hose

Air hose Low pressure diver's air hose Air hoses are used in underwater diving, such as scuba diving, to carry air from the surface or from air tanks or diving pumps to the diver. Air hoses are therefore a necessary part of standard diving dress and any type of surface supplied diving equipment. They are an essential part of scuba diving equipment, used to deliver pressurized air from the first stage of a diving regulator to the other components.

Air hoses are used between locomotive sand railroad cars for their brakes, and are also used between those tractors and semi-trailers which use air brakes. Types of air hoses*.Air hose for surface supplied diving.*.Low pressure hoses connecting to demand valve and for inflating dry suits and buoyancy

compensators. These are designed to be used at pressures up to about 20 bar (2.0 MPa; 290 psi).*.High pressure hoses connecting to a pressure gauge. These have operating pressures in excess of 300 bar (30 MPa; 4,400 psi).See also. Glad-hand connector*.Hose (tubing).Snorkel. Standard diving dress. Surface supplied diving

A hose is a flexible hollow tube designed to carry fluids from one location to another. Hoses are also sometimes called pipes (the word pipe usually refers to a rigid tube, whereas a hose is usually a flexible one), or more generally tubing. The shape of a hose is usually cylindrical (having a circularcross section).

Hose design is based on a combination of application and performance. Common factors are size, pressure rating, weight, length, straight hose or coil hose, and chemical compatibility.

Hoses are made from one or a combination of many different materials. Applications mostly use nylon, polyurethane, polyethylene, PVC, or synthetic or natural rubbers, based on the environment and pressure rating needed. In recent years, hoses can also be manufactured from special grades of polyethylene (LDPE and especially LLDPE). Other hose materials include PTFE (Teflon), stainless steel and other metals.

Figure 2.6. Air Hose

2.6. Safety Value

A safety valves a valve which has the function of increasing the safety of a thermal-hydraulics plant. An example of safety valve could be a pressure safety valve (PSV), i.e. a pressure relief valve(PRV) which automatically releases a substance from a boiler, pressure vessel, or other system, when the pressure or temperature exceeds preset limits. Also pilot-operated relief valves could have the function of safety valves. Safety valves were first used on steam boilers during the Industrial Revolution. Early boilers operating without them were prone to accidental explosion.

Vacuum safety valves (or combined pressure/vacuum safety valves) are used to prevent a tank from collapsing while it is being emptied, or when cold rinse water is used after hot CIP (clean-in-place) or SIP (sterilization-in-place) procedures.

When sizing a vacuum safety valve, the calculation method is not defined in any norm, particularly in the hot CIP / cold water scenario, but some manufacturers have developed sizing simulations. Function and design Across-section of a proportional-safety valve the earliest and simplest safety valve was used on a 1679steam digester and utilized a weight to retain the steam pressure (this design is still commonly used on pressure cookers); however, these were easily tampered with or accidentally released. On the Stockton and Darlington Railway, the safety valve tended to go off when the engine hit a bump in the track.

A valve less sensitive to sudden accelerations used a spring to contain the steam pressure, but these (based on a Salter spring balance) could still be screwed down to increase the pressure beyond design limits. This dangerous practice was sometimes used to marginally increase the performance of a steam engine. In 1856, John Rams bottom invented a tamper-proof spring safety valve that became universal on railways. Safety valves also evolved to protect equipment such as pressure vessels (fired or not) and heat exchangers.

The term safety valve should be limited to compressible fluid applications (gas, vapor, or steam).The two general types of protection encountered in industry are thermal protection and flow protection.

For liquid-packed vessels, thermal relief valves are generally characterized by the relatively small size of the valve necessary to provide protection from excess pressure caused by thermal expansion. In this case a small valve is adequate because most liquids are nearly incompressible, and so a relatively small amount of fluid discharged through the relief valve will produce a substantial reduction in pressure.

Figure 2.7. Safety Value

Flow protection is characterized by safety valves that are considerably larger than those mounted for thermal protection. They are generally sized for use in situations where significant quantities of gas or high volumes of liquid must be quickly discharged in order to protect the integrity of the vessel or pipeline. This protection can alternatively be achieved by installing a high integrity pressure protection system (HIPPS).

2.7) Pressure Relief Value

The pressure relief valve (PRV) is a type of valve used to control or limit the pressure in a system or vessel which can build up for a process upset, instrument or equipment failure, or fire. The pressure is relieved by allowing the pressurized fluid to flow from an auxiliary passage out of the system.

The relief valve is designed or set to open at a predetermined set pressure to protect pressure vessels and other equipment from being subjected to pressures that exceed their design limits. When the set pressure is exceeded, the relief valve becomes the "path of least resistance" as the valve is forced open and a portion of the fluid is diverted through the auxiliary route.

The diverted fluid (liquid, gas or liquid–gas mixture) is usually routed through a piping system known as a flare header or relief header to a central, elevated gas flare where it is usually burned and the resulting combustion gases are released to the atmosphere.[1] As the fluid is diverted, the pressure inside the vessel will stop rising. Once it reaches the valve's reseating pressure, the valve will close. The blow down is usually stated as a percentage of set pressure and refers to how much the pressure needs to drop before the valve receipts. The blow down can vary from roughly 2–20%, and some valves have adjustable blow downs.

In high-pressure gas systems, it is recommended that the outlet of the relief valve is in the open air. In systems where the outlet is connected to piping, the opening of a relief valve will give a pressure build up in the piping system downstream of the relief valve. This often means that the relief valve will not re-seat once the set pressure is reached. For these systems often so called "differential" relief valves are used.

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Chapter 3

LITERATURE REVIEW

3.1) Sustainable urban rail systems: Strategies and technologies for optimal management of regenerative braking energy

Arturo González-Gil

In a society characterized by increasing rates of urbanization and growing concerns about environmental issues like climate change, urban rail transport plays a key role in contributing to sustainable development. However, in order to retain its inherent advantages in terms of energy consumption per transport capacity and to address the rising costs of energy, important energy efficiency measures have to be implemented.

Given that numerous and frequent stops are a significant characteristic of urban rail, recuperation of braking energy offers a great potential to reduce energy consumption in urban rail systems. This paper presents a comprehensive overview of the currently available strategies and technologies for recovery and management of braking energy in urban rail, covering timetable optimization, on-board and wayside Energy Storage Systems (ESSs) and reversible substations.

For each measure, an assessment of their main advantages and disadvantages is provided alongside a list of the most relevant scientific studies and demonstration projects. This study concludes that optimizing timetables is a preferential measure to increase the benefits of regenerative braking in any urban rail system. Likewise, it has been observed that ESSs are a viable solution to reuse regenerative energy with voltage stabilization and energy saving purposes.

Electrochemical Double Layer Capacitors has been identified as the most suitable technology for ESSs in general, although high specific power batteries such as Li-ion may become a practical option for on-board applications in the near future. Furthermore, it has been demonstrated that reversible substations are a feasible and commercially available technology, although their economic viability strongly depends on the ability to sell the excess regenerated energy to the public network operators for an appropriate price.

Finally, it has been that a transfer of knowledge at international level between operators, manufacturers and other stakeholders is essential to achieve the great potential offered by regenerative braking, both in terms of energy efficiency, emissions reduction and system reliability.

3.2) A Review of Regenerative Braking Systems

Clegg, S.J. (1996) A Review of Regenerative Braking Systems. Working Paper. Institute of Transport Studies, University of Leeds, Leeds, UK.

When a conventional vehicle applies its brakes, kinetic energy is converted to heat as friction between the brake pads and wheels. This heat is carries away in the airstream and the energy is effectively wasted the total amount of energy lost in this way depends on how often, how hard and for how long the brakes are applied. Regenerative braking refers to a process in which a portion of the kinetic energy of the vehicle is stored by a short term storage system.

Energy normally dissipated in the brakes is directed by a power transmission system to the energy store daring deceleration. That energy is held until required again by the vehicle, whereby it is converted back into kinetic energy and used to accelerate the vehicle. The magnitude of the portion available for energy storage varies according to the type of storage, drive train efficiency, and drive cycle and inertia weight. A lorry on the mom way could travel 100 miles between stops.

This represents little saving even if the efficiency of the system is 100%. City center driving involves many more braking events representing a much higher energy loss with greater potential savings. With buses, taxis, delivery vans and so on there is even more potential for economy. Since regenerative braking results in an increase in energy output for a given energy input to a vehicle, the efficiency is improved the amount of work done by the engine of the vehicle is reduced, in turn reducing the amount of prime energy required to propel the vehicle. In order for a regenerative braking system to be cost effective the prime energy saved over a specified lifetime must offset the initial cost, size and weight penalties of the system.

The energy storage unit must be compact, durable and capable of handling high power levels efficiently, and any auxiliary energy transfer or energy conversion equipment must be efficient, compact and of reasonable cost.

3.3) Energy Regeneration and conversion efficiency in a hydraulic hybrid propulsion system

Linda Hall Library

An energy storage system having a limited capacity is employed for the purpose of (i) removing the burden of acceleration from internal and external-combustion type prime movers used in rubber-tired and rail urban mass transit vehicles and (ii) providing an efficient regenerative braking system to significantly increase fuel economy during typical stop-start vehicle schedules. Energy is stored in a hydraulic accumulator which is designed to be an integral part of the propulsion system. Data from laboratory tests are presented to indicate achievable energy conversion efficiencies. Computer simulation of various size vehicles being driven over typical transit-vehicle schedules is used to estimate the reduction in vehicular emissions ans energy consumption resulting from the energy storage capability. An increase in fuel economy of up to 30% and an emissions reduction of up to 36% (NO sub x) were observed for the spark-ignited prime mover. When a simple cycle, single shaft gas turbine was simulated, the maximum increase in fuel economy was 24% with up to 50% reduction in emissions.

3.4) Experimental assessment of energy saving due to trains regenerative braking in an electrified subway line

IEEE Transactions on Power Delivery (Volume:13 , Issue: 4)

The paper deals with the research activity conducted in order to determine the impact of regenerative braking techniques adopted on board of trains operating in subway electrified systems. Even though systems adopting this technique are very diffuse worldwide, experimental results demonstrating the impact on energy consumption are rarely made available for the scientific community. The paper reports the results of an extensive experimental activity conducted on an electrified subway line in Rome, in order to estimate the energy saving due to the techniques above mentioned.

Since the monitoring activity of the system demand in absence of regenerative braking had to be limited to the traffic peak hours of only two subsequent days, an available model, being able to simulate the instantaneous demand profile of DC electrified subway power systems, has been used in order to

extend the numerical evaluations based on the experimental activity to a whole day of operation

3.5) Regenerative braking system for car US 4993780 A

Koji Tanaka, Takashi Shima,Isuzu Motors Limited

A regenerative braking system for a car in which when a hydraulic circuit is not operated, effective maximum displacement controlling current and minimum displacement controlling current for a pump/motor in the hydraulic circuit are studied on the basis of a variation of the sensed displacement angle when the maximum permissible current and the minimum operating current previously given to a displacement angle controlling electromagnetic proportional control valve are respectively decreased and increased stepwise. A displacement controlling current per a unit capacity for the control valve is determined

Chapter 4

FABRICATION OF PROJECT

RE-DESIGNING ALTERING

4.1) Welding of silencer to mild steel pipe

Using the gas welding process MS pipe was welded at silencer exhaust.

And fill the hole of the silencer using gas welding

4.1.1. Pipe welding process

Welds that you cannot make in a single pass should be made in interlocked multiple layers, knotless than one layer for each 1/8 inch of pipe thickness. Deposit each layer with a weaving or oscillating motion. To prevent entrapping slag in the weld metal, you should clean each layer thoroughly before depositing the next layer. Butt joints are commonly used between pipes and between pipes and welded fittings. They are also used for butt welding of flanges and welding stubs.

In making a butt joint, place two pieces of pipe end to end, align them, and then weld them. When the wall thickness of the pipe is 3/4 inch or less, you can use either the single V or single U type of butt joint; however, when the wall thickness is more than 3/4 inch, only the single U type should be used. Butt joints and socket fitting joints. Flange connections. Fillet welds are used for welding slip-on and threaded flanges to pipe.

Depending on the flange and type of service, fillet welds may be required on both sides of the flange or in combination with a bevel weld. Fillet welds are also used in welding screw or socket couplings to pipe, using a single fillet weld Sometimes flanges require alignment one type of flange square and its use in vertical and horizontal alignment. Flange alignment. Another form of fillet weld used in pipe fitting is seal weld a seal weld is used primarily to obtain tight-ness and prevent leakage. Seal welds should not be considered as adding strength to the joint. JOINT PREPARATION AND FIT-UP You must carefully prepare pipe joints for welding if you want good results. Clean the weld edges or surfaces of all loose scale, slag, rust, paint, oil, and other foreign matter.

Ensure that the joint surfaces are smooth and uniform. Remove the slag from flame-cut edges; however, it is not necessary to remove the temper color. When you prepare joints for welding, remember that bevels must be cut accurately. Bevels can be made by machining, grinding, or using a gas cutting torch. In fieldwork, the welding operator usually must make the bevel cuts with a gas torch. When you are beveling, cut away as little metal as possible to allow for complete fusion and penetration.

Proper beveling reduces the amount of filler metal required which, in turn, reduces time and expense. In addition, it also means less strain in the weld and a better job of design and welding. Align the piping before welding and maintain it in alignment during the welding operation. The maximum alignment tolerance is 20 percent of the pipe thickness. To ensure proper initial alignment, you should use clamps or jigs as holding devices. Apiece of angle iron makes a good jig for a small-diameter pipe, while a section of channel or I-beam is more suitable for larger diameter pipe. Angle iron jig. TACK WELDING.

When welding material solidly, you may use tack welds to hold it in place temporarily. Tack welding is one of the most important steps in pipe welding or any other type of welding. The number of tack welds required depends upon the diameter of the pipe.

For ½-inch pipe, you need two tacks; place them directly opposite each other. As a rule, four tacks are adequate for standard size of pipe. The size of a tack weld is determined by the wall thickness of the pipe. Be sure that a tack weld is not more than twice the pipe thickness in length or two thirds of the pipe thickness in depth. Tack welds should be the same quality as the final weld. Ensure that the tack welds have good fusion and are thoroughly cleaned before proceeding with the weld. SPACERS

In addition to tack welds, spacers sometimes are required to maintain proper joint alignment. Spacers are accurately machined pieces of metal that conform to the dimensions of the joint design used. Spacers are sometimes referred to as chill rings or backing rings, and they serve a number of purposes. They provide a means for maintaining the specified root opening, provide a con-lenient location for tack welds, and aid in the pipe alignment. In addition, spacers can prevent weld spatter and the formation of slag or icicles inside the pipe.

When the atmospheric temperature is less than 0°F*.When the surfaces are wet*.When rain or snow is falling, or moisture is condensing on the weld surfaces*.During periods of high wind At temperatures between 0°F and 32°F, heat the weld area within 3 inches of the joint with a torch to a temperature warm to the hand before beginning to weld.

Wear facing Welders can greatly extend the life of construction equipment by the use of wear facing procedures. Wear facing is the process of applying a layer of special composition metal onto the surface of another type of metal for the purpose of reducing wear.

The selection of a wear facing alloy for application is based on the ability of the alloy to withstand impact or abrasion. Impact refers to a blow or series of blows to a surface that results in fracture or gradual deterioration. Abrasion is the grinding action that results when one surface slides, rolls, or rubs against another. Under high-compressive loads, this action can result in gouging. Alloys that are abrasion resistant are poor in with-standing impact. Conversely, those that withstand impact well are poor in resisting abrasion; however, there are many alloys whose wear facing properties fall between the two extremes. These alloys offer some protection against abrasion and withstand impact well.

WORKPIECE PREPARATION before you wear-face a work piece, all dirt, oil, rust, grease, and other foreign matter must be removed. If you do not, your finished product will be porous and subject to spelling. You also need a solid foundation; therefore, repair all cracks and remove any metal that is fatigued or rolled over. PREHEATING Depending on the type of metal, sometimes it is necessary to preheat the base metal to lessen distortion, to prevent spalling or cracking, and to avoid thermal shock The preheating temperature depends on the carbon and alloy content of the base metal

4.2) Design and implementation of electric circuit

The spool (sliding type) consists of lands and grooves. The lands block oil flow through the valve body. The grooves allow oil or gas to flow around the spool and through the valve body. There are two fundamental positions of directional control valve namely normal position where valve returns on removal of actuating force and other is working position which is position of a valve when actuating force is applied. There is another class of valves with 3 or more position that can be spring centered with 2 working position and a normal position.

Figure 4.1.Connection of electric circuit

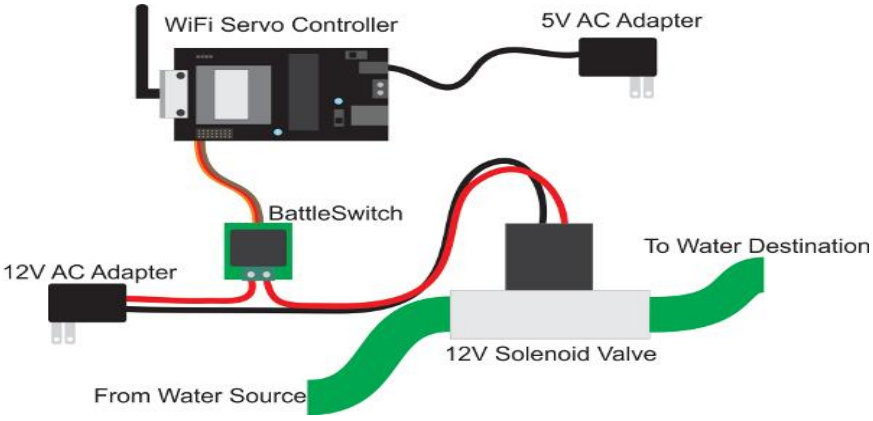

Figure 4.2.connection of solenoid value

4.3) Design of air tank

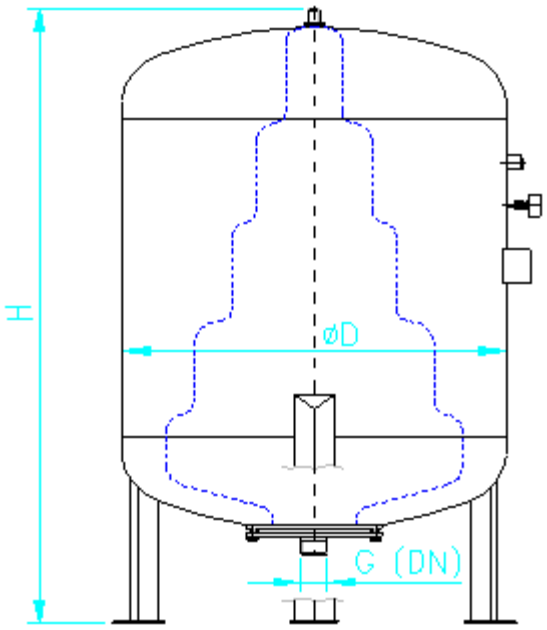

Figure 4.3.structure of air tank

An air receiver is essential to every compressed air system to act as a buffer and a storage medium between the compressor and the consumption system. There are in principal two different air receivers in a compressed air system:

- PRIMARY receiver - located near the compressor, after the after-cooler but before filtration and drying equipment
- SECONDARY receivers - located close to points of larger intermittent air consumption

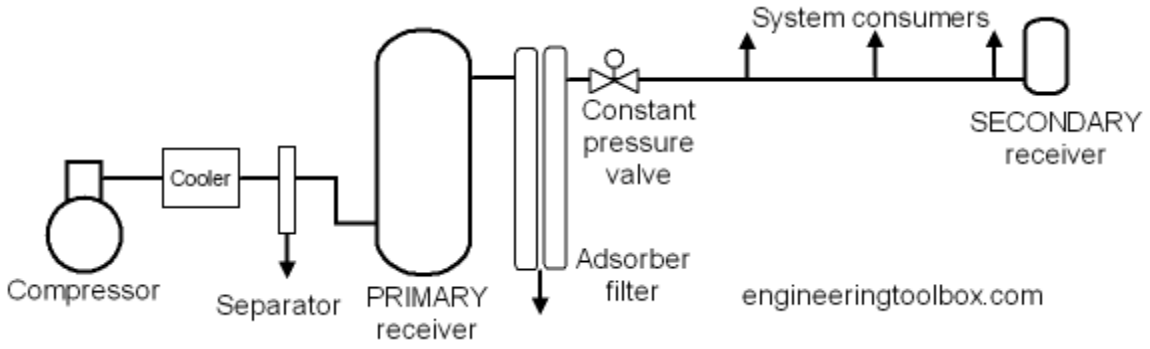

Figure 4.4 Air tank connecting circuit

The maximum capacity of the compressor in a well-designed systems always exceed the maximum mean air consumption of the system (maximum mean air consumption is the mean air consumption over some reasonable time).

Since the maximum capacity of an air compressor also always exceed the minimum air consumption in the system - the compressor must modulate its capacity during normal work, often by using primitive strategies as on/off modulating or more advanced strategies as frequency drives and inverters. Primitive modulating strategies cause more pressure variations in compressed air systems than more advanced strategies.

In addition, the air consumption vary due to the process supported. In shorter periods the demand for compressed air may even exceed the maximum capacity of the compressor. In fact, it is common in well-designed systems not to design the compressor for the maximum peek loads.

4.3.1) Air receivers in compressed air systems serves the important purposes

- equalizing the pressure variation from the start/stop and modulating sequence of the compressor
- storage of air volume equalizing the variation in consumption and demand from the system

In addition the receiver serve the purpose of

- collecting condensate and water in the air after the compressor

4.3.2) Sizing the Air Receiver

The air receiver must in general be sized according

- the variation in the consumption demand
- the compressor size and the modulation strategy

Depending on the system. In practice it is common that the manufacturer use standardized receivers for specific compressor models based on their know-how.

For calculating the receiver, note that it is necessary with a pressure band for the receiver to be effective. If the consumption process requires 100 psig and the compressor is set to 100 psig, there is no storage and no buffer. Any increased demand will make a pressure drop below 100 psig until the compressor responds by increasing the air volume compressed.

If the compressors operates at 110 psig the difference between 110 psig and 100 psig accounts for the air stored in the receiver. If the demand increases, the pressure can drop 10 psig before the minimum requirement is met. Pressure and flow controllers can be used after the receiver for stabilizing downstream pressure to 100 psig and flattening demand peaks. Note that in a compressed air system the pipe work also makes the purpose of a buffered volume.

4.4) Design of Air hose and Relief value

Consisting of a five-piece forged and welded unit, the air hose hanger incorporates a ball and socket design that enables the integral 60 degree hose fitting to swing in any direction. Since hose and fittings can move with the coupler, hose kinking, tracking and braking are reduced. A welding plate attaches completed assemblies to the car. The unit includes a 1 1/4 inch, 60 degree angle fitting for application to cars with long shank couplers and/or sliding center sills. Hangers come in various lengths.

Figure 4.5.Air Hose

Hose inside diameter plays a big role in proper air tool operation. The smaller the hose inside diameter, less air gets through the line.\

Hose length is also a factor. As air is forced through the line, pressure decreases the farther the air has to travel.

For example, a 3/8” internal diameter hose has over two times the cross sectional area than a 1/4" ID hose. So a 1/4" ID hose will drop about 20 PSI in 20 ft. at 15 CFM. The same length with a 3/8” hose drops only 2.8 PSI. Select a high grade 3/8" all-weather 300 PSI hose for maximum air delivery and flexibility. PVC jacked hose is very durable and abrasion resistant.

Use a 1/2" hose only for the shortest runs, like a short self-coiling hose near the tank or 1 foot main line.

4.5) Analyzing of stress in pipe line

The analysis of piping under pressure, weight and thermal expansion is complex. This complexity can be understood by knowledge of Principal Axis System.Stress is considered as the ratio of Force to Area. To find the stress in the small element, say cube of a piece of pipe, construct a three-dimensional, mutually perpendicular principal axis system with each axis perpendicular to the face of the cube it intersects.

Each force, acting on the cube can be resolved into force components, acting along each of the axis. Each force, acting on the face of the cube divided by area of the cube face is called the principal stress.The principal stress acting along the centerline of the pipe is called longitudinal principal stress. This stress is caused by longitudinal bending, axial force loading or pressure.

Radial principal stress acts on a line from a radial line from center of pipe through the pipe wall. This stress is compressive stress acting on pipe inside diameter caused by internal pressure or a tensile stress caused by vacuum pressure.

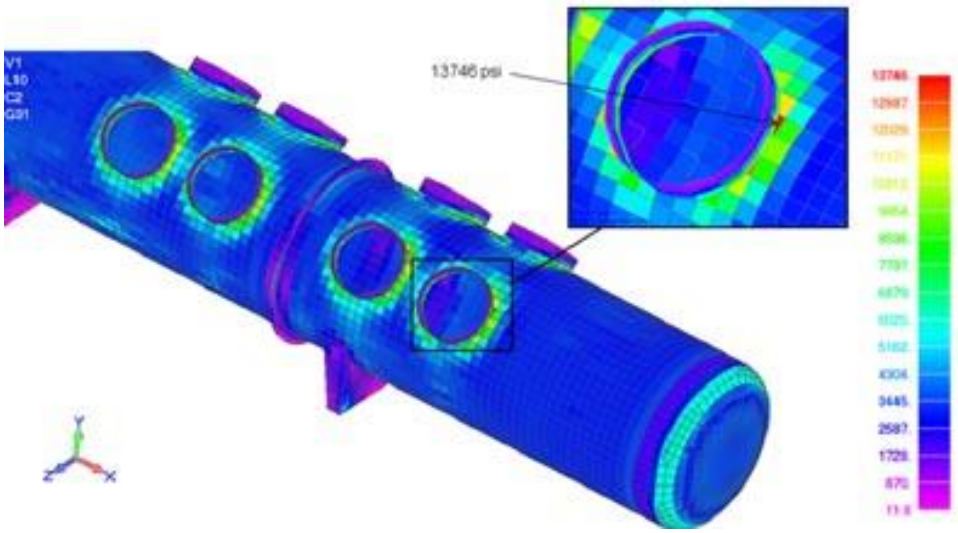

Figure 4.6.Stress analyzing in pipe

4.6) Heat transferring

Heat transfer is the exchange of thermal energy between physical systems. The rate of heat transfer is dependent on the temperatures of the systems and the properties of the intervening medium through which the heat is transferred. The three fundamental modes of heat transfer are conduction, convection and radiation. Heat transfer, the flow of energy in the form of heat, is a process by which a system changes its internal energy, hence is of vital use in applications of the First Law of Thermodynamics. Conduction is also known as diffusion, not to be confused with diffusion related to the mixing of constituents of a fluid.

The direction of heat transfer is from a region of high temperature to another region of lower temperature, and is governed by the Second Law of Thermodynamics. Heat transfer changes the internal energy of the systems from which and to which the energy is transferred. Heat transfer will occur in a direction that increases the entropy of the collection of systems.

Heat is defined in physics as the transfer of thermal energy across a well-defined boundary around a thermodynamic system. The thermodynamic free energy is the amount of work that a thermodynamic system can perform.

Enthalpy is a thermodynamic potential, designated by the letter "H", that is the sum of the internal energy of the system (U) plus the product of pressure (P) and volume (V). Joule is a unit to quantify energy, work, or the amount of heat.

Heat transfer is a process function (or path function), as opposed to functions of state; therefore, the amount of heat transferred in a thermodynamic process that changes the state of a system depends on how that process occurs, not only the net difference between the initial and final states of the process. Thermodynamic and mechanical heat transfer is calculated with the heat transfer coefficient, the proportionality between the heat flux and the thermodynamic driving force for the flow of heat. Heat flux is a quantitative, vectorial representation of the heat flow through a surface.

In engineering contexts, the term heat is taken as synonymous to thermal energy. This usage has its origin in the historical interpretation of heat as a fluid (caloric) that can be transferred by various causes,[3] and that is also common in the language of laymen and everyday life. The transport equations for thermal energy (Fourier's law), mechanical momentum (Newton's law for fluids), and mass transfer (Fick's laws of diffusion) are similar, and analogies among these three transport processes have been developed to facilitate prediction of conversion from any one to the others.

Thermal engineering concerns the generation, use, conversion, and exchange of heat transfer. As such, heat transfer is involved in almost every sector of the economy. Heat transfer is classified into various mechanisms, such as thermal conduction, thermal convection, thermal radiation, and transfer of energy by phase changes.

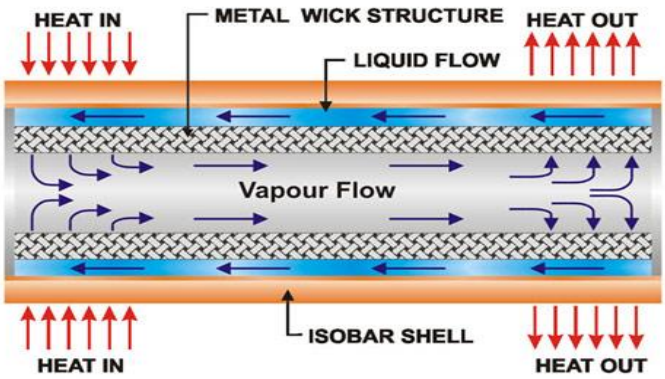

Figure 4.7.Heat Transfer at pipe

Chapter 5

FABRICATION AND TESTING

5.1) Process carried out in the project

First of all we joined the half inch mild steel pipe at the exhaust of the silencer by gas welding process. Then we threaded the T-slot with the exhaust pipe coming from the silencer.

Then we joined the motorized ball valve at one end of the T-slot and the other end with another mild steel rod. At last we connect twenty liter air tank at the mild steel rod coming from the T-slot. We have a included the electrical system for switching solenoid valve.

We use gas welding and threading process to connect the equipment's based on the requirement. We separately used a electrical wiring system for controlling motorized ball valve.

5.2) Braking performance test

Figure 5.1.Normal brake to Regenerative brake

Bike brake pads wear out, they get dirty and they need to be maintained and replaced. If you find that your bike brake pads need to be switched,

We have a great selection of replacement bike brake pads for disc brakes, cantilever brakes and V-brakes. When you start noticing a decrease in stopping power or a weird noise, it's probably time to check your brake pads. Our braking system provides efficient braking without the wear and tear of a normal braking system. Although the braking is not powerful as the friction brakes. It brings the vehicle to a stop with increased braking distance.

"Testing braking performance successfully using normal braking wire"

5.2) Testing the pressure

S.NO	TIME(SEC)	SPEED(RPM)	PRESSURE(KPA)
1.	0	2700	0.25
2.	5	1200	1.2
3.	10	0	3

Table 7.1.Pressure testing table

Many techniques have been developed for the measurement of pressure and vacuum. Instruments used to measure pressure are called pressure gauges or vacuum gauges. A manometer is an instrument that uses a column of liquid to measure pressure, although the term is currently often used to mean any pressure measuring instrument.

Figure 5.2.Pressure gauge

A vacuum gauge is used to measure the pressure in a vacuum which is further divided into two subcategories high and low vacuum (and sometimes ultra-high vacuum). The applicable pressure ranges of many of the techniques used to measure vacuums have an overlap. Hence, by combining several different types of gauge, it is possible to measure system pressure continuously from 10 mbar down to 10^{-11} mbar.

Chapter 6

RESULTS AND DISCUSSION

6.1) Saving compressed air in 20 liter tank

Approximately 70% of all manufacturers have a compressed air system. These systems power a variety of equipment, including machine tools, material handling and separation equipment, and spray painting equipment. Energy audits conducted by the U.S. Department of Energy (DOE) suggest that over 50% of compressed air systems at small to medium sized industrial facilities have low-cost energy conservation opportunities.

Significant air emissions are released when electricity is produced. In Minnesota, one-fourth of the energy-related emissions of carbon dioxide, sulfur dioxide, lead and mercury are from generating electric power. Industry uses over 34% of this electricity. Reducing electricity used by compressed air systems will help improve Minnesota's air quality.

Successful saving of the compressed air is performed and the air is stored.

Figure 6.1.Saving the compressed air

7. CONCLUSION

Compressed air is one of the most expensive uses of energy in a manufacturing plant. About eight horsepower of electricity is used to generate one horsepower of compressed air. Calculating the cost of compressed air can help you justify improvements for energy efficiency.

On this project is help to some use full work like “Air Suspension, Turbo charger etc. for after collecting the compressed air in 4-stroke engine

Main conclusion of this project is wastage energy of the two wheelers is changed into some useful work

7.1) Picture of the project

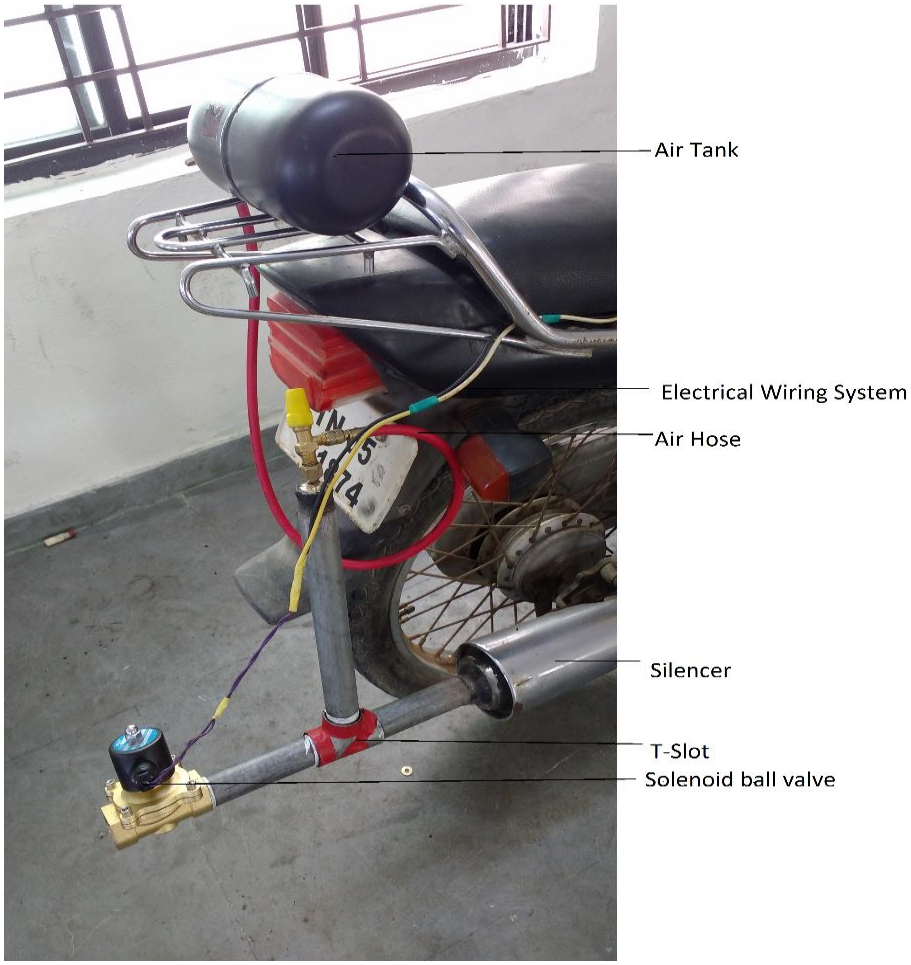

Figure7.1.Real time picture of the project

7.2) Cost per year

To find the annual cost of electricity used to power a compressed air system, calculate the cost for running the system under loaded and unloaded conditions. For each, multiply:

- horsepower (hp)
- conversion factor 0.746 kW/hp
- total operating hours per year (hr/yr)
- cost per kilowatt-hour ($/kWh)
- % time fully-loaded or unloaded
- % full-load hp, loaded or unloaded

Divide the product by the motor's efficiency.

7.1.1) Cost for Specific End Uses

Calculate the cost of compressed air for specific end uses. This allows you to determine if compressed air should be used in specific applications (ie. as fans or blowers), or if other electric-motor operated equipment would be more efficient.

First calculate the volume of air produced annually for a specific operation by multiplying:

- horsepower (hp)
- cubic feet per minute per horsepower (cfm/hp)

Chapter 8

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