DESIGN OF 90 DEGREE TURNING MECHANISM

A project report

Submitted by

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CHAPTER-1
INTRODUCTION

1.1 INTRODUCTION

Steering is the term applied to the collection of components, linkages, which will allow for a vessel or vehicle to follow the desired course. An exception is the case of rail transport by which rail tracks combined together with railroad switches provide the steering function.

The most conventional steering arrangement is to turn the front wheels using a hand–operated steering wheel which is positioned in front of the driver, through the steering column, which may contain universal joints to allow it to deviate somewhat from a straight line.

Other arrangements are sometimes found on different types of vehicles, for example, a tiller or rear–wheel steering. Tracked vehicles such as tanks usually employ differential steering that is, the tracks are made to move at different speeds or even in opposite directions to bring about a change of course.

Production cars are designed to under steer and rarely do over steer. If a car could automatically compensate for an under steer/over steer problem, the driver would enjoy nearly neutral steering under varying operating conditions. Right angle steering system is a serious effort on the part of automotive design engineers to provide near-neutral steering.

Also in situations like low speed cornering, vehicle parking and driving in city conditions with heavy traffic in tight spaces, driving would be very difficult due to vehicle's larger wheelbase and track width. Hence there is a requirement of a mechanism which result in moving the car in sideways and it can be achieved by implementing right angle steering mechanism instead of regular two wheel steering.

CHAPTER-2

LITERATURE REVIEW

2.1 LITERATURE REVIEW

International Journal for Innovative Research in Science & Technology90 Degree Steering Mechanism Arjun V Pradeep April 2016 new absolute eco-friendly vehicle with independent, low emission transportation possible for people who utilize wheelchair could definitely be an improvement in this system. For this, an eco-friendly vehicle, like an electric car which can steer through 90degrees, thus reducing the turning radius with low efforts has to be defined. Automotive of present time does not have the ability to steer through 90 degrees. Such vehicles can help disabled people effectively. A lot of researches have been done on this field soaps to implement this methodology but it has not yet been implemented. The idea is to use electric motors on any two diagonal wheels and a counter phase system implementation. The mechanism works at low speed only. The steering mechanism uses rack and pinion in defined gear ratios with the help of some bevel gears. The rear wheels are mounted in such a way that the power is transmitted even when it is being steered through 90 degrees. The vehicle is designed in such a way that it has facilities for disabled people to enter into and out of the vehicle without any external help. Even for people who depends fully on wheel chairs can easily enter the vehicle through the inclined passage provided at the rear side. Advantages of this system is that it can work in limited space and it reduces the time and effort for steering through 90 degrees thus making the system more flexible. It can be used for other applications such as parking, farm vehicles, trucks, forklifts etc.

SMART PARKING CAR WITH 90 DEGREE ROTATIONNEERAJ KUMAR, OMPARKASH DEC 2015, It keen to develop a system for parking of cars which would be suitable and practical for Indian society. As know that there are already some systems which are using technology like multi floor parking system and

automated parking area system. But these systems are little bit impractical in context to Indian society as these systems result in extra consumptions of money and power. So “Smart parking system for cars” would be a cheap and less expensive system for parking and simple construction as well. Nowadays, the every vehicle existed mostly still using the two wheel steering system to control the movement of the vehicle whether it is front wheel drive, rear wheel drive or all-wheel drive. Four-wheel steering is a technologically, tremendous effort on the part of automotive design engineers to provide near-neutral steering. In situations like low speed cornering, vehicle parking and driving in city conditions with heavy traffic in tight spaces, high speed lane changing would be very difficult due to vehicle’s larger wheelbase and track width which brings high inertia and traction into consideration. Hence there is a requirement of a mechanism which result in less turning radius and it can be achieved by implementing four wheel steering mechanism instead of regular two wheel steering. This system finds application in off-highway vehicles such as forklifts, agricultural and construction equipment mining machinery also in Heavy Motor Vehicles. It is also useful in passenger cars. It improves handling and helps the vehicle make tighter turns. This system is used to minimize the turning radius.

DEVELOPMENT OF FOUR WHEEL STEERING SYSTEM FOR A CAR K. Lohith1, Dr. S. R. Shankapal2, M. H. Monish Gowda Production cars are designed to understeer and rarely do oversteer. If a car could automatically compensate for an understeer/oversteer problem, the driver would enjoy nearly neutral steering under varying operating conditions. Four-wheel steering is a serious effort on the part of automotive design engineers to provide near-neutral steering. Also in situations like low speed cornering, vehicle parking and driving in city conditions with heavy traffic in tight spaces, driving would be very difficult due to vehicle’s

larger wheelbase and track width. Hence there is a requirement of a mechanism which result in less turning radius and it can be achieved by implementing four wheel steering mechanism instead of regular two wheel steering. In this project Maruti Suzuki 800 is considered as a benchmark vehicle.

CHAPTER-3

COMPONENTS AND DESCRIPTION

COMPONENTS AND DESCRIPTION

The components that are used in the project 90 DEGREE STEERING MECHANISM are as follows,

- Motor
- Battery
- Chain drive
- Sprocket
- Bearings
- Control unit
- Spur gear

D.C. MOTOR:

3.1 DESCRIPTION OF DC MOTOR

An electric motor is a machine which converts electrical energy to mechanical energy. Its action is based on the principle that when a current-carrying conductor is placed in a magnetic field, it experiences a magnetic force whose direction is given by Fleming's left hand rule.

When a motor is in operation, it develops torque. This torque can produce mechanical rotation. DC motors are also like generators classified into shunt wound or series wound or compound wound motors.

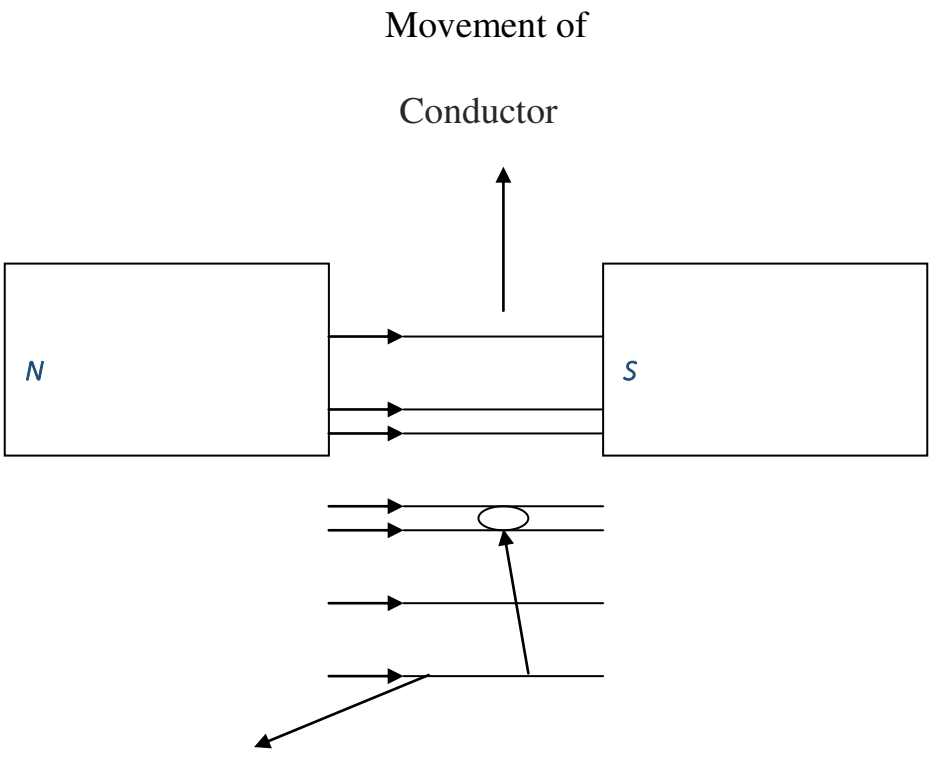
- **FLEMING'S LEFT HAND RULE:**

Keep the force finger, middle finger and thumb of the left hand mutually perpendicular to one another. If the fore finger indicates the direction of magnetic field and middle finger indicates direction of current in the conductor, then the thumb indicates the direction of the motion of conductor.

- **PRINCIPLE OF OPERATION OF DC MOTOR:**

The uniform magnetic field in which a straight conductor carrying no current is placed. The conductor is perpendicular to the direction of the magnetic field.

The conductor is carrying a current away from the viewer, but the field due to the N and S poles has been removed. There is no movement of the conductor during the above two conditions. In figure III the current carrying conductor is placed in the magnetic field. The field due to the current in the conductor supports the main field above the conductor, but opposes the main field below the conductor.



Magnetic flux ------- Current Carrying Conductor

FIG 3.1 OPERATION OF DC MOTOR

The result is to increase the flux density in to the region directly above the conductor and to reduce the flux density in the region directly below the conductor. It is found that a force acts on the conductor, trying to push the conductor downwards as shown by the arrow. If the current in the conductor is reversed, the strengthening of flux lines occurs below the conductor, and the conductor will be pushed upwards.

Now consider a single turn coil carrying a current as shown in the above figure. In view of the reasons given above, the coil side A will be forced to move downwards, whereas the coil side B will be forced to move upwards. The forces acting on the coil sides A and B will be of same magnitude. But their direction is opposite to one another. As the coil is wound on the armature core which is supported by the bearings, the armature will now rotate. The commutator periodically reverses the direction of current flow through the armature. Therefore the armature will have a continuous rotation.

A simplified model of such a motor is shown in figure VI. The conductors are wound over a soft iron core. DC supply is given to the field poles for producing flux. The conductors are connected to the DC supply through brushes

Let's start by looking at the overall plan of a simple 2-pole DC electric motor. A simple motor has 6 parts, as shown in the diagram below.

- An armature or rotor
- A commutator
- Brushes
- An axle
- A field magnet
- A DC power supply of some sort

When put all of these parts together, a complete electric motor:

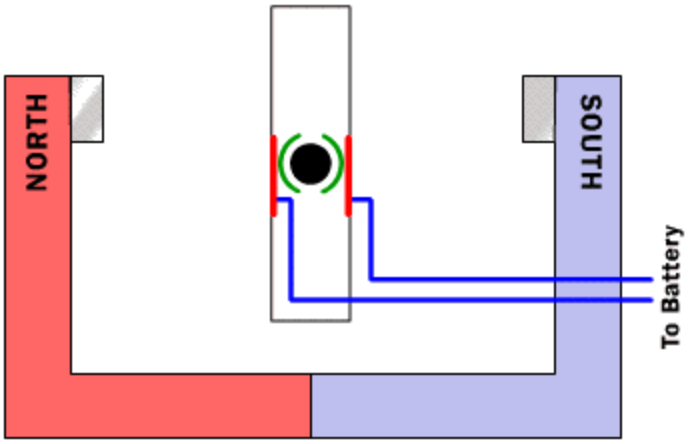


FIG 3.2 DC ELECTRIC MOTOR

In this figure, the armature winding has been left out so that it is easier to see the commutator in action. The key thing to notice is that as the armature passes through the horizontal position, the poles of the electromagnet flip. Because of the flip, the North Pole of the electromagnet is always above the axle so it can repel the field magnet's North Pole and attract the field magnet's South Pole. If ever take apart an electric motor will find that it contains the same pieces described above: two small permanent magnets, a commutator, two brushes and an electromagnet made by winding wire around a piece of metal. Almost always, however, the rotor will have three poles rather than the two poles as shown in this article. There are two good reasons for a motor to have three poles:

It causes the motor to have better dynamics. In a two-pole motor, if the electromagnet is at the balance point, perfectly horizontal between the two poles of the field magnet when the motor starts imagine the armature getting "stuck" there. That never happens in a three-pole motor.

Each time the commutator hits the point where it flips the field in a two-pole motor, the commutator shorts out the battery (directly connects the positive and negative terminals) for a moment. This shorting wastes energy and drains the battery needlessly. A three-pole motor solves this problem as well.

It is possible to have any number of poles, depending on the size of the motor and the specific application it is being used in.

3.2 BATTERY

INTRODUCTION:

In isolated systems away from the grid, batteries are used for storage of excess solar energy converted into electrical energy. The only exceptions are isolated sunshine load such as irrigation pumps or drinking water supplies for storage. In fact for small units with output less than one kilowatt. Batteries seem to be the only technically and economically available storage means. Since both the photo-voltaic system and batteries are high in capital costs. It is necessary that the overall system be optimized with respect to available energy and local demand pattern. To be economically attractive the storage of solar electricity requires a battery with a particular combination of properties:

(1) Low cost
(2) Long life
(3) High reliability
(4) High overall efficiency
(5) Low discharge
(6) Minimum maintenance
    (A) Ampere hour efficiency
    (B) Watt hour efficiency

The lead acid battery for storing the electrical energy from the solar panel for lighting the street and so about the lead acid cells are explained below.

- **LEAD-ACID WET CELL:**

Where high values of load current are necessary, the lead-acid cell is the type most commonly used. The electrolyte is a dilute solution of sulfuric acid . In the application of battery power to start the engine in an auto mobile, for example, the load current to the starter motor is typically 200 to 400A. One cell has a nominal output of 2.1V, but lead-acid cells are often used in a series combination of three for a 6-V battery and six for a 12-V battery.

The lead acid cell type is a secondary cell or storage cell, which can be recharged. The charge and discharge cycle can be repeated many times to restore the output voltage, as long as the cell is in good physical condition. However, heat with excessive charge and discharge currents shortens the useful life to about 3 to 5 years for an automobile battery. Of the different types of secondary cells, the lead-acid type has the highest output voltage, which allows fewer cells for a specified battery voltage.

- **CHEMICAL ACTION:**

Sulfuric acid is a combination of hydrogen and sulfate ions. When the cell discharges, lead peroxide from the positive electrode combines with hydrogen ions to form water and with sulfate ions to form lead sulfate. Combining lead on the negative plate with sulfate ions also produces he sulfate. Therefore, the net result of discharge is to produce more water, which dilutes the electrolyte, and to form lead sulfate on the plates.

As the discharge continues, the sulfate fills the pores of the grids, retarding circulation of acid in the active material. Lead sulfate is the powder often seen on the outside terminals of old batteries. When the combination of weak electrolyte and sulfating on the plate lowers the output of the battery, charging is necessary.

On charge, the external D.C. source reverses the current in the battery. The reversed direction of ions flows in the electrolyte result in a reversal of the chemical reactions. Now the lead sulfates on the positive plate reactive with the water and sulfate ions to produce lead peroxide and sulfuric acid. This action re-forms the positive plates and makes the electrolyte stronger by adding sulfuric acid.

At the same time, charging enables the lead sulfate on the negative plate to react with hydrogen ions; this also forms sulfuric acid while reforming lead on the negative plate to react with hydrogen ions; this also forms currents can restore the cell to full output, with lead peroxide on the positive plates, spongy lead on the negative plate, and the required concentration of sulfuric acid in the electrolyte.

The chemical equation for the lead-acid cell is

$$Pb + pbO_2 + 2H_2SO_4 \underset{\text{Discharge}}{\overset{\text{Charge}}{\rightleftharpoons}} 2pbSO_4 + 2H_2O$$

On discharge, the pb and pbo_2 combine with the SO_4 ions at the left side of the equation to form lead sulfate ($pbSO_4$) and water (H_2O) at the right side of the equation.

One battery consists of 6 cells, each have an output voltage of 2.1V, which are connected in series to get a voltage of 12V and the same 12V battery is connected in series, to get a 24 V battery. Thus it placed in the water proof iron casing box.

- **CARING FOR LEAD-ACID BATTERIES:**

Always use extreme caution when handling batteries and electrolyte. Wear gloves, goggles and old clothes. “Battery acid” will burn skin and eyes and destroy cotton and wool clothing.

The quickest way of ruin lead-acid batteries is to discharge deeply and leave stand “dead” for an extended period of time. When discharge, there is a chemical change in the positive plates of the battery. It change from lead oxide when charge out lead sulfate when discharged. If remain in the lead Sulfate State for a few days, some part of the plate dose not returns to lead oxide when the battery is recharged. If the battery remains discharge longer, a greater amount of the positive plate will remain lead sulfate. The parts of the plates that become “sulfate” no longer store energy. Batteries that are deeply discharged, and then charged partially on a regular basis can fail in less than one year.

Check batteries on a regular basis to be sure getting charged. Use a hydrometer to check the specific gravity of lead acid batteries. If batteries are cycled very deeply and then recharged quickly, the specific gravity reading will be lower than it should because the electrolyte at the top of the battery may not have mixed with the “charged” electrolyte.

Check the electrolyte level in the wet-cell batteries at the least four times a year and top each cell of with distilled water. Do not add water to discharged batteries. Electrolyte is absorbed when batteries are much discharged. If add water

at this time, and then recharge the battery, electrolyte will overflow and make a mess.

Keep the top of batteries clean and check that cables are tight. Do not tighten or remove cables while charging or discharging. Any spark around batteries can cause a hydrogen explosion inside, and ruin one of the cells.

On charge, with reverse current through the electrolyte, the chemical action is reversed. Then the lead ions from the lead sulfate on the right side of the equation re-form the lead and lead peroxide electrodes.

3.3 CURRENT RATINGS:

Lead-acid batteries are generally rated in terms of how much discharge currents can supply for a specified period of time; the output voltage must be maintained above a minimum level, which is 1.5 to 1.8V per cell. A common rating is ampere-hours based on a specific discharge time, which is often 8h. Typical values for automobile batteries are 100 to 300 A.h.

As an example, a 200 A.h battery can supply a load current of 200/8 or 25A, used on 8h discharge. The battery can supply less current for a longer time or more current for a shorter time. Automobile batteries may be rated for “cold cranking power”, which is related to the job of starting the engine. A typical rating is 450A for 30s at a temperature of 0 degree F.

Low temperatures reduce the current capacity and voltage output. The ampere-hour capacity is reduced approximately 0.75% for each decreases of 1º F below normal temperature rating. At 0ºF the available output is only 60 % of the ampere-hour battery rating.

In cold weather, therefore, it is very important to have an automobile battery unto full charge. In addition, the electrolyte freezes more easily when diluted by water in the discharged condition.

3.4 SPECIFIC GRAVITY:

Measuring the specific gravity of the electrolyte generally checks the state of discharge for a lead-acid cell. Specific gravity is a ratio comparing the weight of a substance with the weight of a substance with the weight of water. For instance, concentrated sulfuric acid is 1.835 times as heavy as water for the same volume. Therefore, its specific gravity equals 1.835. The specific gravity of water is 1, since it is the reference.

Specific-gravity readings are taken with a battery hydrometer, Note that the calibrated float with the specific gravity marks will rest higher in an electrolyte of higher specific gravity.

The importance of the specific gravity can be seen from the fact that the open-circuit voltage of the lead-acid cell is approximately equal to

$$V = \text{Specific gravity} + 0.84$$

For the specific gravity of 1.280, the voltage is 1.280 = 0.84 = 2.12V, as an example. These values are for a fully charged battery.

- **CHARGING THE LEAD-ACID BATERY:**

The requirements are illustrated in figure. An external D.C. voltage source is necessary to produce current in one direction. Also, the charging voltage must be more than the battery electromotive force. Approximately 2.5 per cell is enough to over the cell electromotive force. so that the charging voltage can produce current opposite to the direction of discharge current.

It may be of interest to note that an automobile battery is in a floating-charge circuit. The battery charger is an AC generator or alternator with rectifier diodes, driver by a belt from the engine. When start the car, the battery supplies the cranking power. Once the engine is running, the alternator charges the battery. It is not necessary for the car to be moving. A voltage regulator is used in this system to maintain the output at approximately 13 to 15 V.

With proper care, lead-acid batteries will have a long service life and work very well in almost any power system. Unfortunately, with poor treatment lead-acid battery life will be very short.

3.5 CONTROL UNIT

In automotive electronics, Electronic Control Unit is a generic term for any embedded system that controls one or more of the electrical system or subsystems in a motor vehicle.

Types of ECU include Electronic/engine Control Module, Power train Control Module , Transmission Control Module , Brake Control Module , Central Control Module , Central Timing Module , General Electronic Module , Body Control Module , Suspension Control Module , control unit, or control module. Taken together, these systems are sometimes referred to as the car's computer. Technically there is no single computer but multiple ones. Sometimes one assembly incorporates several of the individual control modules.

Some modern motor vehicles have up to 80 Electronic control units. Embedded software in Electronic control units continues to increase in line count, complexity, and sophistication. Managing the increasing complexity and number of Electronic control units in a vehicle has become a key challenge for original equipment manufacturers .

3.6 SPUR GEAR

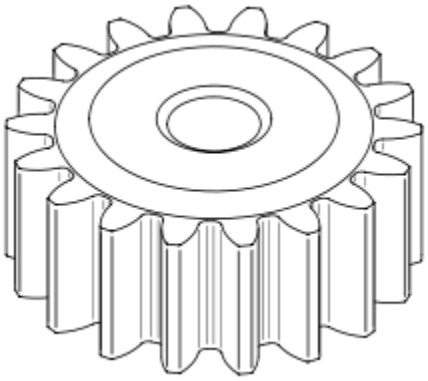


FIG 3.3 SPUR GEAR

Spur gears or straight-cut gears are the simplest type of gear. It consist of a cylinder or disk with the teeth projecting radially, and although not straight-sided in form, the edge of each tooth is straight and aligned parallel to the axis of rotation. These gears can be meshed together correctly only if it is fitted to parallel shafts.

The spur gears, which are designed to transmit motion and power between parallel shafts, are the most economical gears in the power transmission industry.

APPLICATION:

- Material handling
- Feed drives
- Machine tools
- Conveyors
- Marine hoists

INTERNAL SPUR GEAR:

The internal gears are spur gears turned "inside out." In other words, the teeth are cut into the inside diameter while the outside diameter is kept smooth.

This design allows for the driving pinion to rotate internal to the gear, which, in turn, allows for clean operation. Intended for light duty applications, these gears are available only in brass. When choosing a mating spur gear, always remember that the difference in the number of teeth between the internal gear and pinion should not be less than 15 or 12.

APPLICATIONS:

- Light duty applications
- Timing
- Positioning
- Rollers
- Indexing

EXTERNAL SPUR GEAR:

Perhaps the most often used and simplest gear system, external spur gears are cylindrical gears with straight teeth parallel to the axis. It is used to transmit rotary motion between parallel shafts and the shafts rotate in opposite directions.

It tend to be noisy at high speed as the two gear surfaces come into contact at once. Internal spur gears: The internal spur gear works similarly to the external spur gears except that the pinion is inside the spur gear. It is used to transmit rotary motion between parallel shafts but the shafts rotate in the same direction with this arrangement.

3.7 BEARING WITH BEARING CAP

The bearings are pressed smoothly to fit into the shafts because if hammered the bearing may develop cracks. Bearing is made up of steel material and bearing cap is mild steel.

INTRODUCTION

Ball and roller bearings are used widely in instruments and machines in order to minimize friction and power loss. While the concept of the ball bearing dates back at least to Leonardo da Vinci, their design and manufacture has become remarkably This technology was brought to its present state of perfection only after a long period of research and development. The benefits of such specialized research can be obtained when it is possible to use a standardized bearing of the proper size and type.

However, such bearing scan not be used indiscriminately without a careful study of the loads and operating conditions. In addition, the bearing must be provided with adequate mounting, lubrication and sealing .Design engineers have usually two possible sources for obtaining information which can use to select a bearing for their particular application:

a) Textbooks

b) Manufacturers'

Catalogs Textbooks are excellent sources; however tend to be overly detailed and aimed at the student of the subject matter rather than the practicing designer. In most cases, contain information on how to design rather than how to select a bearing for a particular application .Manufacturers' catalogs, in turn, are also excellent and contain a wealth of information which relates to the products of the particular manufacturer. These catalogs, however, fail to provide alternatives which may divert the designer's interest to products not manufactured by the company .Our Company,

however, provides the broadest selection of many types of bearings made by different manufacturers.

For this reason,a condensed overview of the subject matter in an objective manner, using data obtained from different texts, handbooks and manufacturers' literature. This information will enable the reader to select the proper bearing in an expeditious manner. If the designer's interest exceeds the scope of the presented material, a list of references is provided at the end of the Technical Section.

Construction and Types of Ball Bearings

A ball bearing usually consists of four parts: an inner ring, an outer ring, the balls and the cage or separator.

To increase the contact area and permit larger loads to be carried, the balls run in curvilinear grooves in the rings. The radius of the groove is slightly larger than the radius of the ball, and a very slight amount of radial play must be provided. The bearing is thus permitted to adjust itself to small amounts of angular misalignment between the assembled shaft and mounting. The separator keeps the balls evenly spaced and prevents from touching each other on the sides where their relative velocities are the greatest. Ball bearings are made in a wide variety of types and sizes. Single-row radial bearings are made in four series, extra light, light, medium, and heavy, for each bore.

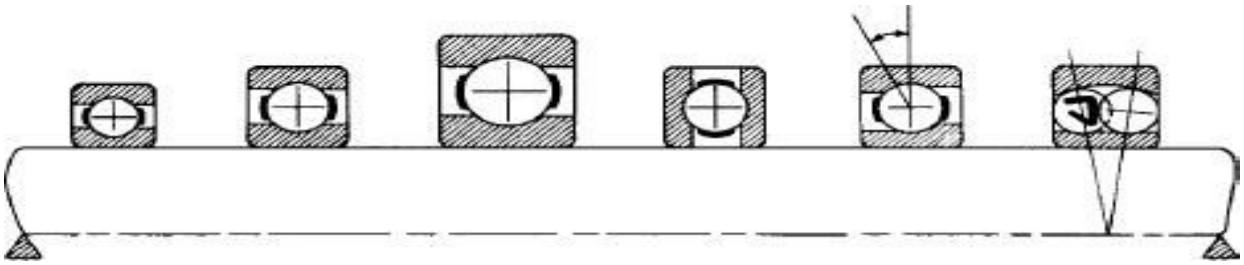


FIG 3.4 BALL BEARING

The heavy series of bearings is designated by 400. Most, but not all, manufacturers use a numbering system so devised that if the last two digits are multiplied by 5, the

result will be the bore in millimetres. The digit in the third place from the right indicates the series number. Thus, bearing 307 signifies a medium-series bearing of 35-mm bore. For additional digits, which may be present in the catalog number of a bearing, refer to manufacturer's details.

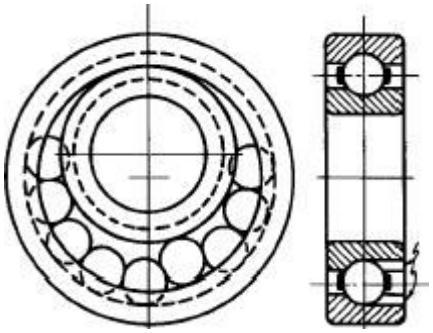


FIG 3.5 BALL BEARING 6202

Some makers list deep groove bearings and bearings with two rows of balls. For bearing designations of Quality Bearings & Components (QBC), see special pages devoted to this purpose. The radial bearing is able to carry a considerable amount of axial thrust.

However, when the load is directed entirely along the axis, the thrust type of bearing should be used. The angular contact bearing will take care of both radial and axial loads. The self-aligning ball bearing will take care of large amounts of angular misalignment. An increase in radial capacity may be secured by using rings with deep grooves, or by employing a double-row radial bearing. Radial bearings are divided into two general classes, depending on the method of assembly. These are the Conrad, or nonfilling-notch type, and the maximum or filling-notch type. In the Conrad bearing, the balls are placed between the rings as shown in Fig. 1-4(a). Then evenly spaced and the separator is riveted in place. In the maximum-type bearing,

the balls are a (a) (b) (c) (d) (e) (f) 100 Series Extra Light 200 Series Light 300 Series Medium Axial Thrust Bearing Angular Contact Bearing Self-aligning Bearing Fig. 1-3 Types of Ball Bearings Fig. 1-4 Methods of Assembly for Ball Bearings (a) Conrad or non-filling notch type (b) Maximum or filling notch type

3.8 SPROCKET AND CHAIN DRIVE

The chain converts rotational power to pulling power, or pulling power to rotational power, by engaging with the sprocket.

The sprocket looks like a gear but differs in three important ways:

1. Sprockets have many engaging teeth; gears usually have only one or two.
2. The teeth of a gear touch and slip against each other; there is basically no slippage in a sprocket.
3. The shapes of the teeth are different in gears and sprockets.

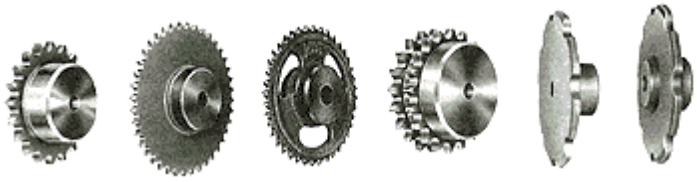


FIG 3.6 SPOCKET AND CHAIN DRIVE

Engagement with Sprockets:

Although chains are sometimes pushed and pulled at either end by cylinders, chains are usually driven by wrapping on sprockets. In the following section, explaining the relation between sprockets and chains when power is transmitted by sprockets.

D.C MOTOR

BASIC INFO

- Sweep Angle: 80°
- Size: 18"
- Part: Wiper Motor
- Range: Double Sid
- Driving Type: Electrical
- Application: Car, Engineering Vehicle, City Bus,
- Specification: CE, RoHS,

PRODUCT DESCRIPTION

Micro DC Motor

1. For car or track or bus or other Auto windows
2. With gear box

Item: CE Approved Wiper Motor

Model: SF-578VA

Voltage: 12V/24V

Power: 50W

Speed: 30rpm/50rpm

Torque: 20N. M

Weight: 1.3Kg.

3.9 LOAD CALCULATIONS:

At stationary condition:

Cross section of l angle =20×2 mm

Total area : $1200 \times 900 = 10.8 \times 10^5$ mm²

Total Load : 200Kg (Approx.)

Stress due to load : Load/Area = (100 x 9.81*100) / (10.8×10^5 mm²)

2 N/mm² (Calculated)

Yield stress for material : 248N/mm² (Obtained)

Calculated stress less than obtained stress, since design is safe.

VEHICLE at moving condition:

The CG of vehicle lies inside the quadrilateral is formed by joining the wheel position point. Since the design is safe.

Specification of Spur Gear

Formulae Specific to Gears with Standard Teeth

Addendum = 1 ÷ Diametral Pitch

Addendum = 0.3183 × Circular Pitch

Dedendum = 1.157 ÷ Diametral Pitch

Dedendum = 0.3683 × Circular Pitch

Working Depth = 2 ÷ Diametral Pitch

Working Depth = 0.6366 × Circular Pitch

Whole Depth = 2.157 ÷ Diametral Pitch

Whole Depth = 0.6866 × Circular Pitch

Clearance = 0.157 ÷ Diametral Pitch

Clearance = 0.05 × Circular Pitch

Outside Diameter = (Teeth + 2) ÷ Diametral Pitch

Outside Diameter = (Teeth + 2) × Circular Pitch ÷ π

Diametral Pitch = (Teeth + 2) ÷ Outside Diameter

DESIGN SPUR GEAR

- MODULE ,m =D/T
- CIRCULAR PITCH,PC = ∏D/T
- DIAMETRAL PITCH ,Pd =T/D

D=Diameter of the pitch circle

T=Number of teeth

Calculation

- Module , M=D/T

20 =240/T ⇒ T=12

- Diametral pitch,Pd=T/D

  =12/240=**0.05**mm

Circular pitch,Pc=∏D/T

  =∏x240/12 = **62.8**mm

- Addendum = 0.3183xPc

  = 0.3183x62.8 = **19.98**mm

- Dedendum = 0.3683xPc

  = 0.3683x62.8 = **23.12**mm

- Working Depth = 0.6366xPc

  = 0.6366x62.8 = **39.98**mm

- Whole Depth = 0.6866xPc

  = 0.6866x62.8 = 4**3.12**mm

- Clearance = 0.05xPc

  = 0.05x62.8 = **3.14**mm

- Outside Diameter = (Teeth+2)xPc/∏

  = (12x62.8)/3.14 = **280**mm

- Tooth thickness = 1.5708xm

= 1.5708x20 = **31.42**mm

DESIGN OF BALL BEARING

Bearing No. 6202

Outer Diameter of Bearing (D) = 35 mm

Thickness of Bearing (B) = 12 mm

Inner Diameter of the Bearing (d) = 15 mm

r_1 = Corner radii on shaft and housing

r_1 = 1 (From design data book)

Maximum Speed = 14,000 rpm (From design data book)

Mean Diameter (d_m) = (D + d) / 2

= (35 + 15) / 2

d_m = 25 mm

WAHL STRESS FACTOR

$$Ks = \frac{4C - 1}{4C - 4} + \frac{0.65}{C}$$

$$= \frac{(4 \times 2.3) - 1}{(4 \times 2.3) - 4} + \frac{0.65}{2.3}$$

Ks = 1.85

Sl. No.	PARTS	Qty.	Material
1	Battery	1	Lead acid
2	Motor	6	-
3	Chain drive	2	M.S
4	Frame	-	M.S
5	Sprockets	2	M.S
6	Control unit	1	-
7	Spur gear	12	M.S
8	Bearing & bearing cap	16	-

TABLE 3.1 LIST OF MATERIALS

CHAPTER-4

MANUFACTURING PROCESS

MANUFACTURING PROCESS

Manufacturing processes are the steps through which raw materials are transformed into a final product. The manufacturing process begins with the creation of the materials from which the design is made. These materials are then modified through manufacturing processes to become the required part. Manufacturing processes can include treating (such as heat treating or coating), machining, or reshaping the material. The manufacturing process also includes tests and checks for quality assurance during or after the manufacturing, and planning the production process prior to manufacturing.

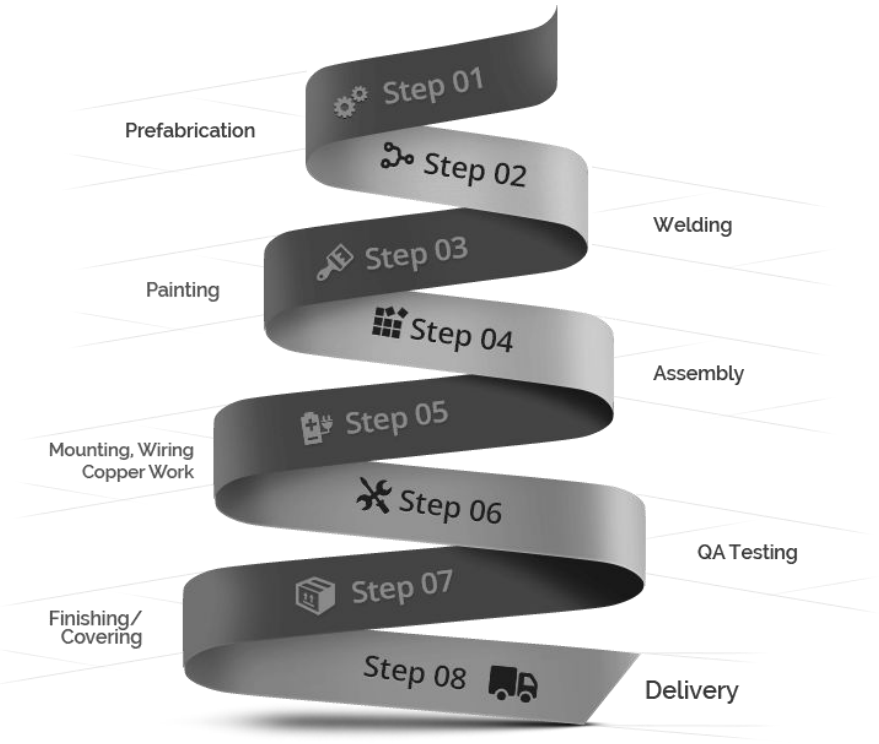


FIG 4.1 MANUFACTURING PROCESS

4.1 Fabrication Processes

These are secondary manufacturing processes where the starting raw materials are produced by any one of the previous manufacturing processes desired. Its assembly involve joining pieces either temporary or permanent. So that

would be perform the necessary function. The joining can be achieved by either or both of heat and pressure joining materials. Many of the steel structure construction, It first rolled and then joined together by a fabrication process are

- Gas welding
- Electric arc welding
- Electrical resistance welding
- Thermo welding
- Brazing welding
- Soldering welding
- Cold welding

Material removal processes:

These are also a secondary removal manufacturing process, where the additional unwanted material is removed in the form of chips from the blank material by a hard tools so as to obtain the final desired shape.

Material removal is normally a most expensive manufacturing process. Because more energy is consumed and also a lot of waste material is generated in this process. Still this process is widely used because it deliver very good dimensional accuracy and good surface finished. Material removal process are also called machining processes. Various processes in this category are

- Turning
- Drilling
- Shaping and planning

- Milling
- Grinding
- Broaching
- Sawing
- Trimming

4.2 WELDING

Welding is a process of joining two metal pieces by the application of heat. Welding is the least expensive process and widely used now a days in fabrication. Welding joints different metals with the help of a number of processes in which heat is supplied either electrically or by mean of a gas torch. Different welding processes are used in the manufacturing of Auto mobiles bodies, structural work, tanks, and general machine repair work. In the industries, welding is used in refineries and pipe line fabrication. It may be called a secondary manufacturing process.

Classification of welding processes:

There are about 35 different welding and brazing process and several soldering methods, in use by the industry today. There are various ways of classifying the welding for example, it may be classified on the basis of source of heat (flames, arc etc.)

In general various welding processes are classified as follows.

1: Gas Welding

(a): Air Acetylene

(b): Oxy Acetylene

(c): Oxy Hydrogen Welding

2: Arc Welding

(a): Carbon Arc welding

(b); Plasma Arc welding

(c): Shield Metal Arc Welding

(d): T.I.G. (Tungsten Inert Gas Welding)

3: Resistance Welding:

(a): Spot welding

(b): Seam welding

(c): Projection welding

(d): Resistance Butt welding

4: Solid State Welding:

(a): Cold welding

(b): Diffusion welding

(c): Forge welding

(d): Fabrication welding

(e): Hot pressure welding

(f): Roll welding

5: Thermo Chemical Welding

(a): Thermite welding

(b): Atomic welding

6: Radiant Energy Welding

(a): Electric Beam Welding

(b): Laser Beam Welding

Welding Joints

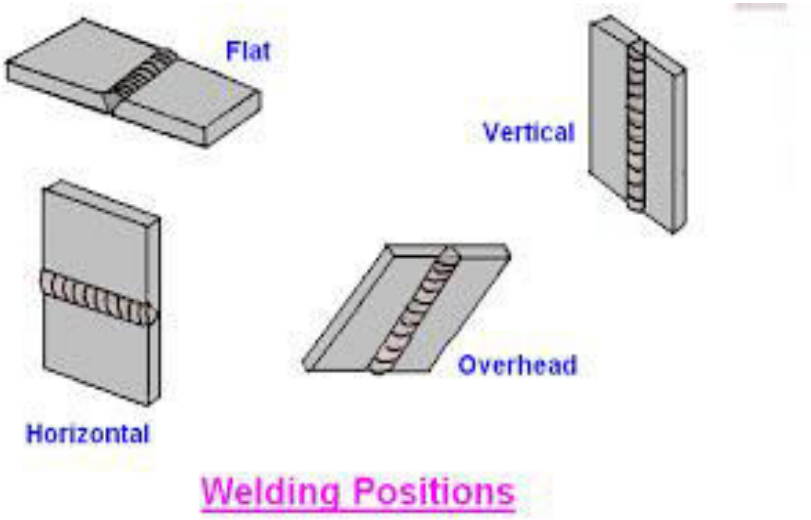


FIG 4.2 WELDING POSITION

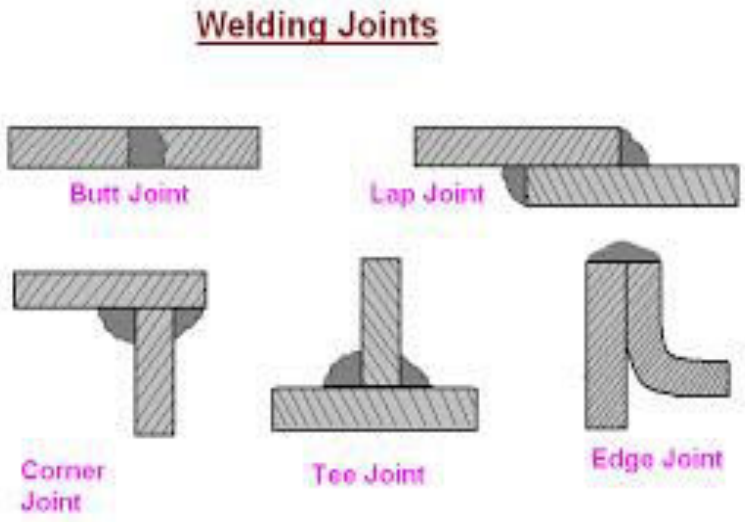


FIG 4.3 WELDING JOINTS

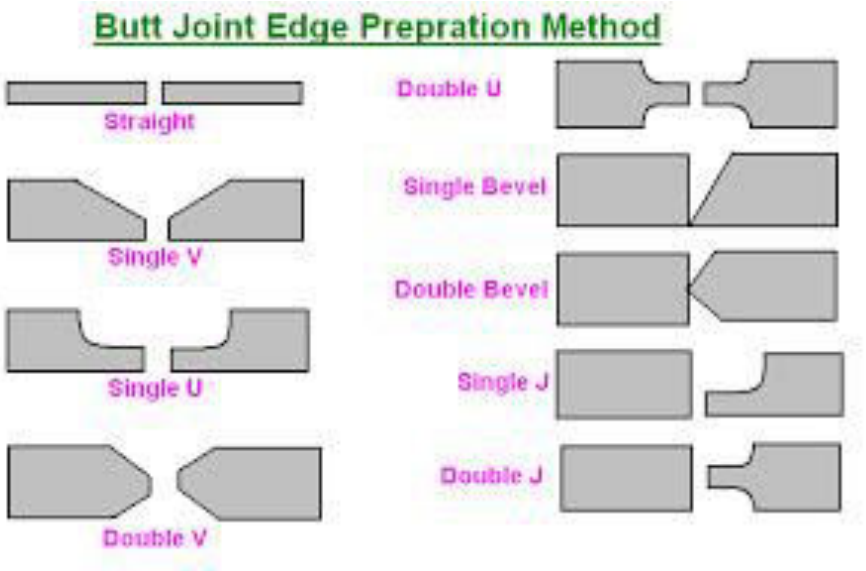


FIG 4.4 BUTT JOINT EDGE PREPARATION

4.3 DRILLING

Drilling is a cutting process that uses a drill bit to cut a hole of circular cross-section in solid materials. The drill bit is usually 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 (swarf) from the hole as it is drilled.

In rock drilling, the hole is usually not made through a circular cutting motion, though the bit is usually rotated. Instead, the hole is usually made by hammering a drill bit into the hole with quickly repeated short movements. The hammering action can be performed from outside of the hole (top-hammer drill) or within the hole (down-the-hole drill, DTH). Drills used for horizontal drilling are called drifter drills.

DRILLING PROCESS:

- Center drilling
- Deep hole drilling
- Gun drilling

- Trepanning
- Micro drilling
- Vibration Drilling

Types of Drilling Jigs:

1. Template jig
2. Plate type jig
3. Open type jig
4. Channel jig
5. Leaf Jig
6. Box type jig

1: Template Jig:

This is the simplest type of jig; It is simply a plate made to the shape and size of the work piece; with the require number of holes made it. It is placed on the work piece and the hole will be made by the drill; which will be guided through the holes in the template plate should be hardened to avoid its frequent replacement this type of jig is suitable if only a few part are to be made.

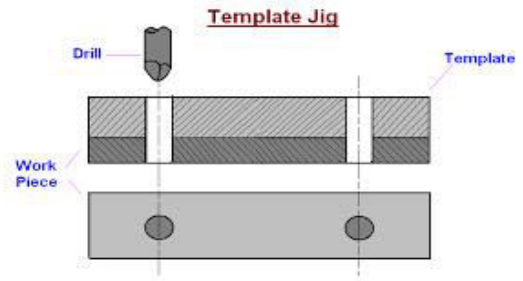


FIG 4.5 TEMPLATE JIG

2: Plate Type Jig:

This is an improvement of the template type of jig. In place of simple holes, drill bushes are provided in the plate to guide the drill. The plate jig are employed to drill holes in large parts, maintaining accurate spacing with each other.

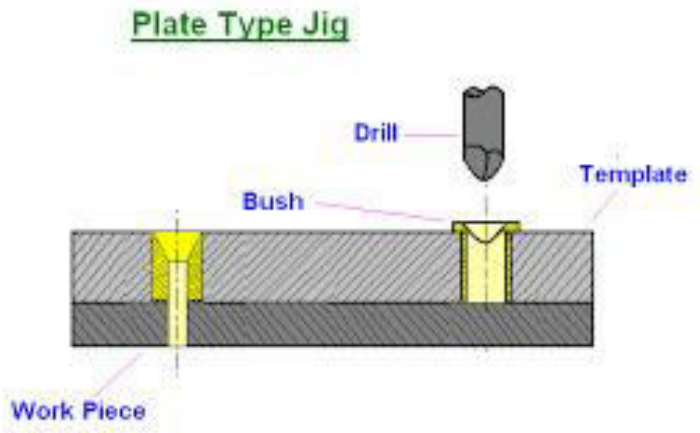


FIG 4.6 PLATE TYPE JIG

3: Open Type Jig:

In this jig the top of the jig is open; the work piece is placed on the top.

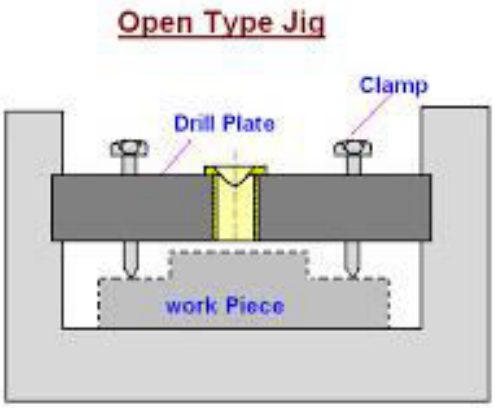


FIG 4.7 OPEN TYPE JIG

4 Channel jig;

The channel jig is a simple type of jig having channel like cross section. The component is fitted within the channel is located and clamped by locating the knob. The tool is guided through the drill bush.

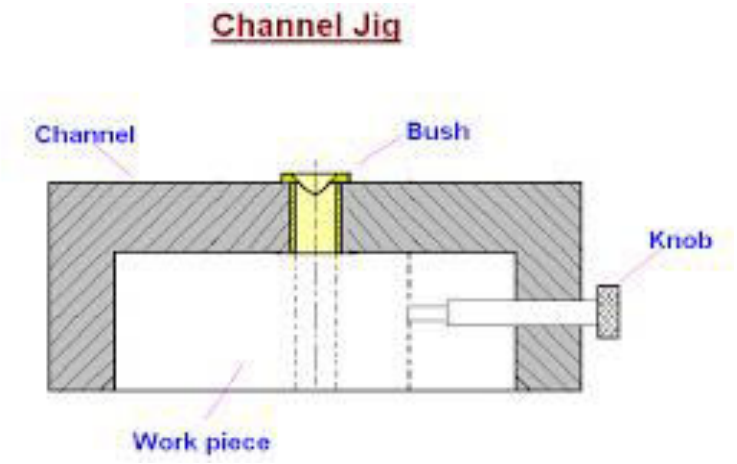


FIG 4.8 CHANNEL JIG

5: Leaf Jig:

It is also a sort of open type jig , in which the top plate is arrange to swing about a fulcrum point , so that it is completely clears the jig for easy loading and unloading of the work piece.

6: Box Type Jig:

When the holes are to drill more than one plane of the work piece, the jig has to be provided with equivalent number of bush plates. For positioning jig on the machine table feet have to be provided opposite each drilling bush plate. One side of the jig will be provided with a swinging leaf for loading and unloading the work piece, such a jig would take the form of a box.

METAL CUTTING OPERATIONS:

1: Blanking:

Blanking is the operation of cutting a flat shape from sheet metal. The product punched out is called the "blank" and the required product of the operation the hole and the metal left behind is discarded as waste.

2: Punching or Piercing:

It is a cutting operation by which various shaped holes are made in sheet metal. Punching is similar to blanking except that in punching, the hole is the desired product. The material punched out from the hole being waste.

3: Notching:

This is cutting operation by which metal pieces are cut from the edge of the sheet, strip or blank.

4: Perforating:

This is a process by which multiple holes are very small and close together are cut in a flat sheet metal.

5: Trimming:

This operation consists of cutting unwanted excess of material from the periphery of a previously formed component.

6: Shaving:

The edge of a blanked part are generally rough, uneven and square. Accurate dimensions of the part are obtained by removing a thin strip of metal along the edges.

7: Slitting:

It refers to the operation of making incomplete holes in a work piece.

8: Lancing:

This is a cutting operation in which a hole is partially cut and then one side is bent down to form a sort of tab. Since no metal is actually removed and there will be no scrap.

9: Nibbling:

The nibbling operation, which is used for only small quantities of components, is designed for cutting out flat parts from sheet metal. The flat parts from simple to complex contours. This operation is generally substituted for blanking. The part is usually moved and guided by hand as the continuously operating punch cutting away at the edge of the desired contour.

Forming Operations:

1: Bending:

In this operation; the material in the form of flat sheet or strip is uniformly strained around a linear axis which lies in the neutral plane and perpendicular it's the length wise direction of the sheet or metal.

2: Drawing:

This is a process of forming a flat work piece into a hollow shape by means of a punch which cause the blank into a die cavity.

3: Squeezing:

Under the operation, the metal is caused to flow to all portions of a die cavity under the action of compressive forces.

INSPECTION

Critical appraisal involving examination, measurement, testing, gauging, and comparison of materials or items. An inspection determines if the material or item is in proper quantity and condition, and if it conforms to the applicable or specified requirements. Inspection is generally divided into three categories: (1) Receiving inspection, (2) In-process inspection, and (3) Final inspection. In quality control (which is guided by the principle that "Quality cannot be inspected into a product") the role of inspection is to verify and validate the variance data; it does not involve separating the good from the bad.

ASSEMBLY

An assembly line is a manufacturing process (most of the time called a progressive assembly) in which parts (usually interchangeable parts) are added as the semi-finished assembly moves from work station to work station where the parts are added in sequence until the final assembly is produced. By mechanically moving the parts to the assembly work and moving the semi-finished assembly from work station to work station, a finished product can be assembled much faster and with much less labor than by having workers carry parts to a stationary piece for assembly.

CHAPTER-5
WORKING PRINCIPLE

5.1 WORKING PRINCIPLE

In this project battery provides the power supply to the control unit. The equipment contains totally six motors, two motors are coupled with the vehicle's left and right wheels of the front side, the next two motors are connected to the vehicle's left and right side of the back side. The four motors are used to run the vehicle. Another two motors are connected to rotate the vehicle wheel 90 degree by the chain drive arrangements.

The keypad in the control unit has six keys are left, right, forward, reverse, park left, and park right. When press the left key in the keypad the vehicle turns left side in a required angle, after that press the right key in the keypad the vehicle turns at right side in a required angle, similarly the forward and reverse motion of the vehicle are controlled by the forward and reverse key in the keypad.

To park the vehicle in left side by press the park left key then the motor connected in the chain drive is turns the wheel left side 90 degree automatically, then the vehicle is parked in the left side, this process is same as right side. Using this easily park the vehicle in various areas.

5.2 ADVANTAGES, DISADVANTAGES AND APPLICATIONS

ADVANTAGES

- Simple in construction.
- Efficient, reliable, safer mode of travelling is achieved.
- Less number of moving parts.
- Separate time for exercise may not be spent.
- Very suitable for exercise-minded people.
- Power generation is done simultaneously.

- Easy to fabricate.
- No need of skilled operators to operate this system.

DISADVANTAGES

- Not suitable for travelling longer distances.
- Not as efficient as motor driven vehicles.

APPLICATIONS

- Applicable in all electrical four wheeler vehicles

CHAPTER-6
DESIGN

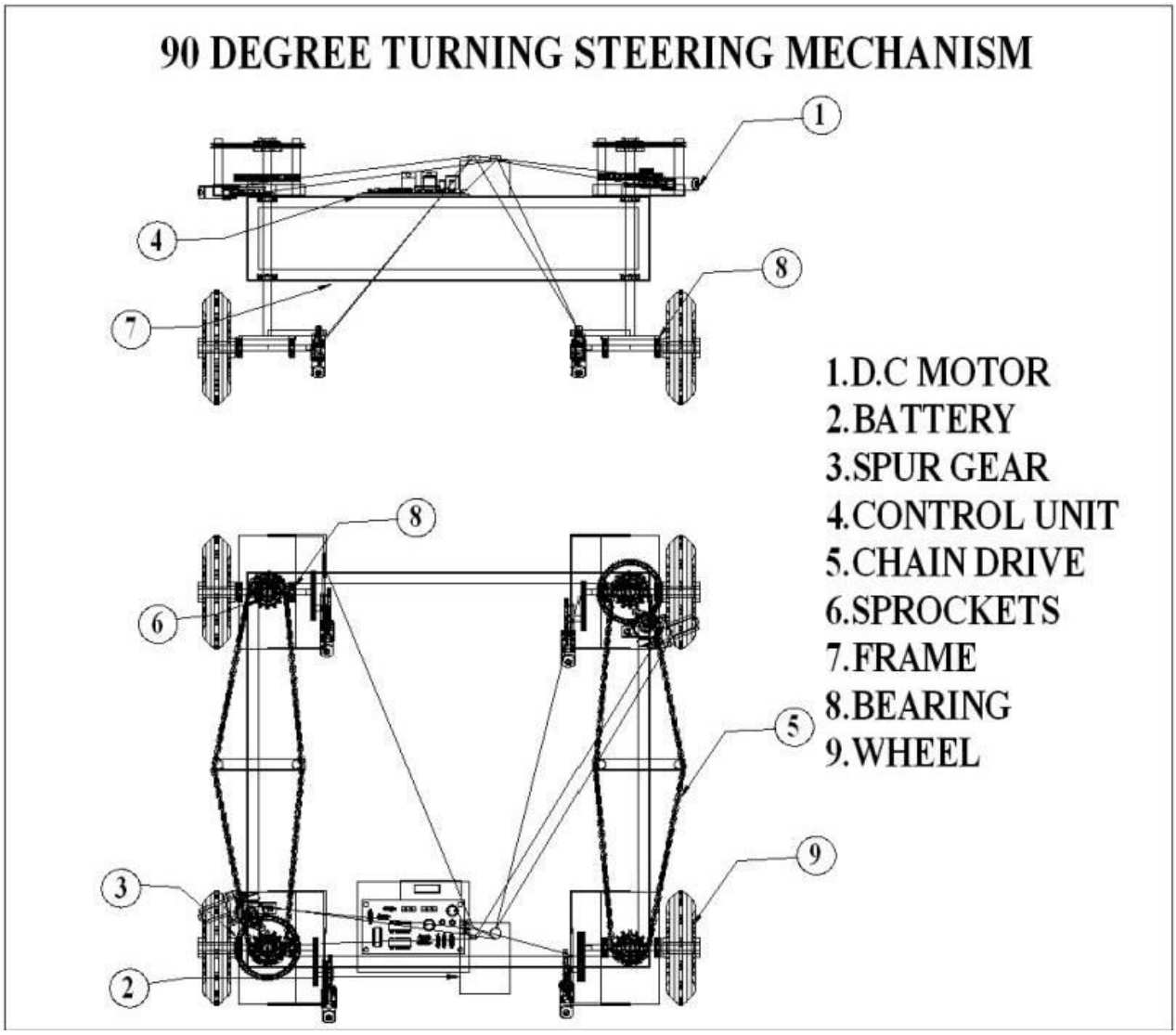


FIG 6.1 DESIGN OF 90 DEGREE TURNING MECHANISM

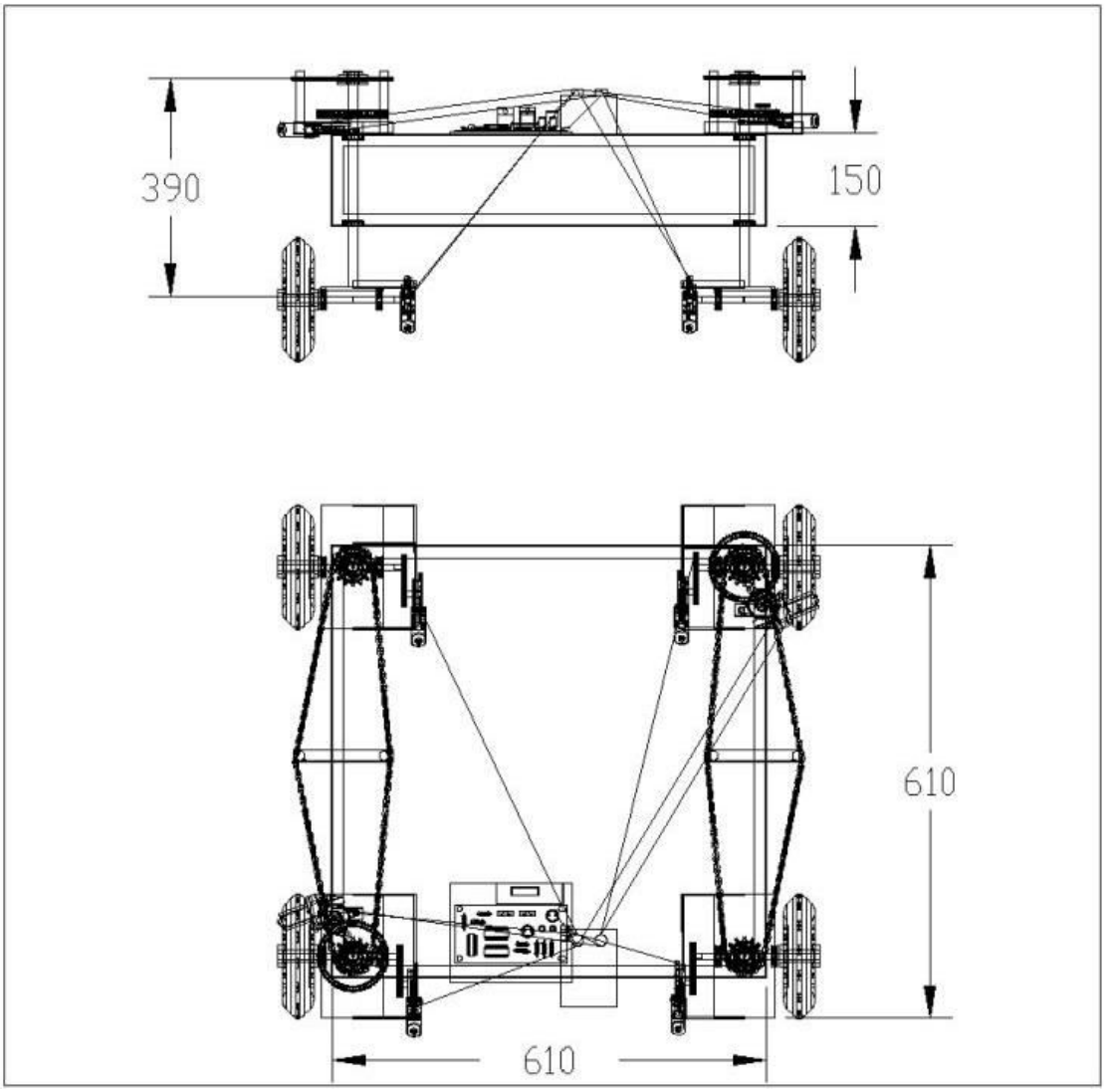


FIG 6.2 DIMENSION OF 90 DEGREE TURNING MECHANISM

CHAPTER-7
COST ESTIMATION

COST ESTIMATION

MATERIAL COST & LABOUR COST

Sl. No.	PARTS	Qty.	Amount (Rs)
1	Battery	1	1200
2	Motor	6	5800
3	Chain drive	2	450
4	Frame	-	900
5	Sprockets	2	300
6	Control unit	1	200
7	Spur gear	12	750
8	Bearing & bearing cap	16	500
9	Miscellaneous cost	-	3000
10	Machining cost	-	2000
11	Labour cost	-	900
		TOTAL =	**16000**

TABLE 7.1 COST ESTIMATION

CHAPTER-8
HARDWARE OUTPUT

FIG 8.1 SNAPSHOT OF 90 DEGREE TURNING MECHANISM

CHAPTER-9
CONCLUSION

CONCLUSION

The problem for the project was to design a car which steers through 90 degrees. 90 degree steering mechanism basically helps to reduce the efforts and space required for a person to steer his vehicle. The 90 degree steering mechanism is established using rack and pinion mechanism which is feasible to manufacture, easy to set up, and highly efficient in attaining counter-phase. A new absolute eco-friendly vehicle with independent, low emission transportation by using electric motors of proper specifications possible for people who utilize wheel chair is designed, with a rear entry facility. Components used in this system are easy to manufacture, material used is feasible, reliable and easily available in market. The main disadvantage of this system is that it can run only at a maximum speed of 35Km/h. An advanced system of solar cells can be used on the roof of the car thereby making the system partially recharging.

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