IJREAT International Journal of Research in Engineering & Advanced Technology, Volume 2, Issue 1, Feb-Mar, 2014
ISSN: 2320 - 8791
www.ijreat.org

Advanced Development Of Semi-Automatic Traction Control System Using Differential Unit

S.Jesu Benner[1], M.Mugesh[2], R.Sunil[3]

[1,2,3] UNIVERSITY COLLEGE OF ENGINEERING ARNI, ARNI, TAMIL NADU, INDIA

ABSTRACT

When a working vehicle travels on a inclined ground or on an unlevelled ground, slipping causes a difference in revolution between right and left wheel impairing straight running of the vehicle.it is therefore conventional practice to equip a working vehicle such as a lawn mower or a garden tractor which needs to be run in a straight manner with a differential locking mechanism to forcibly stop the differential revolution of the wheels. If the differential lock remained on during all time then it may leave scratches on the ground. Hence an automatic differential locking system has to be designed to eliminate the above disadvantage. This system permits the differential to be locked only when the steering angle is below a predetermined value and release the lockup when the steering angle exceeds it.

In this report we will be developing an automatic differential locking system for a vehicle with having a 2 wheel drive.

Keywords: differential locking, slipping, steering angle, locking mechanism

1. 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.

This can be problematic when one wheel does not have enough traction, such as when it is in snow or mud. The wheel without traction will spin without providing traction and the opposite wheel will stay still so that the car does not move. This is the reason for a device known as a "limited slip differential" or "traction control".

The solution to the above problem is to have a differential locking system which can be engaged or disengaged either manually or automatically, as per the conditions or a sensor based system can be developed that will sense the difference in speed or stalling of one wheel to lock the differential so that both wheels will have same traction.

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

ISSN: 2320 - 8791
www.ijreat.org

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.[1][2]

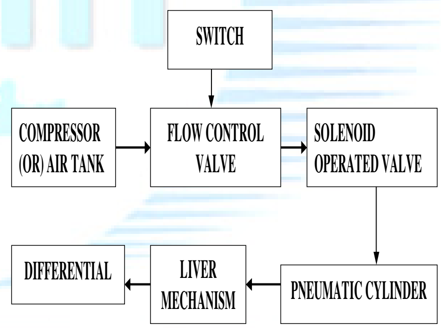
Kunihiko Suzuki [6] discussed a theory that a four wheel drive system of a vehicle has center differential between four wheels and rear wheels and a means for restraining or locking the center differential. The four wheel drive combined with control system for automatically locking the center differential 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.

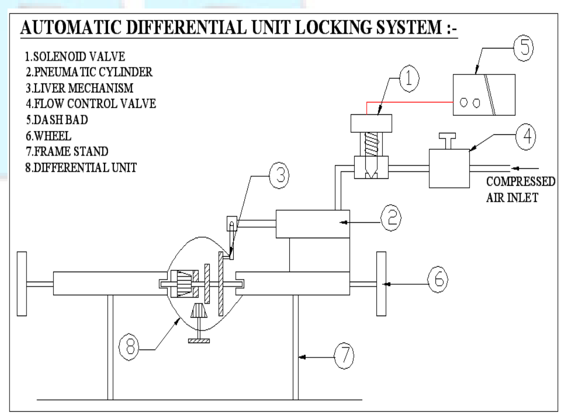
There are some drawbacks in the existing mechanism and we overcome it in the proposed project. The first is while climbing in steep hills the differential is not really needed as the speed of the vehicle is low. And also there are some transmission loses in the differential. So at this time the unit 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 and so the recovery is made easier.

2.WORKING PRINCIPLE

The main purpose of this project is to lock the differential or to disengage the differential at the time when it is needed to be. So to lock the differential we need to connect the two shafts on the either side so that the differential has no effect on the axle. Now to connect the two shafts we use two circular plates on the either sides of the differential. Both are in such a way that they get mated as soon as possible even in their rotation. So when the pneumatic valve is actuated then one of the plates is pushed to the other so that the plates get mated and hence the shafts are connected. So thus the differential is disengaged. To engage the differential again a spring is used to push the plates apart. Thus this is the working principle of this project.

3.BLOCK DIAGRAM





4. DESIGN AND DRAWINGS

4.1. PNEUMATIC CYLINDER

4.1.1. Design of Piston rod:

Load due to air Pressure.

Diameter of the Piston (d) = 35mm

Pressure acting (p) = 6kgf/cm²

Material used for rod = C45

Yield stress (σ_y) =36kgf/mm²

Assuming factor of safety =2

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

=px (πd²/4)

=6x {(πx3.5²)/4}

p =57.73Kgf

Design Stress (σ_y) = σ_y / F_0 S

= 36 / 2

=18Kgf/mm²

= P /(π d² / 4)

d=√4p/π [σ_y]

=√4 x57.73/{πx18}

=2.02mm

∴Minimum diameter

Of rod required for = 2.02 mm

The load

We assumed rod diameter

=12.5mm

4.1.2. Design of cylinder thickness:

Material used = Cast iron

Assuming internal = 35 mm

Diameter of the cylinder Ultimate tensile stress = 250 N/mm

=2500gf/mm²

ultimate tensile stress

/ Factor of safety =working stress

Assuming factor of safety

= 4

Working stress (ft.) = 2500 /4

= 625Kgf/cm²

According to 'LAMES EQUATION'

$(t)= r_i\{\sqrt{(f_t+ p) / (f_t - p)}-1\}$

Where,

Minimum thickness of cylinder (t)

r_i= inner radius of cylinder in cm.

f_t= Working stress (Kgf/cm²)

p=Working pressure in Kgf/cm²

∴ Substituting values we get,

$t=1.75 \{\sqrt{(625 + 6) / (625 - 6)} -1\}$

t=0.0168 cm

=0.17 mm

assume thickness of cylinder =2.5 mm

Inner diameter of barrel =35 mm

Outer diameter of barrel =35 + 2t

= 35+ 2x 2.5

=40 mm

4.2. DESIGN OF PISTON ROD:

4.2.1. DIAMETER OF PISTON ROD:

Force of piston Rod (P) = P x area

= p x $\pi/4xd^2$

= $6\pi/4x3.5^2$

=57.73Kgf

Also,force on piston rod (P) = $(\pi/4)(d_p)^2xf_t$

57.73= $(\pi/4)x(d_p)^2x$

625

$\therefore dp^2$ =57.73x($4/\pi$)x

(1/625)

=0.12

d_p=3.4 mm

By standardizing dp =12.5 mm

4.2.2. Length of piston rod:

Approach stroke =50 mm

Length of threads =2 x 20

=40mm

Extra length due to front cover

=12 mm

Extra length of accommodate head

= 20 mm

Total length of the piston rod

=50+40+12+20

=122 mm

By standardizing, length of the piston rod

=130mm

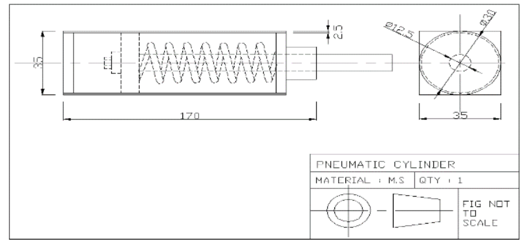


Fig.3.Pneumatic Cylinder

5. TECHNICAL DATA

5.1. Single acting pneumatic cylinder

Stroke length : Cylinder stoker length 100 mm

Quantity : 1

Seals : Nitride (Buna-N) Elastomers

End cones : Cast iron

Piston : EN – 8

Media : Air

Temperature : 0-80 ° C

Pressure Range : 8 N/m²

5.2. 3/2 solenoid valve:-

Technical Data:
Size : ¼"

Pressure : 0 to 8 kg / cm^2

Media : Air

Type : 3/2

Applied Voltage : 230V A.C

Frequency : 50 Hz

5.3. Flow control Valve

Port size : $0.635x10^{-2}$ m

Pressure : 0-8 x 10^5 N/m²

Media : Air

Quantity : 1

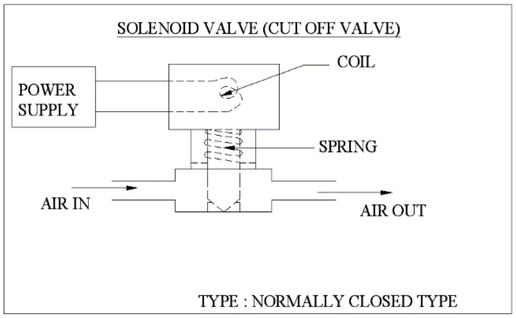


Fig.4.Solinoid valve

CONCLUSION

This project work has provided us an excellent opportunity and experience, to use our limited knowledge. We gained a lot of practical knowledge regarding, planning, purchasing, assembling and machining while doing this project work. We feel that the project work is a good solution to bridge the gates between institution and industries.

We are proud that we have completed the work with the limited time successfully. The SEMI AUTOMATIC LOCKABLE DIFFERENTIAL is working with satisfactory conditions. We are able to understand the difficulties in maintaining the tolerances and also quality. We have done to our ability and skill making maximum use of available facilities. In conclusion remarks of our project work, let us add a few more lines about our impression project work.

In concluding the words of our project, since the locking of the differential is very much useful in reducing a considerable amount of loss due the transmission through the differential and also in recovering the heavy trucks from pits in rainy season this could be a source for the above said solutions.

REFERENCES

1. "Theory of Machines" by Khurmi and Gupta 2008 Revised
2. www.freepatentsonline.com
3. Alfred sigl, Sershiem; Germany (1987); "Vehicle with Lockable differential" U.S. patent, no 4,671,373 June 1987.
4. Kanwar Bharat Singh "Advances in Automobile Engineering: Brake Assisted Differential Locking System" Proceedings of the World Congress on Engineering 2008 Vol II WCE 2008, July 2 - 4, 2008, London, U.K.
5. Prof. Dr.-Ing. Berthold Schlecht, TU Dresden Dr.-Ing. Tobias Schulze, Drive Concepts GmbH Dresden "Design and optimization of planetary gears under consideration of all relevant influences"
6. KunihokeSuzuki, sagamihara; Japan (1985). "Four wheel drive system with center differential lock Control responsive to rpm difference" U.S. patent, no.4, 552,241; 12 Nov. 1985
7. www.worldautomotive.wordpress.com