Electronic Actuated Brakes for the Combination of Agricultural Tractor Trailer

Syed Mansur Noor
Prof.Ram Meghe Institute of Technology and Research
Sant Gadge baba Amravati University, Amravati

Prof. M. P. Nawathe
Prof.Ram Meghe Institute of Technology and Research
Sant Gadge baba Amravati University, Amravati

Prof. A. M. Wankhade
Jawaharlal darda institute of engineering and technology, Yavatmal

Abstract

The Automotive Research Association of India (ARAI) and The regional transport office (RTO), India took out a government regulation in late 2005 which state all the vehicles especially tractors capable of towing should have a service type of brake in there trolley. However all attempts to install brakes went futile and could not stand the test of time. The present electronic actuator for brakes is our endeavour towards providing a solution to this vexing problem. The electronic actuator for brakes operates scissor jack via high torque motor while its controlling is provided at the feet of driver. The vehicle and its trolley are connected merely by a cable wire, which provide an easy means for trolley engagement and disengagement. The invention by no means is a flash of genius, but hope it marks the beginning of an entirely new braking system.

Introduction:-

The Automotive Research Association of India (ARAI) recommended the following performance requirement for the combination of agricultural tractor and trailer for braking system are.

- The braking system shall be so designed and installed as to enable the vehicles in normal use to comply with the under mentioned requirements.
  In particular, the braking system shall be so designed and installed as to resist corrosion and the effects of aging during service, which could lead to a sudden loss of braking efficiency.
- The braking equipment of a vehicle shall be composed of the service braking system, the parking braking system, and when required for the power braking system. The service, parking and the automatic braking system may have common components.
- Wear on the brakes shall be compensated by means of a system of manual or automatic adjustment. In addition , the controls and the parts of the transmissions and of the brakes shall possess a reserve of travel and perhaps a suitable adjustment device such that, when the brakes become heated or the brake linings have sustained a certain degree of wear, braking is ensured without an immediate adjustment being necessary.

Up to this point, each one of our sub courses has covered all the things that were needed to make a vehicle go forward and backward. We now know that an operator has controls to make this equipment go fast or slow; to the right or left; through mud,

snow, sand; and on level roads. But what does the operator do if a child runs out in front of this moving vehicle, or when travelling on a road a point is reached where a bridge is washed out? The answer is that the operator must have one or more controls that will bring the vehicle to a stop rapidly and with a small amount of effort. The braking system provides these controls. Braking is the use of friction to slow a vehicle, bring it to a halt, or hold it in a standing position. A brake is a device that is secured to the vehicle axle housings, which do not rotate, and is used to slow down or hold the wheels, which do rotate. When the rotating parts are brought in contact with the non rotating parts, the friction caused by the rubbing creates the braking action. Different types of brake have be invented to slow down or to stop the vehicle.

But the use of electronic components in automobiles is set to accelerate and with ongoing efforts to improve safety and comfort. 250 electronic components are used in a car, for example, 50 MCUs are used in a car [2]. Therefore, car makers in Europe and Japan are developing for safety such as both collision safety and preventive safety and new car technology for intelligent car such as intelligent transport system (ITS), rear view camera system, Road-to-vehicle and Inter-vehicle Communication Systems, auto-parking system, hybrid car, electric car, and hydrogen fuel car [3]. So to give one more safety device to vehicle with the help of same circuit(by doing minor changes) a new concept of "Electronic actuator for brake" is introduce to you. Hydraulic or air brakes can used but the cost of implementation is very high and also does not have the compatibility, like in case of tractor trolley or any other towing vehicle. In this case it is highly difficult to install the compressor on the engine and in case of hydraulic braking system booster cannot be installed and the brake pipe cannot be engage and disengaged frequently as every time bleeding[4][7] has to be done.

Design prerequisites

The goal of the brake actuation system designer is to select the proper components to provide optimum brake performance for a given application. To do this the designer must start at the vehicle service brakes and "work backward" to the method of actuation. Specific design prerequisites for the vehicle brakes as well as the brake actuation system must be identified. The six key prerequisites that will be discussed are: (1) vehicle stopping parameters, (2) the resultant brake torque and kinetic energy required, (3) service brake capacity, (4) brake line pressure, (5) brake volume and (6) operator input effort [6].

Background of the invention

Speed of the vehicles is retarded with the help of brakes, for example, hydraulic brakes. Conventional brake system comprises generally a booster, a master cylinder, hydraulic pipe line, wheel cylinder and brake liners or brake shoes are used. In case of hydraulic brakes, muscular energy of driver is provided to operate the booster which in turn operates the master cylinder smoothly in order to apply brakes. Generally, vacuum is required to operate the booster and therefore vacuum generating means are needed to generate the vacuum. The vacuum generating means comprises either vacuum pump or engine inlet manifold. Therefore, conventional brake system requires many components and thus the cost of the brake system and also maintenance cost of the brake system is high.

There are other disadvantages associated with the conventional brake system. One of the disadvantages is that brake means are not provided with towing vehicles or trolleys which can be operated by the same paddle which is used to apply brakes to the tractor itself.

Another disadvantages associated with the conventional brake system is that brake system are not provided with towing vehicles or trolleys and therefore both the main vehicle and the towing vehicle do not stop simultaneously and therefore, some time, accident takes place.

Yet another disadvantage associated with the prior art is that in the conventional brake system a time lag is created and therefore it is difficult to synchronize the timing to apply brakes to the vehicles, for example, tractor and a trolley, simultaneously.

Still another disadvantage is that towing vehicles are quite often required to be attached and detached from the main drawing vehicle and therefore the brake pipe line has to be connected and disconnected and thus bleeding takes place and lot of energy is needed to bring the brake system to its normal position.

If you take the example of the air brake then compressor, air tank, etc thing has to attach to tractor. But all these things are so expensive that neither the tractor manufacturer nor the trolley manufacturer is ready to bear this cost.

Key feature of the invention

This actuator can be applied to any of the braking system that is in case of hydraulic braking system booster can be replaced and in case of air brake system whole system except the axle can be replaced with the electronic actuator. The application of actuator is discussed in detail.

Construction

In the given model of braking system (figure 1), wheel drum (12) is used which is fitted with its corresponding brake liners (11), wheel cylinder (10) and master cylinder (8). The piston of the master cylinder is coupled with a connecting rod, which is then further connected to scissor jack which in turn is operated with the help of motor(5). The power is directly supplied from the battery to the motor. The amount of supply is directly controlled by control unit (4). The control unit used in this mechanism is responsible for the duration of the supply given to the motor. The sensor(7) fitted with the connecting rod of the master cylinder gives a feedback signal to the control unit, which is processed by the control unit and hence decide the duration of supply. The sensor is calibrated with the potentiometer (1) which is fabricated with the brake paddle. If the sensor feedback is equal to that of paddle potentiometer then the control unit stops the motor whereas if the sensor is behind the potentiometer then control unit gives a positive supply; similarly if the sensor somehow exceeds the potentiometer then the control unit gives negative supply. The motor of the jack drives the lead screw which gives a displacement to the piston of the master cylinder. Hence the master cylinder supplies pressurized brake oil to the wheel cylinder and expands the brake liner and so the brakes are applied to the wheels.

Working

1. As the paddle is pressed by the driver, the potentiometer (1) which is connected to paddle send signal to control unit (4).
2. After getting signal to control unit(4), control unit process this signal and send to motor and motor start rotate in clock wise direction and this way the master cylinder is pressed.
3. Then the motor(5) start to rotate till the input signal by control unit and output signal sent by sensor gets balanced.
4. When the paddle is released the potentiometer again sends back the signal to control unit.
5. Then control unit again process the signal and send it to motor and then it rotate in anticlockwise direction and vice versa.
6. This way the brakes are applied.

Electronically actuated brakes

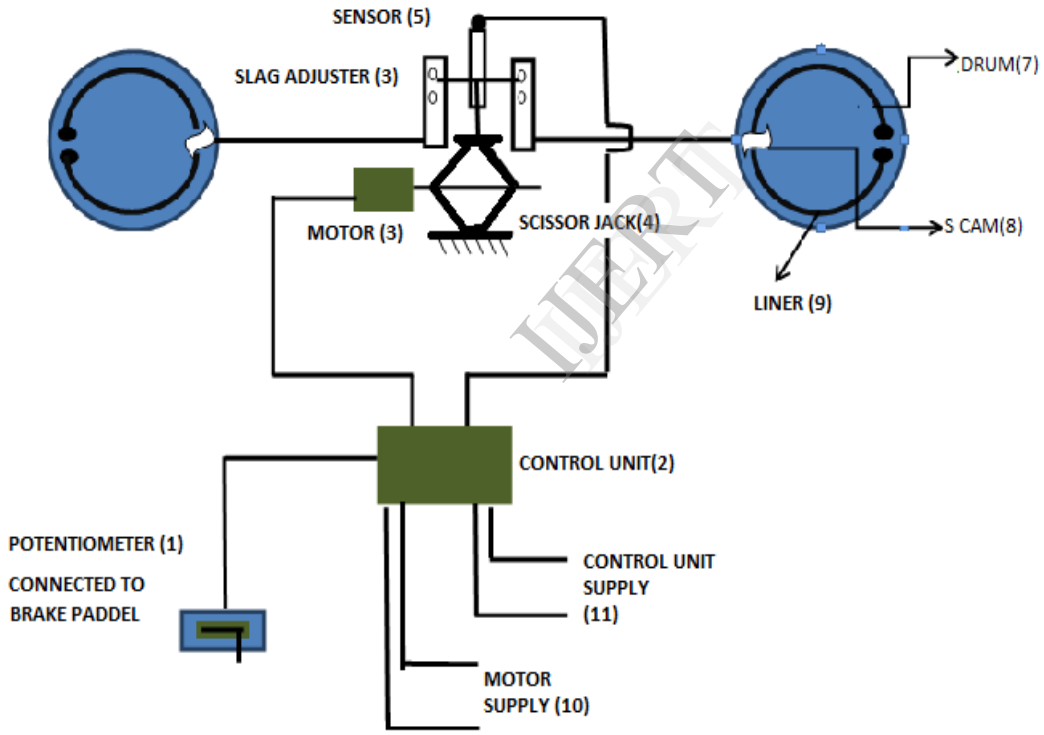

Figure 2

Working

1. As the paddle is pressed by the driver, the potentiometer which is connected to paddle send signal to control unit.

2. After getting signal to control unit, control unit process this signal and send to motor and motor start rotate in clock wise direction and this way the slag adjuster is pressed which rotate the S cam due to which linear are expanded and brakes are applied .
3. Then the motor start to rotate till the input signal by control unit and output signal sent by sensor gets balanced.
4. When the paddle is released the potentiometer again sends back the signal to control unit.
5. Then control unit again process the signal and send it to motor and then it rotate in anticlockwise direction and slag adjuster is released.
6. This way the brakes are applied.

Advantages of the invention over traditional braking system

In case of towing vehicle where the engine is connected to trolley with the help of knuckle joint and which needs to be frequently attached and detached, with the help of simple socket brakes can be attached or detached from the engine. And thus are more flexible at the joints. Potentiometer which operates this system can be coupled with the same brake paddle that operates the brakes of engine wheel and thus engine & trolley comes to halt simultaneously. Irrespective of engine model, brakes can be applied to one and all. If the master cylinder is operated electronically thus negligible muscular energy is required to apply the brakes. As the hydraulic system is completely installed on the trolley so brake pipe are never detached from master cylinder so bleeding is not required every time. No amendment has to be made in engine to install this braking system. Hence this system can be applied on any vehicle.

Conclusion

The invention conceived above has been materialised and operated under strenuous conditions which proves it practicality. It has the potential to get installed with ongoing and future models of vehicles.

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Biographies

SYED MANSUR NOOR received the B.E. degree in Mechanical Engineering from the Sant Gadge Baba Amaravati University of India, in 2009.Currently he is pursuing the masters degree in P.T&M from PRMIT&R, Bandera, Amravati. His subjects of interest are Automobile engg, Production tech, etc. Author may be reached at

M.P.NAWATHE is currently working as professor in mechanical engineering department at PRMIT&R Bandera, he has published several papers in many international journals and conferences. His area of interest are Production technology, manufacturing process, Author (Professor Author) may be reached at

ASHISH W.WANKHADE is currently working as professor in mechanical engineering department at JDIET Yavatmal he has published several papers in many international journals and conferences. His area of interest are CAD/CAM, Author (Professor Author) may be reached