AUTOEM19

Karpaga Vinayaga College of Engineering and Technology

Department of Automobile Engineering

May 2019

Editorial Team

1. Ezhumalai. P IV Year Automobile Engineering

2. Lokesh. G IV Year Automobile Engineering

3. Kanishkar. B III Year Automobile Engineering

4. Manojdev. D III Year Automobile Engineering

5. Mr. R.Praveenkumar,
   Assistant Professor,
   Department of Automobile Engineering,
   KVCET.

Vision of the Institution:

- Imparting innovative higher education with greater accentuation on high value systems shaping personnel for nation-building.

Mission of the Department :

- To impart quality technical education by providing state-of-art infrastructure with dedicated faculty.
- To provide contemporary technical education for facing the needs and challenges of industries and research establishment at global level.
- To effect socio-economic transformation of society by inculcating human values and social responsibilities

Vision of the Department

- To become the preferred destination and Centre of Excellence in Automobile Engineering.

Mission of the Department

- To provide state-of-the-art infrastructure to impart quality education in Automobile Engineering.
- To develop employable and industry ready engineers capable of solving real time problems in automobile industries.
- To inculcate the social values, ethics, and leadership qualities among the students.

Program outcomes (POs)

PO	Description
PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
PO3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Educational Objectives

PEO No.	Program Educational Objectives Statements
PEO1	Graduates of the program will have successful career in automobile or allied engineering industries or research organizations
PEO2	Graduates of the program will exhibit life long learning by engaging themselves in current technological advancement throughout their career.
PEO3	Graduates of the program will work effectively in teams by discharging professional responsibilities and following ethical practices

Program Specific Outcomes:

PSO1	Our graduates will be able to Apply knowledge of automotive design, Automotive materials and Hybrid vehicle technology to solve complex problems in automobile engineering and its allied areas.
PSO2	Our graduates will be able to Analyze, design and evaluate Automobile components and systems with the help of modern CAD/CAM/CAE tools while ensuring best engineering practices.

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Engine Trends

ABSTRACT

The internal combustion engine has been with us for a long time - since about 1885. Familiar layouts soon appeared with, for example, six cylinders seen as early as 1902. Multiple valves per cylinder, double overhead cam-shafts, super-chargers, turbo-chargers, and fuel injection are all well and truly pre-war. After that, it might be said that there was no very novel and lasting engine concept (perhaps the Wankel rotary engine excepted) until the oil crisis and stricter anti-pollution laws started a movement towards greater engine efficiency. Engines have grown more efficient and less polluting (if well maintained) since the 1980s but cars and 4WDs grew heavier and bigger in the 1990s as oil prices fell, cancelling out some of the gains. Some day oil will become inordinately expensive to use as a fuel, as OPEC's production squeeze of 2000 reminds us. Getting ready for that day, a number of refinements of, and alternatives to, the internal combustion engine are coming to show-rooms or running in laboratories and in test vehicles.

TRENDS

Direct Injection

Direct injection is where fuel is injected (directly) into the cylinders, not mixed with air in the inlet manifold or inlet ports before being drawn into the cylinders. Diesel engines inject fuel either into the cylinder proper or into a small chamber off the cylinder, but direct injection on petrol (gasoline) engines is not new either, e.g. the world war II DB601 aircraft engine (?Me109?) used it. However, petrol direct injection is a recent development in mass produced cars. Mitsubishi released such a system in the 1996 Galant and the 2000 Pajero sold in Japan uses it. The Australian Orbital Engine Company started work with Mercedes Benz and Siemens in 1998 on a direct injection system for cars that is said to use lower pressures than Mitsubishi's. (Orbital's direct injection is already used in Mercury Marine 2-stroke outboard engines.)

The advantages of direct injection are that the fuel can be placed in the combustion space in a more controlled manner than with conventional (inlet) injection systems. "Lean running" is possible by forming a richer cloud in the vicinity of the spark plug. The challenge is to control precisely the amount, size and distribution of the fuel droplets to suit varied driving conditions, and to do this reliably over the life of the vehicle. Lean mixtures also tend to lead to the formation of oxides of Nitrogen, NOx, a pollutant limited by legislation although exhaust gas recirculation can be used to reduce engine temperatures and thus NOx formation to some extent.

Electric Propulsion

Electric vehicles are nothing new, many being used in the early 1900s. However batteries remain large, heavy, expensive, slow to recharge and have a limited life. Hybrid systems (below) show much promise, allowing a small efficient petrol engine to carry the "base load" with batteries to cover high power demand.

As of 2000, the best bet for electric power seems to be the fuel cell.

Fuel Cells

If an electric current is passed through water, the water is split into hydrogen and oxygen. The fuel cell, as used in space-craft, reverses this reaction combining hydrogen and oxygen to release electrical energy with pure water as a byproduct. In principal hydrogen could replace petrol and diesel as the fuel for transport. In the short to medium term hydrogen could be produced from hydrocarbons, in the long term power stations, perhaps solar powered, could produce it. The attraction of using the fuel cell to generate electricity, over burning the hydrogen in an internal combustion engine, is that the fuel cell is very efficient indeed, achieving 45% to 60% efficiency (c) 4wd.sofcom.com --> versus a petrol engine's 15% to 35%. There are problems: hydrogen is an explosive gas that is difficult to store. This could be solved in the "cost no object" space program, but distributing hydrogen, storing it at service stations, refueling cars safely, devising fuel tanks that are safe-ish in accidents is going to be difficult. However, experimental cars such as the Daimler Chrysler Necar 4 have been demonstrated using hydrogen fuel cells.

As an interim measure, systems that generate their hydrogen on demand from a liquid hydrocarbon, most likely petrol (gasoline) or methanol, may be adopted. The fuel can be distributed using existing infrastructure. However efficiency falls because of the conversion process, carbon dioxide is a by-product (although CO2 is also produced if fossil-fuel power stations are used to generate hydrogen), and sulphur can poison the fuel cell if it get past the hydrogen generator.
(2000 November: See the Mercedes Benz Necar 5.)

Hybrid Engines

A hybrid propulsion system uses a petrol or diesel engine with an electric motor in some combination. One variation is to have the wheels driven only by the electric motor or motors, current coming from batteries. The petrol engine (say) drives a generator to charge the batteries; it can be turned on and off as needed, and can be optimized to run efficiently in a narrow rev' range.

Batteries can be smaller than in an all-electric car because they only have to supply current for short periods. The hybrid car still has the range of a conventional petrol or diesel car.

A second variation is to have a relatively small petrol engine drive the wheels through a mechanical transmission. An electric motor provides assistance when high power is needed - overtaking and climbing hills. Some engine power is diverted to charging the batteries at times of low power demand. The Honda Insight is one such car, for sale in America from December 1999 (probably being sold at a loss to test the waters). It is said to achieve a low consumption figure of 3.85 litres per 100km.

The electric motor can also act as a generator slowing the car - called regenerative braking - to help recharge the batteries and reducing wear on the brakes.

A hybrid car can use a smaller internal combustion engine which spends most of its time operating in the more efficient part of its range. The next "Jeep", the replacement for the Hummer, the RST-V is planned to to employ hybrid propulsion for the purposes of quiet running and limp-home redundancy.
(2000 November: Chrysler Daimler announced plans to offer a hybrid system in the Dodge Durango 4x4 in 2003. Also see the Toyota Prius.)

Miller Cycle

As discussed under super-charging below, the efficiency of an engine is generally improved if its expansion ratio is increased, i.e. if as much energy as possible is extracted from the exhaust gases so that they leave the tail-pipe cold and at slow speed. This could be achieved by having an exhaust stroke that is longer than the compression stroke. At first sight this seems to be a geometric impossibility, but it can be managed by sacrificing some of the upward movement of the piston - leaving the inlet valves open for a while. Some of the inlet gases will be expelled back into the inlet manifold, but so what? The compression stroke uses a fraction of the upward movement of the piston, but the power expansion stroke uses its full downward movement. Such tricks have been played with large marine diesel engines for many years, but they only recently became practical on car engines with improved tolerances and electronic controls. The idea was patented by Ralph Miller in the 1940s.

Mazda has been fitting 2.3 litre Miller cycle engine to its Eunos 800M since about 1997. The Mazda engine incorporates a super-charger and inter-cooler, the explanation being that this compensates for the effective reduction in engine capacity due to the shorter compression stroke; the super-charger is said to be more efficient at compressing the intake mixture than a full compression stroke would be. (The logical extreme would seem to be to do all the compression with a super-charger, closing the inlet valves just before igniting the mixture, but perhaps super-chargers do not work well at such high pressures?)

- **Mazda Miller-cycle, 4-valves/cyl, V6 DOHC**
- **bore: 80.3mm, stroke: 74.2mm, swept volume 2254cc**
- **power: 149kW at 5500rpm, torque: 282Nm at 4000rpm**

Steam

There is no immediate prospect of steam power making a come back on the road; steam is not the victim of a conspiracy theory, the thermodynamics are just not right. The most recent Australian link with automotive steam seems to be the various experimental Pritchard steam cars built during the 1960s and 1970s, and the Gvang prototype of 1972 (Davis 1987).

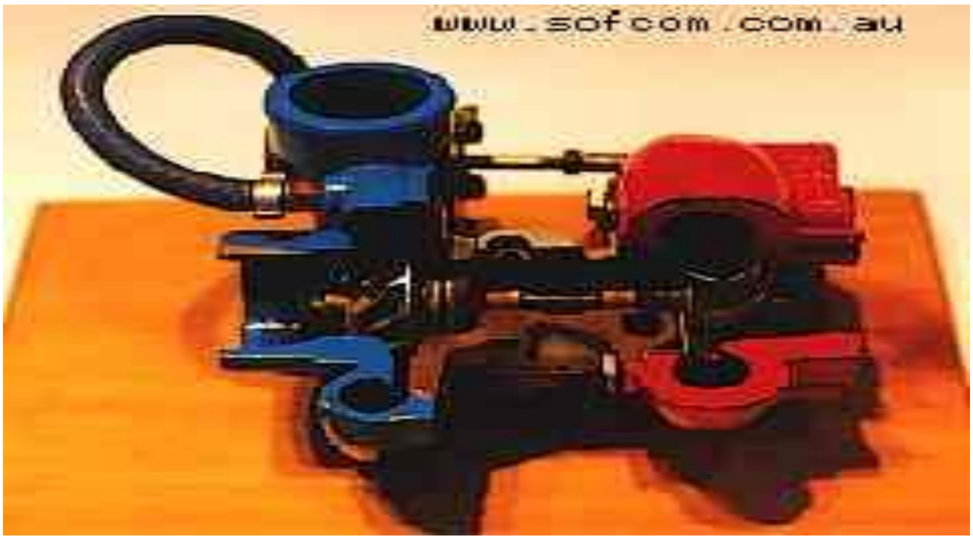
However as of 2000, a British team [www] is looking at raising the land speed record for a steam powered car. A Stanley steamer set a world land speed record of 127.66mph at Ormond Beach (Daytona) Florida in 1906. This stood until a petrol engined Benz achieved 131mph in 1910. The British team includes Glynne Bowsher who was the chief mechanical designer for the supersonic "car" ThrustSSC. "The initial target is 150mph but the car is being designed for speeds of 200 mph or more."

Super- and Turbo-Charging

Forcing more air into a cylinder allows more fuel to be burned, generating more power from an engine of a given weight and size; that's the basic idea behind super-charging and turbo-charging. A super-charger is driven by the engine, either by gears or by a belt from the crank-shaft. Super-charging was popular in 1930s' racing engines - Bentley, Auto-Unions and Mercedes Benz. The latter has revived it in a line of compressor models in the 1990s. Even GM Holden has bolted a super-charger to the Commodore V6.

Super-charging increases power but not necessarily efficiency; it increases the compression of the intake air but not its expansion after the fuel is burned. Think of a sealed cylinder at room temperature and pressure with the piston at bottom dead centre. As the piston moves up, doing work, the air is compressed and grows hotter. As the piston passes top dead centre it is forced down by the compressed air which grows colder returning to room temperature and pressure. If there were no frictional losses and if the cylinder were perfectly insulated there would be no net loss of energy. In a working engine, fuel is ignited near top dead centre. This makes the air-fuel mixture hotter than ever, which increases the pressure even more, and drives the piston down strongly. Now when the piston nears the bottom the gases are still relatively hot and under some pressure, i.e. they contain residual energy which is simply dumped into the exhaust system and wasted. Having said that, if the super-charger is used intermittently for high power demand only, it can allow the use of a smaller, lighter engine; see variable compression below.

An engine's efficiency can be improved if its expansion ratio is increased. In principle, this could be done by feeding the exhaust gases into a second (larger) low-pressure cylinder - forming a compound engine - but the extra weight, size and complexity make this impractical in a car engine (but note that double and triple expansion designs were common in large steam engines). A common alternative is to drive a turbine from the exhaust gases. Invariably (?) the turbine is used to drive a compressor, giving us a turbo-charged engine. By a happy accident, the turbine extracts most power at wide throttle openings just when high boost is wanted. The modern turbo-charging craze, arguably begun by Audi, has generally been promoted as increasing power rather than efficiency.



No law says that the turbine must drive a compressor. It could assist in driving the crankshaft and such designs, also called compound engines, did appear in aircraft piston engines: A super-charger was driven from the crankshaft and an exhaust-gas turbine helped the pistons to turn the crankshaft and thus the propeller and, of course, the super-charger. Some "eccentrics" have recently rediscovered the logical progression to the gas turbine and jet engine: Remove the role of the reciprocating piston, replacing it with a fixed combustion chamber. Apparently it is possible to make a crude gas turbine from an automotive turbo-charger although extracting any useful power from it is another matter. Do not try this at home - there is no little danger of hot, sharp bits of metal escaping at high speed. Some car makers such as Rover did experiment with gas turbines but the poor fuel economy of car-sized units was the main stumbling block.

Two-Strokes

The 4-stroke engine has effectively pushed the 2-stroke engine aside in petrol (gasoline) driven cars. The 2-stroke gives twice as many bangs per revolution - more power for less weight - but pollution is a problem with some fuel and lubricating oil escaping into the exhaust unless direct injection is adopted together with a sealed sump. The Orbital Engine Company has put their direct injection system into 2-stroke outboard motors for boats.

On the other hand, the 2-stroke diesel engine is alive and well - in some trucks. A 2-stroke needs the intake air to be lightly pressurized to blow out the last exhaust gases from the cylinder and a super-charger can manage this quite well. Diesels inject fuel into the cylinder near top dead centre when all the valves are closed. One wonders if a 2-stroke petrol engine with a super-charger and direct injection might be a goer.

Valve Operation

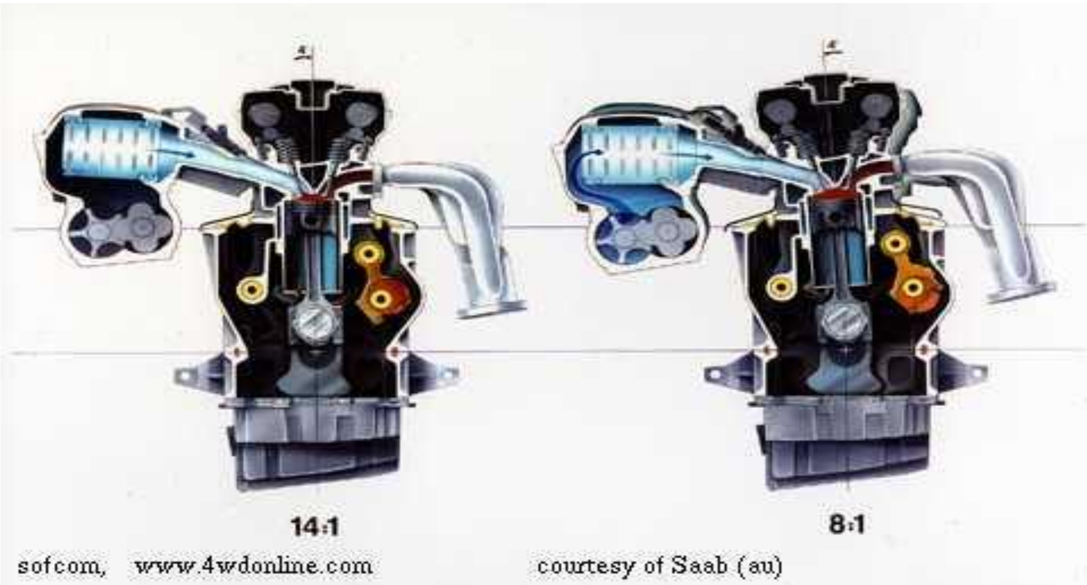
Inlet and outlet valves in all (?) production engines are operated by camshafts - either on the side of the block acting via pushrods and rocker arms, or single (sohc) or double (dohc) overhead camshafts. Audi has been leading the pack towards no less than five valves per cylinder - three inlet and two outlet valves (although F1 and sports-car racing engines remain on four per cylinder). Toyota seems to have been the first to offer 4 valves per cylinder in a passenger diesel 4WD.

High power is developed at high rev's and requires inlet valves, in particular, to open wider and for longer. Engines with these characteristics typically develop maximum torque at high rev's and can be inflexible and difficult to drive. Various systems became available from manufacturers such as Honda from the 1980s to vary (a) the point at which valves open and (b) the duration of the valves being open; typically extra lobes on a camshaft can be moved together or apart to cover a variable angle. Such an engine can be both tractable at low speed in traffic and sporty when given its head.

Springs, to close the valves, have been with us since the year dot. Some racing engines have had desmodromic valve systems - valves opened and closed by cams. Since the 1990s+/- formula one engines and some experimental engines have used compressed gas instead of valve springs - it must be lighter and faster acting. We probably will not see this on production cars.

In the late 1990s, Mercedes Benz has been experimenting with electrically operated valves, i.e. opened and closed by solenoids. The advantage is completely variable valve timing without any mechanical complexity. In fact it has been possible to do away with the throttle, controlling the amount of air entering the cylinders through the valve timing. There must be questions over reliability.

Variable Compression



2000 February: Saab showed a prototype variable compression engine at the Geneva Motor Show. This engine tries to solve the problem of being both a small, fuel-efficient engine and a large, powerful engine by changing its geometry Devised by Per Gillbrand 20 years ago, the Saab Variable Compression (SVC) engine can vary its compression ratio between 8.0:1, for wide throttle, high-power settings and 14.0:1, for light throttle, fuel efficient operation. The trick is made possible by tilting the "monohead" (head and cylinders) by up to 4° about an axis on the left of the engine (in the diagram). This changes the distance of the cylinder head from the crank by a few millimetres - enough to change the cylinder volume at top dead centre by nearly a factor of two.

By itself, lowering the compression ratio would not increase power at all but it enables the super-charger to switch to a higher boost pressure without any danger of pre-ignition. Squeezing more air into the cylinders allows more fuel to be burned - more power.

The 1.6 litre, 5-cylinder prototype delivers 168kW of power and 305Nm of torque. Boost pressure varies up to a maximum of 2.8 bar. In effect, the engine can behave like a 1.6-litre motor out of a shopping trolley or like a 3+ litre engine on demand. (e.g. The 3.2 litre V6 in the 1999 Mercedes ML320 produces 160kW.)

- Saab Variable Compression engine, 1.598 litres, 5-cyl, c.r.: 8:1 to 14:1 variable,
- Max. monohead tilt angle: 4 degrees, Max. super-charger boost: 2.8 bar
- power: 168 kW, torque: 305 Nm, bore: 68mm, stroke: 88mm

CONTROLLED COMBUSTION ENGINE

The REVETEC Engine design consists of two counter-rotating "trilobate" (three lobed) cams geared together, so both cams contribute to forward motion. Two bearings run along the profile of both cams (four bearings in all) and stay in contact with the cams at all times. The bearings are mounted on the underside of the two inter-connected pistons, which maintain the desired clearance throughout the stroke.

The two cams rotate and raise the piston with a scissor-like action to the bearings. Once at the top of the stroke the air/fuel mixture is fired. This is the power stroke during which the maximum mechanical advantage is reached after the piston has moved approximately 5% of its travel from top dead centre (approx. 10° ATDC), which makes better use of the high cylinder pressures at this point in the cycle. In comparison a conventional engine reaches its maximum mechanical advantage after the piston has moved approximately 40% of its travel from top dead centre (approx. 60° ATDC). A side effect of this is a CCE can idle at a much lower RPM. Because the piston assembly only moves in one dimension (unlike the case in an engine with connecting rods), contact with the cylinder wall is minimized, which reduces wear and lubrication requirements. The cams create less piston shock, which allows ceramic components to be used. The engine can run in either direction if symmetrical lobes are used. The effective cranking distance is determined by the length from the point of bearing contact to the centre of the output shaft (not the stroke). The dual bearings contact the two cams in the opposite side which cancels the side forces out. The piston assembly does not experience any side force which will reduce wear and lubrication requirements at the cylinder contact. One module which consists of a minimum of five moving components, produces six power strokes per revolution. Increasing the number of lobes on each cam to five produces ten power strokes without increasing the number of components.

Advantages

The following advantages are claimed for the CCE engine at

- Predicted production power to dressed weight ratio is 0.40 bhp/lb. For comparison a Continental 100 hp (75 kW) engine is 0.465 hp/lb, dressed
- Efficiency - Recent tests gave good results, for a gasoline engine, when running lean. fewer moving and total components. As a result of fewer components, more easily manufactured than conventional engines.
- identical cylinder head assembly (“top end") to conventional engines. Most existing head technology can be either adapted or utilised.
- Flexible design - can be four-stroke, two-stroke, petrol, diesel or gas, natural or forced aspiration.
- Eliminated irregularly reciprocating components such as connecting rods. No second order balancing required.
- Output shaft can be run in either direction if multilobed cams with symmetrical lobes are employed.
- The CCE can be designed to operate at greatly reduced operating speeds while delivering high torque output.
- Substantial reduction in stroke reduces heat loss through cylinder wall.
- Extended piston dwell is possible because engine design allows a lower than normal compression ratio to be used reducing power loss from compression cycle.
- Able to fire on a leaner mixture than conventional engines.
- Maximum mechanical advantage can be applied to output shaft at only 20 degrees ATDC utilising high cylinder pressure early in the stroke, compared to around 60 degrees ATDC for conventional engines.
- Lower emissions can be achieved due to increased control over combustion.
- Low idle speed due to increase in mechanical efficiency at the top of the stroke.
- Little or no bore contact/piston side thrust, which reduces wear on cylinder bore.

- Can have different port timing on compression stroke than power stroke allowing better control.
- Lower centre of gravity on the boxer design. Due to controlled piston acceleration rates the CCE reduces engine vibration.
- A hollow output shaft can be utilised for specialty applications, such as peristaltic pumps.

Disadvantages

The following have yet to be verified independently.

- Vibration
- Reliability, especially when running lean as is required for good economy.
- Emission**.**

Rotating Liner Engine

The rotation liner engine(RLE), a unique lubrication concept for traditional internal combustion engines. The RLE incorporates a rotation liner between the piston and the engine block, exploiting the well proven piston and piston ring advantage of the historic sleeve valve engine (a total of 200 million horsepower of SVE's were built during WW2) and applying it to the modern exhaust-emission-driven reciprocating engine. The RLE improves efficiency, decreases pollutants, increases durability, and has applications thought the range of the $50B+ heavy-duty diesel market. The historical evidence demonstrated exceptional durability, reduces friction, and reduction of fuel consumption of prior rotation sleeve engines, called sleeve valve engines. The basic engineering assumption behind the RLE has been confirmed by preliminary results from single cylinder light-duty based RLE prototype.

Diesel Exhaust Emissions Regulations and the RLE

RLE technology is being developed at the right time because lower friction reduces fuel consumption which, in turn, reduces emissions. In the case of particulate matter (PM), this reduction will be more than proportional. Diesel engine exhaust emissions are heavily regulated, demanding a number of operating changes, many of which will severely impact efficiency and lubrication, which ultimately affects cost of owning and operating these engines. Engines which are able to meet the 2003 emissions regulations have actually shown a loss in engineperformance. Without improvements in fundamental engine design, the 2007 emissions regulations may cause even larger efficiency losses. In order to meet these regulations, modern diesel engines operate at even greater pressure.

Excess air in the combustion chamber reduces nitrogen oxides (NOx), but also increases peak pressure with little added thermodynamic benefit. As a result, friction and wear of the piston assembly increases. Required recirculation of exhaust gases (EGR) also increases friction because of increased metallic contact due to more acid in the cylinders. Also, new diesel engines will require exhaust catalysts to meet 2007 emissions regulations. These catalysts are often incompatible with the conventional zinc-based additives that lubricate metallic contact. Rotating liner engine technology overcomes or avoids most of these challenges. The value proposition of RLE technology is compelling and offers an attractive way of diversifying the original engine manufacturers' market risk

BY

Adithyan M

Rajasekaran R

Sathish B

Second year

DESIGN OF SOPHISTICATED GEAR SHIFTING FOR EASE PROPELLING OF AUTOMOBILES

ABSTRACT

Now-a-days cars become the essential commodity all over the world. That's why the automobile companies are rapidly increasing. Today's customers need more comfort at any cost. For that purpose companies are investing lot of money in R&D, which is the hub of product development.

As a part of ours, we added sophistication in gear shifting which is based on the real time project "***Sophisticated gear shifting for ease propelling for Automobiles***".

The passenger cars that now ply on the road have transmission either of manual or automatic type of gear changing. Our objective is to create a mechanism to reduce the inconvenience caused when changing gears in the car. In this system,

- ✓ The gear shifting here is by mere pressing of feather touch buttons present on the dash board.
- ✓ The gear shifting is by hydraulic force achieved by a simple modification to the gear box.

This project if implemented is a clear alternative for the Automatic transmission because of its low cost and ease of use. Moreover the whole set up is small and requires a very small space.

INTRODUCTION:

The paper deals with the real time project, "***Sophisticated gear shifting for ease propelling for Automobiles***". The paper deals with the various design aspects of the creation of this project.

This project is aimed at giving driver the convenience for gear shifting. The car with this project will have a series of buttons in the format of 4 forward, a reverse and a neutral. The clutch operation may or may not be put in the car depending on the user. The power for gear shifting is got from hydraulic fluid. The power for fluid is from the power steering pump. So a car with a power steering can be easily adaptable to this project. The project has been started as a concept and it requires a lot more work to be done to put in a car.

PROBLEM DEFINITION:

Whenever a project is carried out there is a reason behind it. The existing cars now pose some problems for the drivers.

TYPE OF TRANSMISSION	MERITS	DEMERITS
Manual Transmission	1.Higher transmission efficiency 2. The mileage of the car and life is also more.	1.Do not give much of comfortless for the drivers 2.Occupies a major area in the cabin resulting in the space congestion
	1. The gear shifting is easy. We just have to select the drive band, which is already preset	1. Engine performance is low. 2. Mileage drop

AUTOMATIC TRANSMISSION	2. Easy for the drivers to shift gear. 3.Selection may be either of lever type or a set of buttons	3. Power loss 4. High cost.

The need of the hour, combining the position of both MT and AT a mechanism has to be created for better mileage and comfortable gear shifting. This is the objective of the project. So a car with this project provides ease of gear shift as in AT without a compromise in mileage as in MT. the cost of the project is less as it requires a minor alteration in the gear box.

DESIGN OF PROJECT:

The project is done as a table top on the FIAT car's gear box. The project design comprises of designing the following parts,

1. Hydraulic circuit
2. Electronic circuit
3. Mechanical components

HYDRAULIC CIRCUIT:

Hydraulic motion is selected for gear shifting owing to its large load acceptance and ease of adaptability in the car. Also the gear shift should be quick. The basic components design is explained in detail.

CYLINDER DESIGN:

Load required to move the selector rod or to change the gear F*=30 Kg*

Pressure built in the compressor unit *P=10 bar*

To find:

Cylinder dimensions D,L=?

1. Cylinder diameter D=?

$$\mathbf{P = F/A}$$

$$(10*10^5)*(\Pi/4)*D^2 = 30*9.81$$

$$D = 0.0194 \text{ m} = \mathbf{20\ mm}$$

2. Cylinder length L =?

Cylinder length L = Stroke Length+ Piston thickness+ Clearance

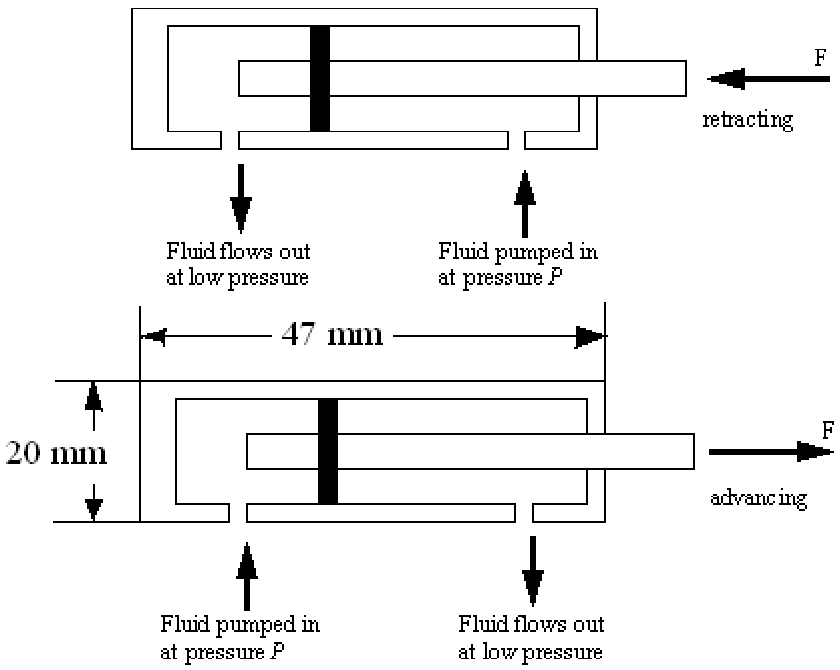
$$L = 30+10+7 = 47 \text{ mm}$$

$$L = \mathbf{47mm}$$

Cylinder diameter= 20mm

Cylinder length= 47mm.

CROSS SECTIONAL VIEW OF THE CYLINDER:



SELECTION OF PUMP:

Selection of pump is based on following characteristics:

- Select the actuator that is appropriate based on loads encountered.
- Determine the flow rate requirements. This involves the calculation of the flow rate necessary to drive the actuator to move the load through a specified distance within the given time.
- Determine the pump speed and select the prime mover. This, together with the flow rate calculation, determines the pump size
- Select the pump based on application
- Select the system pressure. These involves in with the actuator size and magnitude of the resistive force produced by the external load

on the system. Also involved here is the total amount of power to be delivered by the pump.

- Select the reservoir and associated plumping, including piping, valving, hydraulic cylinders, motors and other miscellaneous components.
- Calculate the overall cost of the system.
- Consider factors such as noise levels, horse power loss, need for a heat exchanger due to heat generated, pump wear, scheduled maintenance service to provide a desired life of the total system.

The above characteristics are satisfied by the **GEAR OIL PUMP** and the following data are obtained from measurement,

Do =75 mm, Di =50 mm, W= 25 mm ,N=1440 rpm

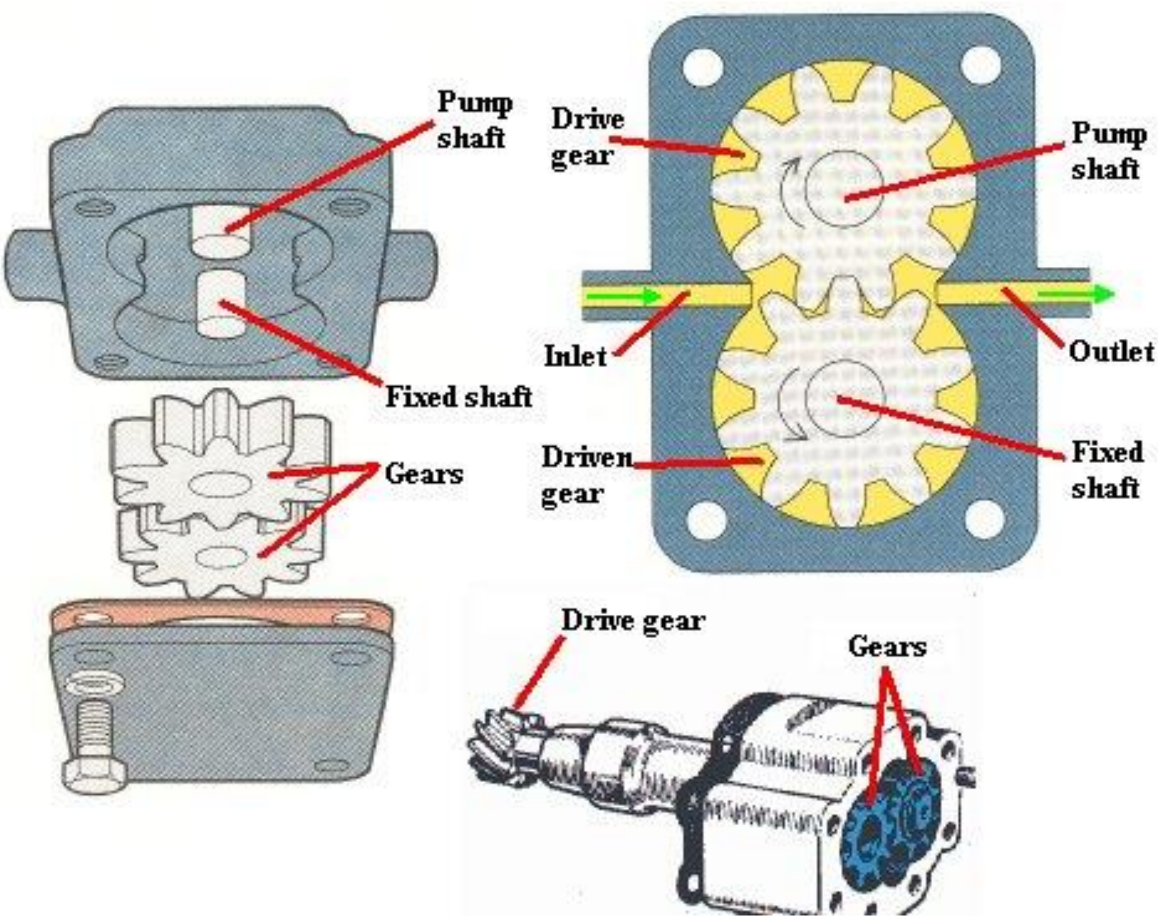
1. Flow rate Q = $(\pi/4)*(Do^2-Di^2)*W*N$

$$= (\pi/4)*(0.075^2-0.050^2)*0.050*1440$$

$$= 0.0883 \text{ m}^3\text{/S} = 0.00147 \text{ m}^3\text{/min} \quad = \mathbf{1.47 \text{ Ltrs/min}}$$

2. Power required = Pressure*Flow rate= $(10*10^5)*0.0883$ = **88.3 kw**

CROSS SECTIONAL VIEW OF THE PUMP:



SELECTION OF RESERVIOR:

1. Reservoir Capacity = 2.5 to 3 Times of Pump flow

= 3*1.47

= 4.41 Ltrs

=4 Ltrs

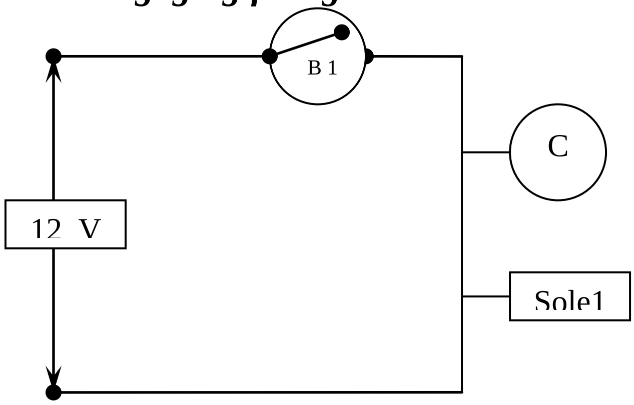
2. Size of the copper tube = **6 mm**
(For transmitting hydraulic fluid to valves)

ELECTRONIC CIRCUIT:

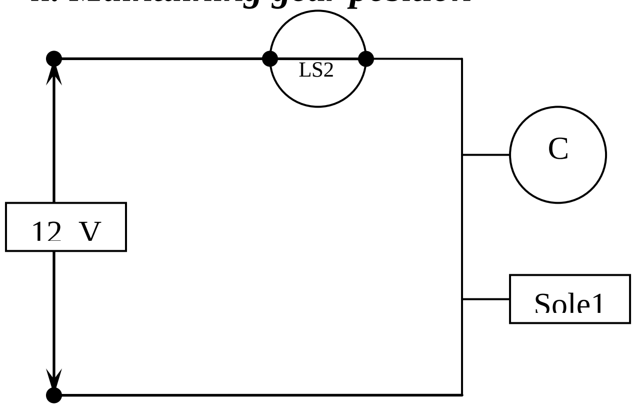
The electronic circuit is used for governing the hydraulic operation. For this purpose we have used two solenoid valves (inlet and outlet) for each gear to be shifted. The supply voltage is from battery which is 12V. there will be six buttons 1, 2, 3, 4, R, N for gear shifting. Each actuates the gear corresponding when pressed.

The diagram below shows the electronic circuit for various operation of the gear shifter.

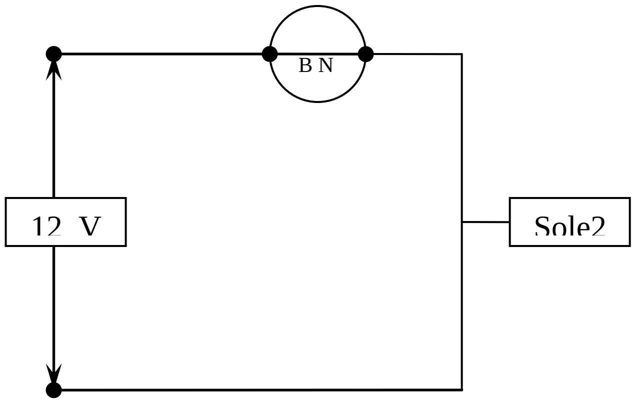
i. Engaging first gear



ii. Maintaining gear position



iii. Releasing gear-neutral position

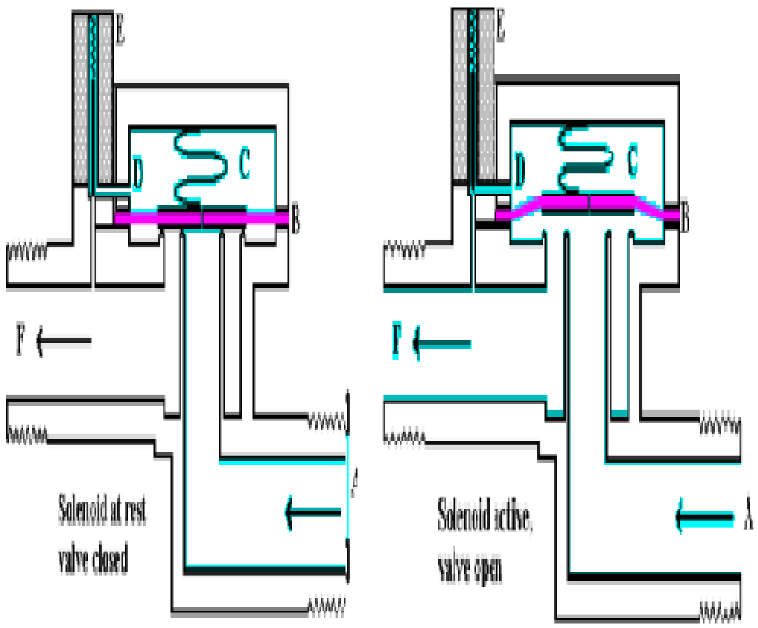


OPERATION OF SOLENOID:

When the solenoid is given electrical supply, it gets activated and allows the pressurized fluid to one side of cylinder.

When it is disconnected from the supply, it gets deactivated and blocks the flow of fluid.

The supply for the solenoid is given from the battery which is meant for ignition purpose.



MECHANICAL COMPONENTS:

The main mechanical component for the project is the spring. The spring is used to counter balance the force exerted by the piston. Moreover it is useful in the return motion of the gear selector rod during gear disengagement. Presence of spring on the gear selector rod helps in the quick action that is required during the gear shift.

DESIGN OF SPRINGS:

We have formula for deflection $Y = 8PD^3n/Gd^4$

Where,

Y= deflection of spring	=1.5 Cm
P= load acting on the spring	=30 Kg
D= Diameter of spring	=3.5 Cm
d= Diameter of spring coil	=0.4 Cm
G= Modulus of elasticity of spring material	$=2*10^5$ N/mm^2
N= no of coils in the spring	=?

No of coils in the spring,

$\mathbf{N = YGd^4/8PD^3}$

$= 1.5*2*10^5*0.4^4*100/(8*30*9.81*3.5^3)$

= **8 coils**

WORKING PRINCIPLE:

The main driving force for the gear shifting is by the hydraulic fluid. The gear shifting along with the clutch operation works with the pressing of buttons. On pressing the button corresponding to the gear, three operations take place,

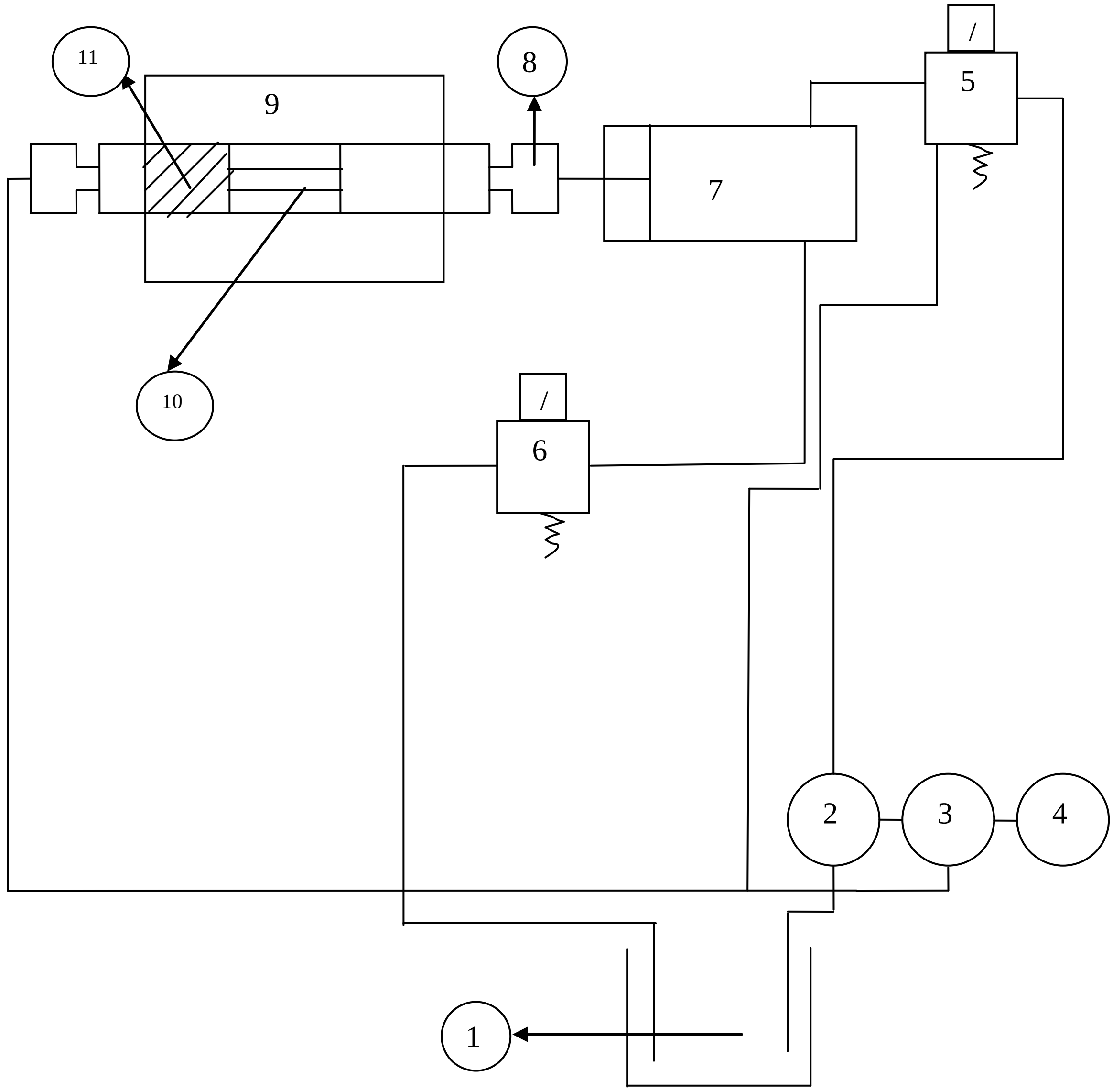
1. Engine rotation

2. Clutch engagement
3. Pump rotation

When the car is switched on the engine rotates, on pressing the button clutch engages. Now electromagnetic clutch engages the pump. Due to the pump rotation the hydraulic fluid is pumped from reservoir to the inlet solenoid valve. Through this valve the fluid pushes the piston in the cylinder. This motion causes the gear shifter rod to engage the gear which is fitted to the piston. In order to avoid slippage of gear a limit switch is used to sense the position of selector rod and cut off the supply.

To bring the car to neutral position we press the N button. Now the outlet solenoid valve energizes so the fluid in the cylinder rushes back to the sump with the aid of spring tension. If the next higher gear has to be selected, the same operation takes place on pressing the next button.

HYDRAULIC CIRCUIT DIAGRAM:

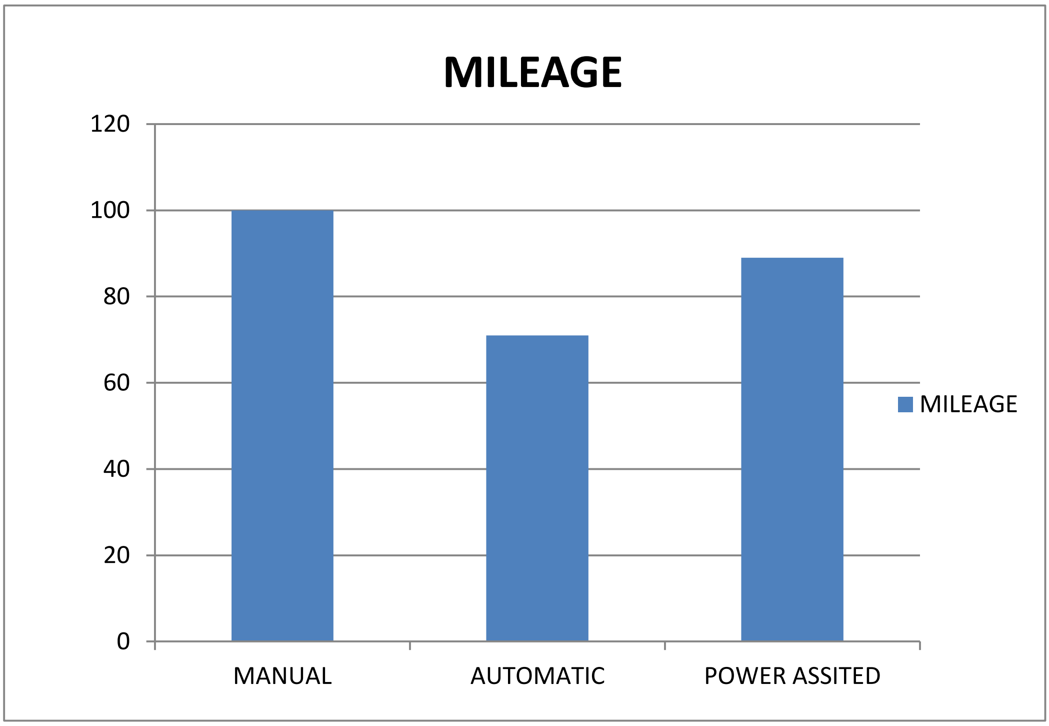


Hydraulic circuit diagram of the project

1. Reservoir.
2. Pump.
3. Clutch
4. Engine
5. Inlet Solenoid Valve
6. Outlet Solenoid Valve
7. Cylinder piston assembly
8. Limit Switch
9. Gear Box
10. Gear selector rod
11. Spring

RELATIVE

GRAPH:



The mileage of manual, automatic and our power assisted gear shifting mechanism is tested in our laboratory under same conditions for several times . With all the graphs combined , a relative graph **X=100** is drawn by using the following relations which in turn is obtained from the experiment.

Mileage of manual for a 'Y' litre of fuel = X

Mileage of automatic for a 'Y' litre of fuel = 0.71X

Mileage of our system for a 'Y' litre of fuel = 0.89X

CURRENT STATUS:

Presently we have done this project as a table top working model. This consists of various parts which are listed below.

1) FIAT Gearbox
2) TOYOTA Power steering compressor
3) Motor for driving the compressor
4) Electromagnetic clutch

5) Tank or reservoir for storing the hydraulic fluid
6) Valves for controlling the flow of hydraulic fluid
7) Limit switch to cut off the supply
8) Hydraulic cylinder and piston assembly
9) Copper tubes for transportation of fluid
10) Fluid Hoses
11) Base structure for holding the gearbox and motor arrangement

The current model is a simple one which is actuated by a stick switch governing the gear selection. This set up works good for two gears. In the future there are plans to incorporate the clutch action in the set up by using the electronic clutch.

MERITS:

- A clear alternative for Auto Transmission this, is much cheaper and user friendly with more features.
- Leg room for passengers at front is increased more since the removal of gear rod.
- Ease of operation, by the use of feather touch buttons.
- A boon for the handicapped, the car can be driven even with only one hand since buttons are used for changing gears.
- No loss in mileage of the car as the load required for gear shift is meager.

DEMERITS:

Since the project is custom made, it requires a skilled technician to assemble the set up in the car, considering the space constraints.
Moreover the driver should be well trained in using the system to avoid malfunction.

CONCLUSION:

This project is an innovative concept. It is a new dimension in the transmission system of a car. This is a simple and versatile pack that may be fitted to any cars existing with power steering. By implementing this smart gear shifter in cars, we can achieve more space, smooth operation, more user friendly, less effort to change the gear and no play. Also the project is a boon for physically challenged persons. The present condition of the project is promising for further developments. Lots of inputs are also got from the car specialists and academicians for its improvement. The concept can be transformed to a real time fitment on further development. We estimate a period of two years to see a car fitted with this mechanism.

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By

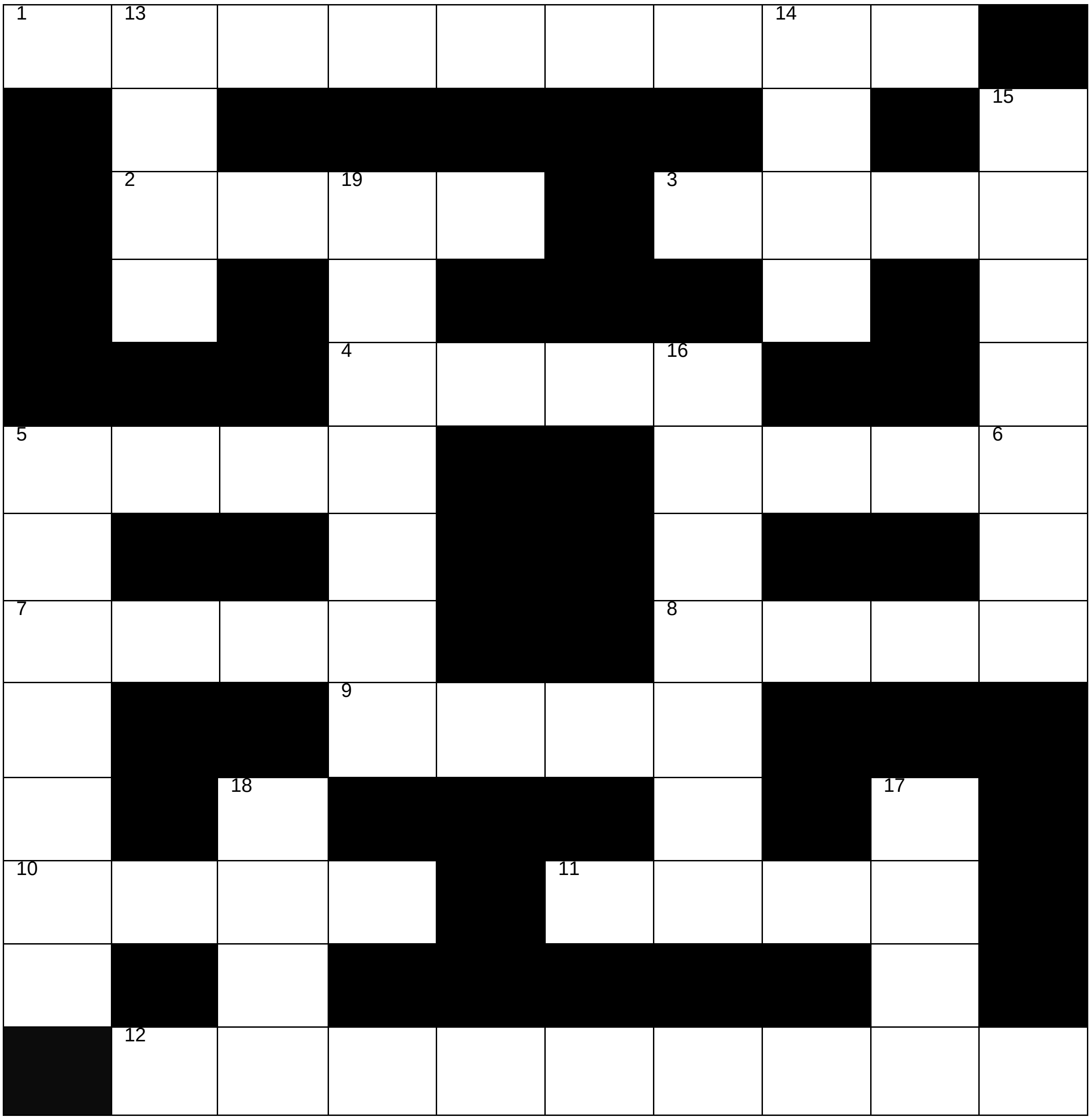
Revanth R

Sundararaman G

Sairam R

Third year

Crux Glosa



Abscissa

1. A **steering gear mechanism** which has only **turning pairs.** The name might have originated in sivakasi.**(9)**
2. **Sounds** like your **relatives** who are all **heated up.** (4)
3. **a folder** to keep important documents ,or, should I say, something to **finish some unfinished work**.(4)
4. The **heart** of the ocean (**hydraulics**). A mechanism to convert mechanical energy to fluid energy.(4)
5. The **feather** weight champion for **weight lifting**. Always accompanied by a **bar**.(4)
6. You wish you were like him because you **admire** this
person.(4)(right to left)
7. **Sounds** like a **saint**'s name. used along with a ratchet.(4)
8. Used to **pick up** hot workpieces, **sounds** like a part of your body.(4)
9. Passage for fluid flow .(4)
10. This one is in your **turf**. Technically its a superficial extent
of a figure (4)
11. It seems the discoverer of **this radiation** was too puzzled to find a good name. So he named it……….. ? (4)
12. An **offer** by a **detergent brand.** Technically, it is used as one way clutch.(9)

Ordinate

13. The **father of machines** whose name suggests it always had fancy apparel on its head.(7)

13. It is sharp **piece of metal** with a strong head. This word is a verb and a noun.(4)
14. A **mechanical operation** which might remind you of beckham.(7)
15. Royal feast will be served in **this**.(7)
16. This **unit** for the product of pressure and area sounds like going out for dinner. (4)
17. They always work as a **couple**. If they were alive they would have incurred the most expensive **dental bills**.(4)

18. Type of **joint** used to join two workpieces. Reminds you of your **mom**(3,4)

By

Mohamed Abbas A

Rakesh R

Sathrack J

Final year

Dare to ride, dare to be Automobile Engineer

Karpaga Vinayaga College of Engieering and Technology
Department of Automobile Engineering
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