FABRICATION OF DIFFERENTIAL LOCKING AUTOMATIC SYSTEM

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ABSTRACT

The proposed mechanism is to lock the differential. By locking the differential the differential is disengaged from the axle. Thus the power is directly transmitted to the axle and hence to the wheels. This will considerably reduce the power loss in some occasions when unwanted loss is happening due to the transmission if power from the shaft to the differential and then to the axle and hence to the wheels. So in mechanism the unwanted power loss in the due course of transmission through the differential is reduced.

There are some drawbacks in the existing mechanism and we overcome it in the proposed project. The first is while climbing in steep hills the differential is not really needed as the speed of the vehicle is low. And also there are some transmission loses in the differential. So at this time the unit is locked and the loss is overcome. Then when a heavy truck is struck in a pit or mud it is very difficult to recover the truck as the differential unit cuts the power which is to be transmitted to the wheel struck. So in this project the unit is disengaged and power is directly given to the axle by pneumatic means and so the recovery is made easier. This is even made use in the vehicle to be driven in the dense forests and even in dessert.

KEYWORDS: *Differential, transmission, pneumatic*

INTRODUCTION

A differential is a device which is used in vehicles over a few decades and when a vehicle is negotiating a turn, the outside wheel travels a greater distance and turns faster than the inside wheel. The differential is the device transmitting the power to each wheel, allows one wheel to turn faster than the other. It splits the engine torque two ways, allowing each output to spin at a different speed. The differential is found on all modern cars and trucks, and also in many all-wheel-drive (full-time four-wheel-drive) vehicles.

These all-wheel-drive vehicles need a differential between each set of drive wheels, and they need one between the front and the back wheels as well, because the front wheels travel a different distance through a turn than the rear wheels. Part-time four-wheel-drive systems don't have a differential between the front and rear wheels; instead, they are locked together so that the front and rear wheels have to turn at the same average speed. This is why these vehicles are hard to turn on concrete when the four-wheel-drive system is engaged.

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LITERATURE REVIEW

A locking differential, such as ones using differential gears in normal use but using air or electrically controlled mechanical system, which when locked allow no difference in speed between the two wheels on the axle. They employ a mechanism for allowing the axles to be locked relative to each other, causing both wheels to turn at the same speed regardless of which has more traction; this is equivalent to effectively bypassing the differential gears entirely. Other locking systems may not even use differential gears but instead drive one wheel or both depending on torque value and direction. Automatic mechanical lockers do allow for some differentiation under certain load conditions, while a selectable locker typically couples both axles with a solid mechanical connection like a spool when engaged

Kunihiko Suzuki [6] discussed a theory that a four wheel drive system of a vehicle has center differential between four wheels and rear wheels and a means for restraining or locking the center differential. The four wheel drive combined with control system for automatically locking the center differential when the difference between the average rotational speed of the right and left front wheels and average rotational speed of right and left rear wheels becomes equal to or larger than predetermined value. The present invention relates to an automotive vehicle having wheels operable about wheel shaft in which locking apparatus is provided so that the wheels on the both side of the vehicle will operate at essentially the same speed. Apparatus are provided to prevent slippage or spinning of the driven wheels. Typically, the vehicle has a locking type differential in which the locking action of the differential can be controlled based the existing vehicle operating condition.

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AUTOMATIC DIFFERNTIAL LOCKING SYSTEM

The review reported by Provatidis regarding the concept of gearless differential can be utilized to distribute the power to the wheels. The Anti-lock braking system is also introduced in newer vehicles to limit the slippage of low traction wheel. There are various devices like Positive Traction, Limited Slip Differential, Locking Differential and Active Differential which help to get more usable traction from vehicles with differentials.

The difference between torques of two axles is very high under slip condition and when differential is locked, the value of torque between two axles is approximately equal. In the case of losing traction due to mud, pit or slippery surface, the locking effect will provide it more speed to overcome the problem. Therefore a simple Automatic Locking Mechanism can be designed to get the desired torsion effect.

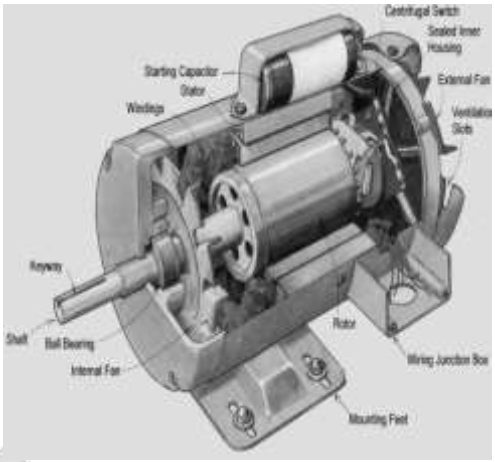
DESCRIPTION OF EQUIPMENTS

AC MOTOR

An AC motor (IM) is a type of alternating current motor where power is supplied to the rotating device by means of electromagnetic induction. It is also called asynchronous motor.

An electric motor converts electrical power to mechanical power in its rotor (rotating part). There are several ways to supply power to the rotor. In a DC motor this power is supplied to the armature directly from a DC source, while in an induction motor this power is induced in the rotating

FIG.ACMOTOR



Device. An induction motor is sometimes called a *rotating transformer* because the stator (stationary part) is essentially the primary side of the transformer and the rotor (rotating part) is the secondary side. Induction motors are widely used, especially polyphase induction motors, which are frequently used in industrial drives.

Induction motors are now the preferred choice for industrial motors due to their rugged construction, absence of brushes (which are required in most DC motors) and — thanks to modern power electronics — the ability to control the speed of the motor.

PULLEY

A pulley is a wheel with a groove along its edge, also called a sheave, for holding a rope or cable. Pulleys are usually used in sets designed to reduce the amount of force needed to lift a load. The same amount of work is necessary for the load to reach the same height as it would without the pulleys. The magnitude of the force is reduced, but it must act through a longer distance. The effort needed to pull a load up is roughly the weight of the load divided by the number of wheels. The more wheels there are, the less efficient a system is, because of more friction between the rope and the wheels.

The pulleys and lines are weightless, and that there is no energy loss due to friction. It is also assumed that the lines do not stretch. With this assumption, it follows that, in equilibrium, the total force on the pulley must be zero. This means that the force on the axle of the pulley is shared equally by the two lines looping through the pulley. The lines are not parallel, the tensions in each line are still equal, but now the vector sum of all forces is zero.

BELT

Belts are used to mechanically link two or more rotating items. They may be used as a source of motion, to transmit power at up to 98% efficiency between two points, or to track relative movement.

FIG CONVEYOR BELT

As a source of motion, a conveyor belt is one application where the belt is adapted to continually carry a load between two points. A belt may also be looped between two points so that the direction of rotation is reversed at the other point. Power transmission is achieved by specially designed belts and pulleys. The demands on a belt drive transmission system.

Belts normally transmit power only on the tension side of the loop. Designs for continuously variable transmissions exist that use belts that are a series of solid metal blocks, linked together as in a chain, transmitting power on the compression side of the loop.

WHEEL

A wheel is a circular component that is intended to rotate on an axle. The wheel is one of the main components of the wheel and axle which is one of the six simple machines. Wheels are also used for other purposes, such as a ship's wheel, steering wheel and flywheel.

Wheels, in conjunction with axles allow heavy objects to be moved easily facilitating movement or transportation while supporting a load, or performing labor in machines. Common examples are found in transport applications. A wheel greatly reduces Friction by facilitating motion by rolling together with the use of axles. In order for wheels to rotate, a moment needs to be applied to the wheel about its axis, either by way of gravity, or by application of another external force.

PNEUMATIC CYLINDER

Pneumatic cylinders impart a force by converting the potential energy of compressed gas into kinetic energy. This is achieved by the compressed gas being able to expand, without external energy input, which itself occurs due to the pressure gradient established by the compressed gas being at a greater pressure than the atmospheric pressure. This air expansion forces a piston to move in the desired direction.

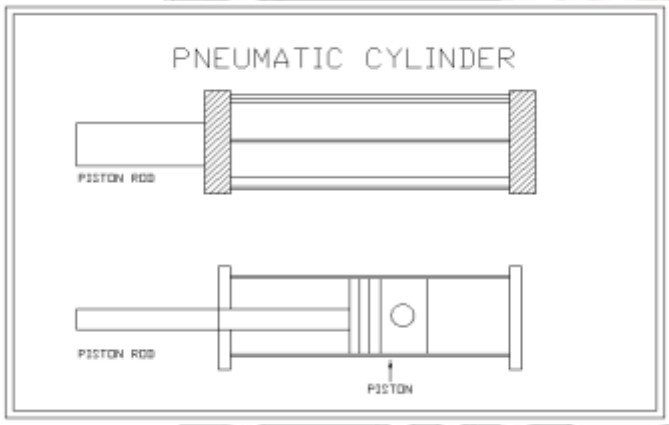


FIG PNEUMATIC CYLINDER

Pneumatic cylinders can be moved both inwards and outwards by compressed air. Cylinders of this type are called double-action

Cylinders.

Cylinders also exist which can only be moved pneumatically in one direction. The return movement is caused by a spring. Cylinders of this type are called "single-action cylinders".

DESIGN CALCULATIONS

PNEUMATIC CYLINDER Design of Piston rod: Load due to air Pressure.

$= 36 / 2 = 8\ N/m^2 = P / (\Pi\ d^2 / 4)\ \therefore\ d = \sqrt{}\ 4\ p / \Pi\ [\sigma Y]$

Material used =Cast iron Assuming internal diameter of the cylinder =35 mm Ultimate tensile stress = 250 N/m^2 Working Stress = Ultimate tensile stress / FOS Assuming factor of safety = 4 Working stress (ft.) = 2500 / 4

=625 N/m² According to _LAMES EQUATION 'Minimum thickness of cylinder (t) = ri {√ (ft. + p) / (ft. – p) - 1}

Where Inner diameter of cylinder in mm is working stress (N/m²) Working pressure in N/m²

Design of Piston rod: Load due to air Pressure.

Design Stress (σy) = σy / FOS

Diameter of the Piston (d) =35 mm

Piston pressure (p) = 6 N/m² C 45

Acting (P) Material used for rod Yield stress (σy) =36 N/m²

Assuming factor of safety = 2

Force acting on the rod (P) = Pressure x Area =

6 x {(Π x 3.5²) /4 = √ 4 x 57.73 / {Π x 18} = √ 4.02 = 2.0mm

∴ Minimum diameter of rod = required for the load we assume diameter of the rod=12

We assume thickness of cylinder = 2.5 mm Inner diameter of barrel = 35 mm Outer diameter of barrel = 35 + 2t = 35 + (2 x 2.5) = 40 mm Total length of the piston rod = 5+45+40+12+20 = by standardizing, length of the piston rod = 130mm

MERITS & DEMERITS

MERITS

- Less Manual force is required to locking the differential unit
- This pneumatic system is also working with the help of air tank
- Time consumption is less
- More efficient system and simple in construction

DE MERITS

- High Initial cost.
- It can cause loss of control on ice. Because they do not operate as smoothly as standard differential there is increased tire wear

PHOTOGRAPH

CONCLUSION

The setup for automatic engagement of the differential when the loss of traction condition is encountered by introducing automatic differential locking system.

Under slip conditions, when differential is under action the differences between two axles is very high as well as Torque and speed are inversely proportional to each other.

Under this project when differential is working and if one wheel loses its traction due to mud, pit, or slippery surfaces the locking effect will provide it with more speed to overcome the traction loose. This can be made use in the vehicle to be driven in the dense forests and even in dessert.

REFERENCES

1. "Design, Development and Testing of Automatic Differential Locking System" (Prof. A. S. Todkar) International Journal of Advanced Engineering Technology. Working mechanism is taken from this journal paper.

2. "Advances in Automobile Engineering: Brake Assisted Differential Locking System", Kanwar Bharat Singh, Proceedings of the World Congress on Engineering. Modifications of the existing prototype is formed from this book.

3. "Manufacturing of Simple Differential Locking System" by Karande Mahesh. Working mechanism of differential locking system is taken.

4. "A Study on Vehicle Differential system" by Chandrakant Singh, Lalit Kumar, Bhumesh Kumar dewangan, Prakash kumarsen.

5. "Design Data" P.S.G. College of Technology, Coimbatore.
Helped in design procedure.