IJETIE International Journal of Emerging Technology and Innovative Engineering
Volume I, Issue 4, April 2015
ISSN: 2394 - 6598
www.ijetie.org

Multi Directional Steeering System

[1] G.Sunny,[2] Krishna Dalmia, [3]Dr.V.V. PrathibhaBharathi[4]J.Nagaraju

[12] Students of Mechanical EngineeringMRCE, Hyderabad, AP,India.
[3]Head of Mechanical Engineering,MRCE, Hyderabad, AP,India.
[4]Associate prof.of Mechanical EngineeringMRCE, Hyderabad, AP,India.

ABSTRACT

A Four Wheel steering (4WS) System is also known as "Quadra Steering System". In this paper, both front as well as rear wheels can be steered according to speed of the vehicle and space available for turning.

Quadra steer is system that gives full size vehicles greater ease while driving at low speed, and improves stability, handling and control at higher speed. Quadra steering system works in following three phases Negative phase, Neutral phase, Positive phase. It enables the car to be steered into tighter parking spaces. It makes the car more stable at speed (less body roll). It makes the car more efficient and stable on cornering, easier and safer lanes change when on motorways.

The steering system allows the driver to guide the moving vehicle on the road and turn it right or left as desired. The main aim is that turning of the vehicle should not require greater efforts on the part of the driver.

KEYWORDS: welding, grinding, drilling, d c motors, batteries

INTRODUCTION

A German scientist Daimler-Benz, for the first time developed four-wheel drive, four-wheel steering vehicles for the forest service. Their rear wheels were designed to turn in opposite direction to the rear wheel so that the vehicle could make sharp turns.

In the year 1978, it was modified by the Japanese scientist "Furukawa". According to him, "all the wheels should turn in the same direction at high speeds & in opposite direction at the lower speeds". Later, it was studied at Oguchi's laboratory at Shibaura Institute of Technology, led by the professor Oguchi. Accordingly, a new mechanism had to be developed by combining an electronic control device and variable gear-ratio mechanism. "When the 4WS system was in development," Furukawa said, "I truly believed that I was creating a technology. But when I look back at it now, perhaps it was the 4WS technology that was nurturing me." "It was the desire to bring what we believed to the world, and to see it accepted by users," Furukawa explained. "That's the thing that made in our process work." The 4WS system undeniably established a new standard in driving performance, but without a doubt it did something more. It brought creative minds together in a solution that would one day benefit the automotive world.

SPECIFICATIONS

CHASIS:

Number of square rods used to make chassis: 5

Nos. Length of the square rods used in chassis: 39

cm Width of chassis: 24 cm

Thickness of square rods used in chassis: 2 cm

L-angle rods: 4 Nos.

Length of the L-angles: 7 cm

Width of the L-angles: 4 cm

Thickness of the L-angles: 4 mm

BATTERY:

Battery specifications: 12 volts, 7amps.

Total battery capacity: 14 hours.

MOTORS:

Number of Driving motors used: 4 Nos.

Driving motors specifications: 12 volts, 3 watts, 30 rpm.

Number of Steering motors used: 1 Nos.

Steering motor specifications: 12 volts, 6 watts, 30 rpm.

WHEELS:

Number of wheels: 4 Nos.

Wheel outer diameter: 10 cm

Wheel inner diameter: 8 cm

Wheel center hole diameter: 8 mm

GEARS:

Outer Diameter = 100mm

Inner Diameter = 80mm

No. of Teeth= 72

Module = m

Addendum Circle Diameter(OD) = d+2m;

Dedendum Circle Diameter(ID) = d-2.314m;

100 = d+2m

80 = d-2.314m

4.314m = 20

M = 4.636

Pitch Circle Diameter = 100-2m = 90.127mm

PINION:

Outer Diameter = 70mm

Inner Diameter = 50mm

No. of Teeth= 54

Module = m

Addendum Circle Diameter(OD) = d+2m;

Dedendum Circle Diameter(ID) = d-2.314m;

70 = d+2m

50 = d-2.314m

4.314m = 20

M = 4.636

Pitch Circle Diameter = 70-2m = 60.727mm

GEAR RATIO = (No. of Teeth Gear)/ (No. of Teeth of Pinion) = T_G/T_p = 72/54 =

1.33 Power, P = 2*(3.14)*N*T/60

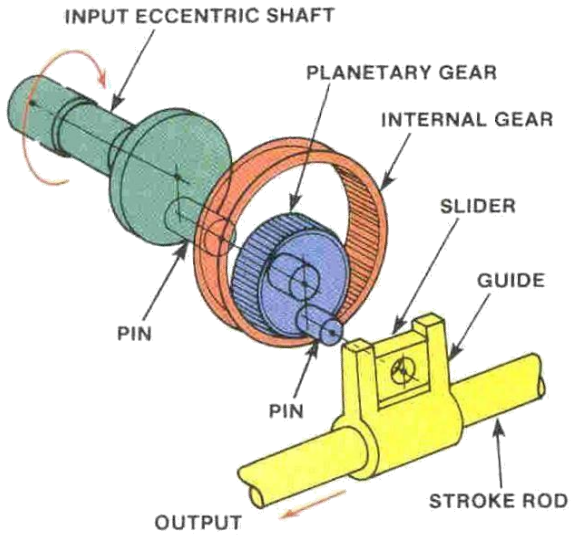
Torque, T = P*(60)/2*(3.14)*N = 1.91

Tangential Load(W_T),

- For Gear = T/(D_G/2)= 1.91/(90.127*10^{-3}) = 21.19N
- For Gear = T/(D_P/2)= 1.91/(60.727*10^{-3}) = 31.45N

EXPERIMENTAL SET UP:

Mechanical 4WS:

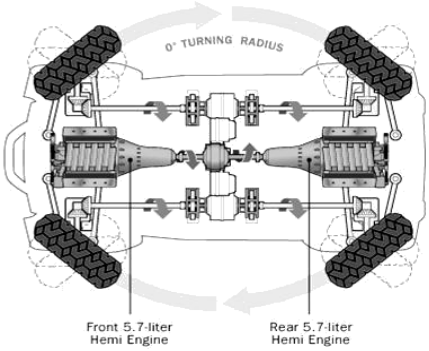


In a straight-mechanical type of 4WS, two steering gears are used-one for the front and the other for the rear wheels. A steel shaft connects the two steering gearboxes and terminates at an eccentric shaft that is fitted with an offset pin. This pin engages a second offset pin that fits into a planetary gear. The planetary gear meshes with the matching teeth of an internal gear that is secured in a fixed position to the gearbox housing. This means that the planetary gear can rotate but the internal gear cannot. The eccentric pin of the planetary gear fits into a hole in a slider for the steering gear.

A 120-degree turn of the steering wheel rotates the planetary gear to move the slider in the same direction that the front wheels are headed. Proportionately, the rear wheels turn the steering wheel about 1.5 to 10 degrees. Further rotation of the steering wheel, past the 120degree point, causes the rear wheels to start straightening out due to the double-crank action (two eccentric pins) and rotation of the planetary gear. Turning the steering wheel to a greater angle, about 230 degrees, finds the rear wheels in a neutral position regarding the front wheels. Further rotation of the steering wheel results in the rear wheels going counter phase with regard to the front wheels. About 5.3 degrees maximum counter phase rear steering is possible. Mechanical 4WS is steering angle sensitive. It is not sensitive to vehicle road speed.

Zero turning circle radius - 360 Mode:

In addition to the aforementioned steering types, a new type of four-wheel steering was introduced by the concept vehicle Jeep Hurricane, one that could significantly affect the way our vehicles are parked in the future. Its shown in the figure:



The Jeep Hurricane concept with Zero Turning Circle Radius

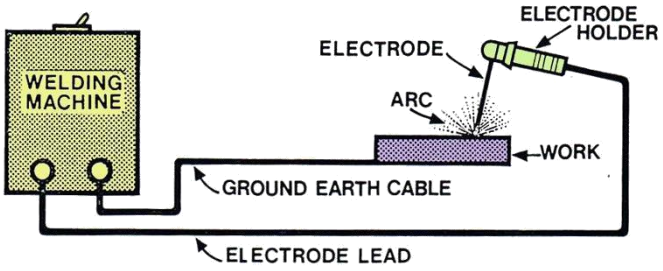
This vehicle has all the three modes of steering described above, though it sports a truly complex drive-train and steering layout with two transfer cases to drive the left and right wheels separately. The four wheels have fully independent steering and need to turn in an unconventional direction to ensure that the vehicle turns around on its own axis. Such a system requires precise calculation from a servo motor with real-time feedback to make certain that all three steering modes function perfectly. The concept didn't make it to production, possibly due to the high costs involved in the power train layout. But the idea presented by the concept continues to find importance. The only major problem posed by this layout is that a conventional rack-and-pinion steering with pitman arms would not be suitable for this mode, since the two front wheels are steered in opposite directions. Steer-by-wire systems would work fine, however, since independent control can be achieved.

Welding:

Welding is the process of joining similar metals by the application of heat, with or without application of pressure or filler metal, in such a way that the joint is equivalent in composition and characteristics of the metals joined. In the beginning, welding was mainly used for repairing all kinds of worn or damaged parts. Now, it is extensively used in manufacturing industry, construction industry (construction of ships, tanks, locomotives and automobiles) and maintenance work, replacing riveting
and bolting, to a greater extent.

ELECTRIC ARC WELDING

Arc welding is the welding process, in which heat is generated by an electric arc struck between an electrode and the work piece. Electric arc is luminous electrical discharge between two electrodes through ionized gas.



Any arc welding method is based on an electric circuit consisting of the following parts:

a. Power supply (AC or DC);

b. Welding electrode;

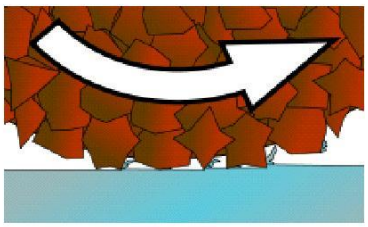
c. Work piece;

d. Welding leads (electric cables) connecting the electrode and work piece to the power supply. Electric arc between the electrode and work piece closes the electric circuit. The arc

temperature may reach 10000°F (5500°C), which is sufficient for fusion the work piece edges and joining them. When a long joint is required the arc is moved along the joint line. The front edge of the weld pool melts the welded surfaces when the rear edge of the weld pool solidifies forming the joint. Transformers, motor generators and rectifiers' sets are used as arc welding machines. These machines supply high electric currents at low voltage and an electrode is used to produce the necessary arc. The electrode serves as the filler rod and the arc melts the surface so that, the metals to be joined

are actually fixed together. Sizes of welding machines are rated according to their approximate amperage capacity at 60% duty cycle, such as 150,200,250,300,400,500 and 600 amperes. This amperage is the rated current output at the working terminal.

Grinding:



Grinding is an abrasive machining process that uses a grinding wheel as the cutting tool. A wide variety of machines are used for grinding:

1. Hand-cranked knife-sharpening stones (grindstones).
2. Handheld power tools such as angle grinders and die grinders.
3. Various kinds of expensive industrial machine tools called grinding machines.
4. Bench grinders often found in residential garages and basements.

Grinding practice is a large and diverse area of manufacturing and tool making. It can produce very fine finishes and very accurate dimensions; yet in mass production contexts it can also rough out large volumes of metal quite rapidly. It is usually better suited to the machining of very hard materials than is "regular" machining (that is, cutting larger chips with cutting tools such as tool bits or milling cutters), and until recent decades it was the only practical way to machine such materials as hardened steels. Compared to "regular" machining, it is usually better suited to taking very shallow cuts, such as reducing a shaft's diameter by half a thousandth of an inch or 12.7 um.

Grinding is a subset of cutting, as grinding is a true metal-cutting process. Each grain of abrasive functions as a microscopic single-point cutting edge (although of high negative rake angle), and shears a tiny chip that is analogous to what would conventionally be called a "cut" chip (turning, milling, drilling, tapping, etc.). Similar abrasive cutting processes are lapping and sanding.

Drilling:

Drilling is a cutting process that uses a drill bit to cut or enlarge a hole of circular cross-section in solid materials. The drill bit is a rotary cutting tool, often multipoint. The bit is pressed against the work piece and rotated at rates from hundreds to thousands of revolutions per minute. This forces the cutting edge against the work piece, cutting off chips from what will become the hole being drilled. Exceptionally, specially-shaped bits can cut holes of non-circular cross-section.

Drilled holes are characterized by their sharp edge on the entrance side and the presence of burrs on the exit side (unless they have been removed). Also, the inside of the hole usually has helical feed marks.

Drilling may affect the mechanical properties of the work piece by creating low residual stresses around the hole opening and a very thin layer of highly stressed and disturbed material on the newly formed surface. This causes the work piece to become more susceptible to corrosion at the stressed surface. A finish operation may be done to avoid the corrosion. Zinc plating or any other standard finish operation of 14 to 20 μm can be done which helps to avoid any sort of corrosion. When possible drilled holes should be located perpendicular to the work piece surface. This minimizes the drill bit's tendency to "walk", that is, to be deflected, which causes the hole to be misplaced. The higher the length-to-diameter ratio of the drill bit, the higher the tendency to walk.

DC Motor:

A DC motor is a mechanically commutated electric motor powered from direct current (DC). The stator is stationary in space by definition and therefore its current. The current in the rotor is switched by the commutator to also be stationary in space. This is how the relative angle between the stator and rotor magnetic flux is maintained near 90 degrees, which generates the maximum torque.

DC motors have a rotating armature winding (winding in which a voltage is induced) but non-rotating armature magnetic field and a static field winding (winding that produce the main magnetic flux) or permanent magnet. Different connections of the field and armature winding provide different inherent speed/torque regulation characteristics. The speed of a DC motor can be controlled by changing the voltage applied to the armature or by changing the field current. The introduction of variable resistance in the armature circuit or field circuit allowed speed control. Modern DC motors are often controlled by power electronics systems called DC drives.

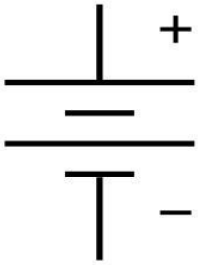
The introduction of DC motors to run machinery eliminated the need for local steam or internal combustion engines, and line shaft drive systems. DC motors can operate directly from rechargeable batteries, providing the motive power for the first electric vehicles. Today DC motors are still found in applications as small as toys and disk drives, or in large sizes to operate steel rolling mills and paper machines.

Batteries:

In electricity, a battery is a device consisting of one or more electrochemical cells that convert stored chemical energy into electrical energy. Since the invention of the first battery (or "voltaic pile") in 1800 by Alessandro Volta, and especially since the technically improved Daniel cell in 1836, batteries have become a common power source for many household and industrial applications. According to a 2005 estimate, the worldwide battery industry generates US$48 billion in sales each year, with 6% annual growth.

There are two types of batteries: primary batteries (disposable batteries), which are designed to be used once and discarded, and secondary batteries (rechargeable batteries), which are designed to be recharged and used multiple times. Batteries come in many sizes, from

miniature cells used to power hearing aids and wristwatches to battery banks the size of rooms that provide standby power for telephone exchanges and computer data centers.



The symbol for a battery in a circuit diagram. It originated as a schematic drawing of the earliest type of battery, a voltaic pile.

In strict terms, a battery is a collection of multiple electrochemical cells, but in popular usage battery often refers to a single cell. For example, a 1.5-volt AAA battery is a single 1.5-volt cell, and a 9-volt battery has six 1.5-volt cells in series. The first electrochemical cell was developed by the Italian physicist Alessandro Volta in 1792, and in 1800 he invented the first battery, a "pile" of many cells in series.

ACTUAL VIEW OF ROBOT:

CONCLUSION:

Even though it is advantageous over the conventional two-wheel steering system, 4WS is complex and expensive. Currently the cost of a vehicle with four wheel steering is more. Thus the four-wheel steering system has got cornering capability, steering at for a vehicle with the conventional two wheel steering. Four wheel steering is growing in popularity and it is likely to come in more and more new vehicles. As the systems become more commonplace the cost of four wheel steering will drop.

There are three modes in 4-wheel steering each of which is individually implemented in most of the 4 wheel steering cars. Each one has its own disadvantage like use of crab mode

increases the turning radius which is turn decreases the ease of maneuvering the vehicle at sharp bends, similarly rear steer mode decreases the turning radius to a greater extent, thus increases the risk of toppling of the vehicle at high speed.

Hence to overcome these problems, both the modes have been introduced together in a locomotive and its performance has been simulated and shown.

From this research, we found that the multi−mode 4WS system provided robust, repeatable results. In particular, it can be concluded that:

1. In headland turning maneuvers, coordinated 4WS showed performance advantages over conventional 2WS through increased aligning distance, decreased headland width, and reduced rear−wheel tracking area.
2. In lateral shifts during chemical application, crab 4WS resulted in substantial reductions of all application error metrics over conventional 2WS. Coordinated 4WS resulted in increased error but revealed an inverse relationship between turning radius and application error.

REFERNCES:

1. "Automotive Technology –A System Approach", Jack Erjavee.
2. "Automotive Suspension and steering System", Thomas W Birch.
3. "Theory of machines"- R.S.Khurmi, J.K.Gupta
4. "Machine Design"- R.S.Khurmi, J.K.Gupta