International Journal of Advance Research in Science and Engineering
Vol. No.5, Special Issue No. (02), March 2016
www.ijarse.com
IJARSE
ISSN 2319 - 8354

STUDY OF CRUISE CONTROL SYSTEM USED VEHICLE

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ABSTRACT

In order to increase the speed of a vehicle, we have to push the accelerator. For maintaining constant speed of the vehicle the pressure on the pedal has to be maintaining constant. But cruise control system maintains the speed of a vehicle at level set by the driver, without using accelerator and without interference of driver.Cruise Control is more common in American manufactured cars than European cars as the roads are straighter and longer. There is less need to break in America on the long journeys causing a cruise control system in a car to become more effective. In India also thus types of highways are developed or developing, on that highways cruise control may play a vital role. Adaptive cruise control which uses radar to follow the car in front while maintaining a safe distance from the car.

I. INTRODUCTION

The function of a cruise control system is to accurately maintain the driver's desired set speed, without intervention from the driver, by driving the throttle-accelerator pedal linkage. A modern automotive cruise control is a control loop that takes over control on the throttle, which is normally controlled by the driver with the gas pedal, and holds the vehicle speed at a set value.

Cruise Control is more common in American manufactured cars than European cars as the roads are straighter and longer. There is less need to break in America on the long journeys causing a cruise control system in a car to become more effective. But luxury European cars like BMW, Mercedes-Benz and Audi are developing adaptive cruise control which uses radar to follow the car in front while maintaining a safe distance from the car. Safety precautions are necessary to ensure the system fully works. Features like a manual override for the driver by accelerating or breaking to avoid immediate danger need to be available.

This project focuses on the manual setting of cruise control not the adaptive CC; this cruise control is a very good example of a feedback control system.

II. HISTORY

Speed control with a centrifugal governor was used in automobiles as early as the 1910s, notably by Peerless. Peerless advertised that their system would "maintain speed whether up hill or down". The technology was invented by James Watt and Matthew Boulton in 1788 to control steam engines. The governor adjusts the throttle position as the speed of the engine changes with different loads.

Modern cruise control (also known as a speedostat) was invented in 1945 by the inventor and mechanical engineer Ralph Teetor. His idea was born out of the frustration of riding in a car driven by his lawyer, who kept speeding up and slowing down as he talked. The first car with Teetor's system was the 1958 Imperial (called

"Auto-pilot")[1]. This system calculated ground speed based on driveshaft rotations and used a solenoid to vary throttle position as needed.A 1955 U.S. Patent for a "Constant Speed Regulator" was filed in 1950 by M-Sgt Frank J. Riley .He installed his invention, which he conceived while driving on the Pennsylvania Turnpike, on his own car in 1948.[3] Despite this patent, the inventor, Riley, and the subsequent patent holders were not able to collect royalties for any of the inventions using cruise control.

Fig.2.1 Centrifugal governor

III. PRINCIPLES OF OPERATION

The block diagram shows the main elements of a typical cruise control system (vehicle speed control system).With use of manual throttle, the cruise control uses a stand alone speed control amplifier and a servo that operates on the main throttle. By using an electronic throttle, the cruise control electronics reduces to the input switches and logic, the electronic control function becomes part of the Engine Control ECU software and operates on the main throttle. From a operational point of view, the cruise control system remains the same with either a manual or electronic throttle.

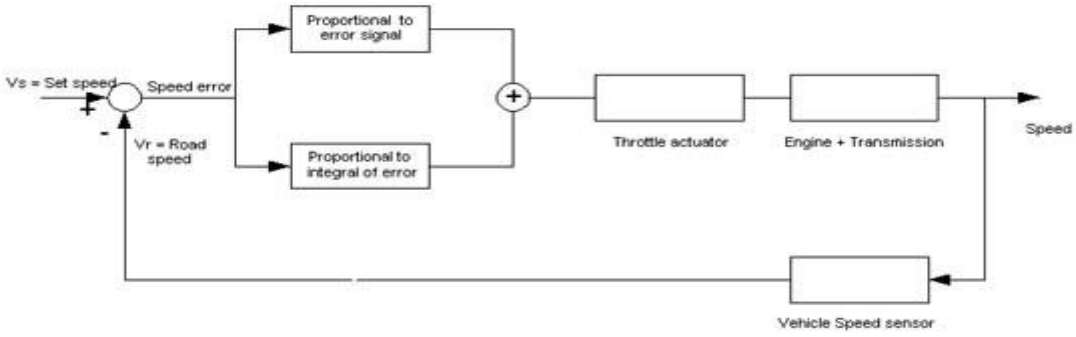

Fig. 3.1 Block diagram of Principles of operation cruise control system

A signal proportional to road speed is fed back and compared with a set speed reference to give a speed error signal that is used to control throttle position, & hence engine power, so as to change the speed to reduce the speed error signal to zero. In some analogue systems, the speed reference voltage is held in a sample and hold

amplifier that uses a low loss capacitor. In other systems, the speed reference voltage is stored as a binary no. in a digital counter.

The cruise control takes its speed signal by rotating driveshaft, speedometer cable, wheel speed sensor from the engine's RPM, from internal speed pulses produced electronically by the vehicle. Most systems do not allow the use of the cruise control below to the minimum speed - typically around 25 mph (40 km/h). The vehicle will maintain the desired speed by pulling the throttle cable with a solenoid, a vacuum driven servomechanism, or by applying the electronic systems built into the vehicle (fully electronic) if it uses a 'drive-by-wire' system.

All cruise control systems must be capable of being turned off both explicitly and automatically when the driver press the brake, and often also the clutch. Cruise control often includes a memory feature to resume the set speed after braking, & a coast feature to reduce the set speed without braking. When the cruise control is engaged, the throttle can still be used to accelerate the car, if the pedal is released the car will then slow down until it reaches the previously set speed.

On the latest vehicles fitted with electronic throttle control, cruise control can be easily integrated into the vehicle's engine management system. Modern "adaptive" systems include the ability to automatically reduce speed when the distance to a car in front, or the speed limit, decreases. This is an advantage for those driving in unfamiliar areas.

The cruise control systems of some vehicles incorporate a "speed limiter" function, which will not allow the vehicle to accelerate beyond a pr-set maximum; this can usually be overridden by fully depressing the accelerator pedal. (Most systems will prevent the vehicle accelerating beyond the chosen speed, but will not apply the brakes in the event of over speeding downhill.)

On vehicles with a manual transmission, cruise control is less flexible because the act of depressing the clutch pedal and shifting gears usually disengages the cruise control. The "resume" feature has to be used each time after selecting the new gear and releasing the clutch. Therefore, cruise control is of most benefit at motorway/highway speeds when top gear is used virtually all the time.

IV. SYSTEM COMPONENTS

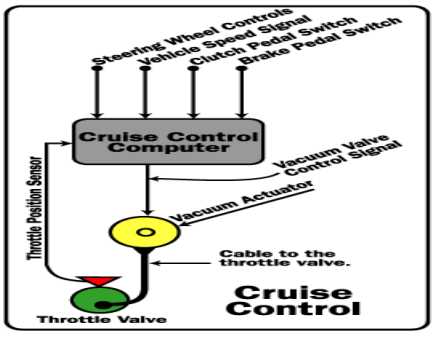

Fig.4.1 System Components

4.1 vehicle's Speed Sensor: The Vehicle Speed Sensor (VSS) is mounted to the transmission and provides a low voltage Alternating Current (AC) signal to the Cruise Control Module (CCM). The CCM converts the AC

signal to a pulse width modulated Direct Current (DC) signal, which is sent to the cruise control module at a rate of 4000 pulses per mile.

4.2 cruise Control Module: The cruise control module has to do three things. First it remembers the speed you set. It stores this set speed until you change it or turn off the ignition. Next it takes the speed signal from the vehicle speed sensor and compares it to the set speed. Lastly it sends pulse signals to the actuator. The actuator will move the throttle linkage to bring the vehicle up to the set speed and then modulate vacuum to maintain that speed.

4.3actuator: The actuator is what actually moves the throttle linkage. It is most often vacuum operated although some actuators are electrically controlled with small, stepper type motors. The actuator moves the linkage as directed by the cruise control module until the set speed has been achieved. It then maintains this speed by controlling the amount of vacuum. It actually modulates the vacuum as the pulses from the control module direct.

4.4 Brake Switch: The cruise control release switch and stop lamp switch are used to disengage the cruise control system. A cruise control release switch and a stop lamp switch, mounted on the brake pedal bracket disengage the system electrically when the brake pedal is pressed. This is accomplished by interrupting the flow of current to the cruise control module. The cruise speed of the vehicle at brake actuation will be stored in the cruise control module memory.

4.5 Clutch Switch: In addition to the brake switch, a vehicle with a manual transmission has a switch very similar to the brake switch and disengages the cruise control system when the clutch pedal is depressed.

4.6 Throttle Linkage: The actual mechanical connection between the cruise control actuator and the engine throttle.

V.THEORY OF OPERATION

Cruise control is a system that automatically controls the speed of an automobile. The driver sets the speed and the system takes over the throttle of the car to maintain the speed. The system thereby improves driver comfort in steady traffic conditions. In congested traffic conditions, where speeds vary widely, these systems are no longer effective. Most cruise control systems do not allow the use of cruise control below a certain speed. In modern designs, the cruise control may need to be turned on before use Sin some designs it is always "on" but not always enabled (not very common), others have a separate "on/off" switch, while still others just have an "on" switch that must be pressed after the vehicle has been started. Most designs have buttons for "set", "resume", "accelerate", and "coast" functions. Some also have a "cancel" button. Alternatively, depressing the brake or clutchpedal will disable the system so the driver can change the speed without resistance from the system. The system is operated with controls easily within the driver's reach, usually with two or more buttons on the steering wheel spokes or on the edge of the hub like those on Honda vehicles, on the turn signal stalk like in many older General Motors vehicles or on a dedicated stalk like those found in, particularly, Toyota aLexus. Earlier designs used a dial to set speed choice.

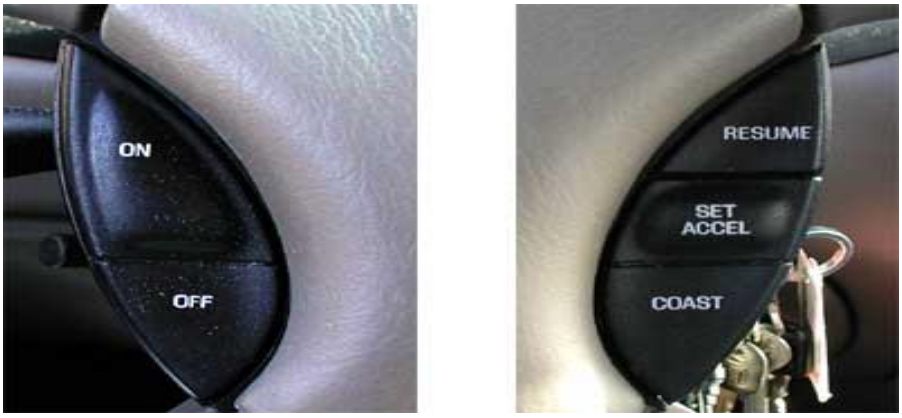

Fig.5.1Cruise control operating system.

The driver must bring the vehicle up to speed manually and use a button to set the cruise control to the current speed. The cruise control takes its speed signal from a rotating driveshaft, speedometer cable, wheel speed sensor from the engine's RPM, or from internal speed pulses produced electronically by the vehicle. Most systems do not allow the use of the cruise control below a certain speed (normally around 25 mph). The vehicle will maintain the desired speed by pulling the throttle cable with a solenoid, a vacuum driven servomechanism, or by using the electronic systems built into the vehicle (fully electronic) if it uses a 'drive-by-wire' system.

All cruise control systems must be capable of being turned off both explicitly and automatically when the driver depresses the brake, and often also the clutch. Cruise control often includes a memory feature to resume the set speed after braking, and a coast feature to reduce the set speed without braking. When the cruise control is engaged, the throttle can still be used to accelerate the car, but once the pedal is released the car will then slow down until it reaches the previously set speed.

6.ADAPTIVE CRUISE CONTROL

Adaptive cruise control uses forward-looking radar, installed behind the grill of a vehicle, to detect the speed and distance of the vehicle ahead of it. Adaptive cruise control is similar to conventional cruise control in that it maintains the vehicle's pre-set speed. However, unlike conventional cruise control, this new system can automatically adjust speed in order to maintain a safe distance between vehicles in the same lane in front of it. If the lead vehicle slows down, or if another object is detected, the system sends a signal to the engine or braking system to decelerate. Then, when the road is clear, the system will re-accelerate the vehicle back to the set speed.

There is a new type of cruise coming onto the market called adaptive cruise control. Two companies, TRW and Delphi Automotive Systems are developing a more advanced cruise control that can automatically adjust a car's speed to maintain a safe following distance. This new technology uses forward-looking radar, installed behind the grill of a vehicle, to detect the speed and distance of the vehicle ahead of it.

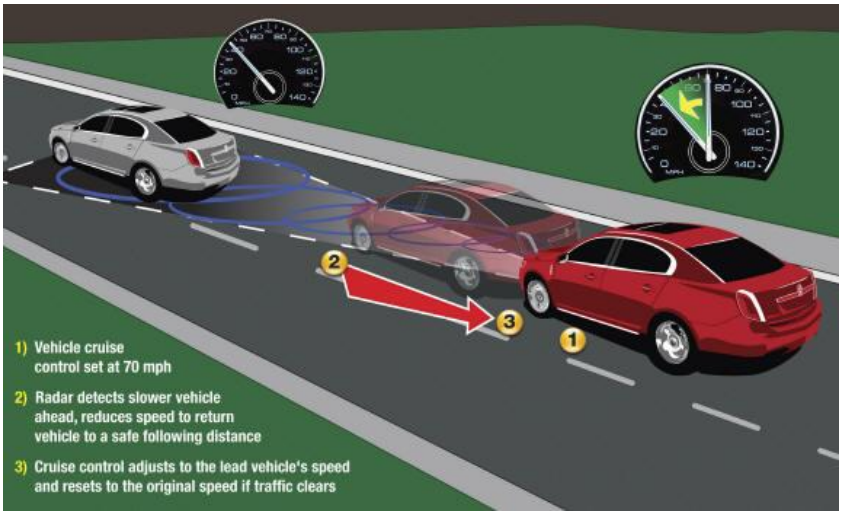

Fig.6.1 Adaptive Cruise Control

Mercedes-Benz became the first car manufacturer to install TRW's adaptive cruise control, called Auto-cruise, adding the device to its European S-Class Saloons. BMW followed Mercedes-Benz later by adding the system to some of its European models. Delphi Automotive Systems has developed a similar adaptive cruise control system, already available on the 2000 Jaguar XKR in Europe. Adaptive cruise control is similar to conventional cruise control in that it maintains the vehicle's pre-set speed. However, unlike conventional cruise control, this new system can automatically adjust speed in order to maintain a proper distance between vehicles in the same lane. This is achieved through a radar headway sensor, digital signal processor and longitudinal controller. If the lead vehicle slows down, or if another object is detected, the system sends a signal to the engine or braking system to decelerate. Then, when the road is clear, the system will re-accelerate the vehicle back to the set speed.

VII. ADVANTAGES

1.Its usefulness for long drives, reducing driver fatigue, improving comfort by allowing positioning changes more safely across highways and sparsely populated roads.

2.It results in better fuel efficiency, because of vehicle running at constant.

3.Low pollution as less fuel is burnt in engine.

4.Some drivers use it to avoid unconsciously violating speed limits. A driver who otherwise tends to unconsciously increase speed over the course of a highway journey may avoid a speeding ticket. Such drivers should note, that a cruise control may go over its setting on a downhill which is steep enough to accelerate with an idling engine.

5.Due to introduction of adaptive cruise control system the number accidents are reduce.

Driving over "rolling" terrain, with gentle up and down portions, can usually be done more economically (using less fuel) by a skilled driver viewing the approaching terrain, by maintaining a relatively constant throttle position & allowing the vehicle to accelerate on the downgrades & decelerate on upgrades, while reducing power when cresting a rise and adding a bit before an upgrade is reached. Cruise control will tend to over

throttle on the upgrades and retard on the downgrades, loss the energy storage capabilities available from the inertia of the vehicle. The inefficiencies from cruise control can be even greater relative to skilled driving in hybrid vehicles.

VIII. DISADVANTAGES

1. When used during inclement weather or while driving on wet or ice-covered roads, the vehicle could go into a skid (although this may be somewhat mitigated by cars equipped with Electronic Stability Control).
2. Stepping on the brake. Such as to disengage the cruise control could result in the driver losing control of the vehicle.
3. Many countries-establish that it is illegal to drive within city limits with the cruise control feature The inefficiencies from cruise control can be even greater relative to skilled driving in hybrid vehicles.
4. The driver might take relaxation as negative and less involved in driving as they are not concentrating on accelerating and braking. This will increase the danger of drivers falling asleep and more accidents.
5. There will be problem in sharp bends as shown in figure 6.

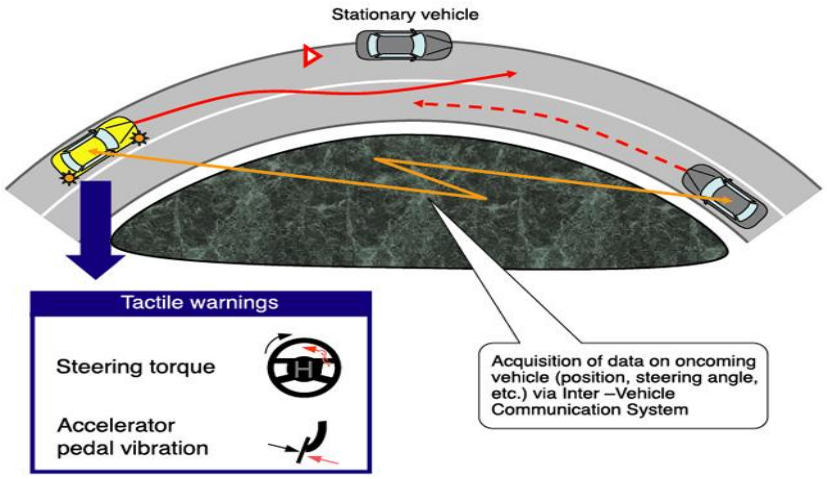

Fig.8.1Sharp bends.

IX. EFFECTS OF CRUISE CONTROL

Social : With the introduction of cruise control the driving experience has become more relaxed especially for long motorway drives where cruise control is most effective. This is a positive factor as it means that drivers will become less stressed and so can concentrate on other aspects of driving i.e. special awareness of other cars around. So this will reduce car accidents. Also there will be less cases of sore feet from pressing the throttle for long periods of time.

But, drivers might take this relaxation as a negative and become less involved with their driving as they are not concentrating on accelerating and braking. This will increase the danger of drivers falling asleep and more accidents.

When adaptive cruise control is introduces it will ensure that there is always a safe following distance between you and the car in front. This is positive as it will take into account reaction times when bad visibility and braking distance.

Economic: Jobs are being created for the research and development of adaptive cruise control but nothing has changed within the instalment of the electronics as it is all automated with robots. So no jobs have been lost due to the introduction of cruise control. Car manufacturing is constantly changing from the old mechanical engineering model to new electronically filled cars. This means that more of the manufacturing of components is done overseas.

Environmental: As the car will be keeping at a more constant speed there will be lower fuel consumption from constantly revving and burning fuel. So it will cost the driver less. Therefore the impact on the environment will positive as less fuel will be needed and used up, so less pollution given off. The electronics of cruise control is made up of lots of circuit boards and components so will no doubt have a small negative effect on the environment from the raw materials used up.

X.NEED IN INDIA

- In INDIA because of developments in a construction, many new highways are developed or developing, on that highways cruise control plays very important role.
- As adaptive cruise controls maintain a safe distance between vehicles in front of car, therefore there is a less chances of accident.
- As the car will be keeping at a more constant speed there will be lower fuel consumption from constantly revving and burning fuel, so it will cost the driver less.
- The impact of cruise control on the environment will positive as less fuel will be needed and used up, so less pollution given off.

XI. CONCLUSION

This report on cruise control is about the system and the main ideas about how it works. Cruise control is fitted to many American cars and the luxury European cars which makes the long motorway journeys more relaxable for the driver. In some Indian cars cruise control is also developed. The electronics of cruise control is linked up to the cars main computer during the main assembly line.Cruise control is an example of a control system with Inputs, Outputs, Feedback Loops and software processing. The inputs and transducers are quite simple.

Cruise Control is an example of the many new and innovative mechatronics ideas which are being introduced for cars to increase the safety and relaxation of the driving experience. Cruise control has a positive impact on driving with a benefit to the environment.

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