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Review Paper on Anti-Lock Braking System

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ABSTRACT
Thispaperelaboratesthe review of Anti-lockAutomaticBrakingSystememploying theelectronicsensors.Ifthevehicle speedisaboveaset ofvelocity rangeforapredefinedsafetylimit,thenthecontrollerbasedsystemperformsseveral functionstolettthevehiclein a safe range of speedthat reducestheiterationofaccidents.[1]AnAutomaticBrakingSystem(ABS)combinesAdvancedDriverAssistsystemsandElectronicStabilityControltoslowdownthevehicleandpotentiallymitigatetheseverityofanimpactwhenacollisionisinevitable.Thebenefits ofAEBSonconventionalbrakingsystemareexplained alongwiththeupcomingdevelopmentswhichmaybepossibleinthisfield.[2]

Keywords: Antilock Braking System, Antilock Brakes, Vehicle Stability Control, Electronic Control Unit(ECU), Safety.

I. INTRODUCTION

AnAntilockBrakingSystem(ABS)isasafety skidfreebrakingmechanismimpliedonvehicles,suchascars,motorcycles,trucksandbuses.ABSoperatesbyeliminatingthewheelsfromlockingupduring braking ,therebymaintainingtraction contact forcewiththesurface of roads.[3]ABSisanautomated brakingsystemthatimpliedtheprinciplesofthresholdandcadencebreaking,techniqueswhichwereearlierperformed totally byskilleddriverssince theABSprocess of braking came into the market globally.[1] ABSperformsatamuchfasterrateandmoreefficientlythanmostdrivers managing it mechanically.AlthoughABSprovides the improved and efficient way tocontrol vehicle stabilityandfurther reduces thestoppingdistancesondryas well as some slipperysurfaces,onsnowy covered and loosely mud gravel land surfaces. ABS directly increases the distance to apply brakes,whilestillimproving andenhancing the control onsteeringto handle it.[2]Sincethis type of braking systemwasimpliedinproductionvehicles, the systemswhich hadbecomeeffective and also increase the demand of ABS in modern vehicles. Enhanced techniqueshelpsnotonly topreventwheel fromlocking upunderbraking,butalsoto alter thefront-to-rearbrakingbiased. Latterthese functions depends onitsspecificcapabilitiesandimplementation,which isknownvariouslyaselectronic brakeforcedistribution,tractioncontrolsystem,emergencybreak forces assist,orelectronicstabilitycontrol(ECS).[4]

II. SUBSYSTEMS OF ANTILOCK BRAKE SYSTEM

SPEED SENSORS

A speed sensor is used to determine the range of acceleration or deacceleration of the wheel in vehicles. These sensors use aHall Effect and electromagnet sensors, or a geared wheel and an electromagnetic coil to generate adifferent ranges of signal. Each of the ABS wheel speed sensors calculates the speed of corresponding wheel with the help of electronic control module.Thycontains a permanent magnet, electromagnetic coil and a worm gear wheel.[5] The magnet produces the magnetic flux around the surface of permanent magnet which further changes the each tooth of the geared wheel (that rotates simultaneously with the vehicle's wheel)passes in front of the magnet's pole piece. Voltages are induced whenever there is a change in magnetic flux at a frequency corresponding to the range of speed of each wheel.[4]

Fig.1, Speed Sensor

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Electronic Control Unit (ECU)

The working of ECU is to amplify, receive and transmitthe signalsfrom sensors to calculate the accelerated speedor deacceleration of the vehicle. It checks the speed of two crossed opposite sided wheels to calculate the estimated speed of overall vehicle.[1] Each wheel slipping capacity is determined by comparing the reference speed with each wheel of vehicle. During the slipping of wheel or wheel acceleration condition signal server to alert the ECU and than it sends signal to sensors located at individual wheel to modulate the brake pressure in respective brake cylinders.

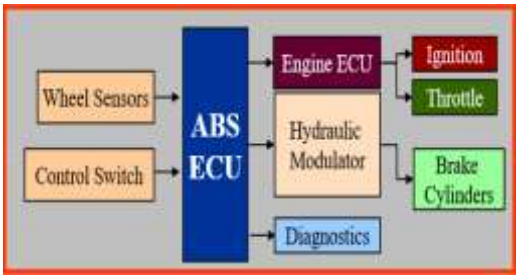

Fig.2, Electronic Control Unit

The ECU performs to the defects or problems by shutting down the entire ABS or by closing and blocking the malfunctioning part of the braking system with the helps of ECU controlled valves.[2]

Valves

The valves were located in the brake line of each brake cylinder that is controlled electronically through ABS under the functioning of ECU. On various systems, there are three positions of valves:

1. The valves are opened in the 1'st position and the brake pedal implies pressure from the master cylinder to the slave cylinder located on each wheel to pass accurate braking force to wheels.
2. The valves blocks the line of the flow of hydraulic pressure in the 2'nd position and the master cylinder helps in isolating the brakes hydraulically.Further which helps to prevents the pressure from rising to high so the driver should hardly push the brake pedal.[2]
3. In 3'rd position the valves allows or enables to free some amount of the pressure from the brakes.

Fig. 3, Valves

The problems which occurs in majority with the valve system are due to the blocking of the valves.They cannot change their position,open or close whenever the valve are clogged.The valve functioning improperly will directly prevent the system from modulating the valves and the pressure is not controlled which is supplied to the brakes. [3]

HYDRAULIC PRESSURE MODULATOR

The pump regulator or modulator is an electric device works hydraulically which reduces, restores and holds and maintains pressure of individual wheel by regulating the magnetic solenoid valve in the hydraulic braking system which contains valves, solenoid, piston and its casing in order to manipulate the pressure in the brake cylinders.The pump helps in restoring the pressure to the hydraulic brakes once the valves have been released.[3]

Fig. 4, Pump Regulator

The controller transmits signal to the pressure regulator which helps in releasing the valve directly whenever the slipping of wheel is detected. After the pressure released by the valves supplied from the driver than a desired amount of hydraulic pressure is restored to the braking system. The controller will regulate the status of pump in order to transmit the desired amount of fluidic pressure and also to reduce skidding effect of wheels.[6]

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ANTI-LOCK BRAKE TYPE

Different schemes of ABS uses depends on the channel valves, number of speed sensors and specially the types of brakes used in the system which are classified as:

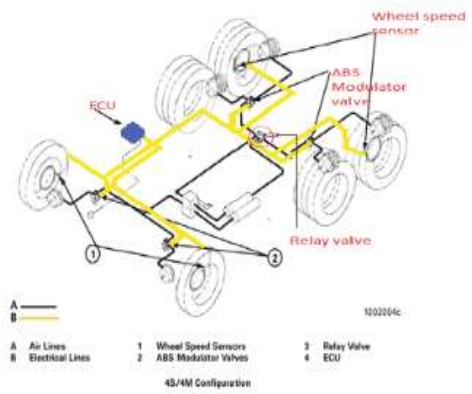

Fig. 5, Anti-lock Brake Type

Single channel with Single ABS Sensor

These type of arrangement is used in heavy load carrying trucks with ABS placed in the rear wheels which consists of one valve that operates both the rear speed sensor and the wheel placed in the rear axle. This is accurately same as back end in the terminology of three directional channel system.[3] It uses a fitting in T-shape to both the rear wheels.The wheels at rear end are monitored simultaneously and the starting of ABS action performed in advance to lockup the wheels.[4]

Three channel with Three ABS Sensor

These type of arrangement is mainly used in pickup trucks in which all the four wheels acts in accordance of ABS,front wheels contains their individual wheel speed sensor and valves and a single wheel-speed sensor with a single valve for both of the wheels at the rear end. The rear axle of the vehicle contains a wheel speed sensor for both the wheels of rear end.[5]

The system provides the individual control to wheels at front end in order to have maximumand at most value of braking force whereas the wheels at the rear end are controlled together. Rear wheels have to start to lock up in advance when the ABSis activated on the rear wheels of vehicle. Because of these types of mechanism it's possible that if the rear wheels will lock during a stopping of vehicle which directly reduces the effectiveness of brakes in the vehicle.[6]

Four Channel with Four ABS Sensor

These type of arrangement is more preferred in which all the four wheels contain their respective speed sensors along with their separate valves to increase the efficiency of braking in vehicles.[2] With these system of setup, the microcontroller and the controlling unit monitorsthese each wheel individually for achieving the maximum efficiency of braking force in the vehicle.[2]

FUNCTIONS OF DIFFERENT SENSORS USED IN ANTI-LOCK BRAKING SYSTEM	
1. ABS controller unit and hydraulic controlled module	• It defines the positioning of the wheels and the speed of the vehicle along with its body stability for providing calculations to control the hydraulic regulating unit. • Once the ABS became active, the main cylinder applies pressure on fluid to the wheel cylinders. • It controls brake fluidic pressure from master cylinder located below the brake pedal to the sleeve cylinders mounted on the respective wheels.. • It functions as a power switch for the hydraulic supply from the pump motor.
2. ABS disk acceleration sensors	• The sensors detects the accelerationof individual wheels in order to change the density of electromagnetic flux which is passing through sensors and converting it into the electrified signal.
3. G Sensor	• Detects a change of quickness in the marginal

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	direction of vehicle.
4. Stopping Light Signal	• Detects and supplies data for interpreting that the brake pedal is pressed or in rest position with the help of lights.
5. ABS Warning Light	• This sensor shows a fault in ABS to the driver at dashboard display.
6. Brake Warning Light	• It provides alert to interpret the level of brake fluid warning.
7. Automatic Transmission control module	• It displays the gear transmission terminologies.

[1]

Table 1, Functions of Different Sensors used in Anti lock Braking System

PRINCIPLE OF ANTILOCK BREAKING SYSTEM

ABS is an automatically responding system that implies the preception of cadenced and threshold forced brakingtechniques which were earlier practiced by skilled drivers since ABS techniques of braking systemis widely spread up in the market globally. ABS performs at a much quick rate and more efficiently than most drivers managing it mechanically.[7]

These cadenced type of braking is a technique in which a driver itself controls the brakes manually on its own as firstly the brakes are applied and then afterwards released in order to prevent the disks from locking and then again applying the brakes and releases it again to prevent locking of disk.[3] The pulses are used in the process of applying and releasing the brakes on the disk to let them free from locking up and make the vehicle free from slipping.[4] This technique was practiced by the drivers in order to achieve better handling over the vehicle at the interval of rapidbraking and stoppingthe vehicle from slipping. The ABS technique or mechanismof braking automatically follows the properties of cadenced braking to making it free from locking up of disks and vehicle free from slipping whenever brake accelerators are applied.[6]

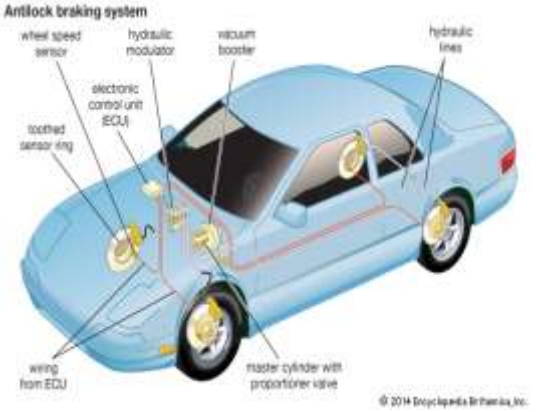

Fig. 6, Working of Anti-lock Braking System

Working of Anti-lock Braking System (ABS)

1. The speed sensors located on each wheels transmit signals from the disks which was further interpreted by the brain of an automobile which is ECU .
2. When the driver apparently presses the brake pedal which makes the disks to deaccelerate at rapid rate and helps in the Locking of the wheel disks.[5]
3. ECU interprets the signal which shows the instant decrease in the velocity of the wheel and then the signal were transmitted to the valves which helps inclosing of valve and the fluidic pressure is reduced to the brake pad and let the wheel to free from locking.
4. Again wheel starts accelerating and the signals are transmitted to the ECU but at this instant the valve are open that directly enhancing the fluidic pressure on brake pads and brakes are applied which again decreases the quickness of the wheel disks and tries to stop the vehicle.[3]

5. This mechanism of applying brakes and releasing it again and again helds 15 times in a single second when the brake are forced hard suddenly by the driver manually. Due to which the locking up of disks is overcome and the vehicle slipping is eliminated. With the help of ABS system, the driver can easily handle the vehicle steering system and further eliminates the chances of an accidents.[2]

REFERENCES;

[1]. REVIEW PAPER ON ANTI-LOCK AND AUTOMATIC BRAKING SYSTEMS R.Sangeethkumar, R. Siva Shankar, Mohamed Marzook, Manova Peniel, Marshal Raj, Karunakaran.

[2]. David W Gilbert (2001), "Magneto ResistiveAndHall Effect Wheel Speed Sensors", "New "Active" Wheel Speed Sensors Changing ABS Diagnostic Procedures", http:// www.asashop.org/autoinc/aug2001/ mech.cfm

[3]. Y Onit, E Kayacan and O Kaynak (2009),ATextbook And Research On, "A Dynamic Method to Forecast Wheel Slip for ABS & its Experimental Evaluation", IEEE Trans. Systems, Man & Cybernetics, Part B: cybernetics, Vol. 39, pp. 551-560.

[4]. ALAN AHLSTRAND AND JOHN HAROLD HAYNES, A Textbook On Braking System, ''Anti-lock Brake Systems(ABS)."

[5]. RUDOLF LIMPERT, "A Textbook On Braking System, Brake Design And Safety" ,Antilock Braking Mechanism And Different Techniques.

[6]. SAVARESI,SERGIO MATTEO,TANELLI,MARA,, "A Textbook On", " Active Braking Control Systems Design For Vehicles"., "Hitting ABS mechanism and workings" 2007.

[7]. WIKIPEDIA, "https://en.nfwikipedia.org/wiki./Advanced ABSemergency_braking_system.