A

MAJOR PROJECT REPORT ON

"WHEEL BASED AGRICULTURE FERTILIZER SPRAYER"

SUBMITTED TO

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In partial fulfillment of the requirements for the award of the degree of Bachelor of Technology in

DEPARTMENT
OF
MECHANICAL ENGINEERING

SUBMITTED BY

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Paloncha Bhadradi Kothagudem dist, Telangana
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PALONCHA BHADRADRI KOTHAGUDEM DIST, TELANGANA

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CERTIFICATE

Certified that this is a bonafide record of the dissertation work entitled *"WHEEL BASED AGRICULTURE FERTILIZER SPRAYER"* done by K.SAI TEJA (18QT1A0304) submitted to the faculty of Mechanical Engineering, in partial fulfillment of the requirements for the Degree of BACHELOR OF TECHNOLOGY with specialization in MECHANICAL ENGINEERING from KLR College of Engineering and Technology – Paloncha.

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With Gratitude

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DECLARATION

I hereby declare that the project entitled ***"WHEEL BASED AGRICULTURE FERTILIZER SPRAYER"*** is submitted to **KLR COLLEGE OF ENGINEERING & TECHNOLOGY** in partial fulfillment of the requirement for the award of Degree of Bachelor of Technology in Mechanical Engineering by JNTUH, the project is done by us and not has been submitted to any other institute or university for the award of any degree or equivalent.

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ABSTRACT

Majority of the sprayer pumps available in market are back mounted, hand pumps that are used to spray pesticides. Pesticide spray pump have to be pumped manually and then carried on the back for spraying in the fields. Agriculture sprayer vehicle operates the pump automatically as it moves, pump is mounted on vehicle so no stress to operator, very low cost. The pumping mechanism is connected to the rear wheel shaft through a gear train. Thus motion of the wheel is converted into automatic pumping of the pumping system. Earlier designs were wither top mounted piston handle pumps or side mounted handle piston Pumps. Both of them are to be carried on the back. Thus the spraying pressure is developed only when the handle is pumped. This causes fatigue and makes the operator tired. For spraying action, the pump is to be continuously pumped by hand to develop sprayer pressure inside the tank, so also the pump with the filled liquid is heavy and has to be carried on the back, hence a simple system that pumps fluid and carries the pump on a vehicle so that operator does not have to carry the pump is needed. Crank link operated pump works automatically when vehicle is moved. The pumping mechanism is connected to the rear wheel shaft through a gear train. Thus motion of the wheel is converted into automatic pumping of the pumping system. Pump is carried on the moving vehicle, the pump is provided with two additional mechanism namely to uniformly spray the pesticides on the crop and secondly a solid fertilizer sprayer with the help of wheel motion. Project work involves the design development analysis of components, fabrication of the unit and testing the equipment to find performance parameters.

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CHAPTER-1

INTRODUCTION

1.1 INTRODUCTION:

Agriculture plays a vital role in Indian economy. Around 65% of population in the state is depending on agriculture. Although its contribution to GDP is now around one sixth, it provides 56% of Indian work force. The share of marginal and small farmer is around 81% and land operated is 44 % in 1960-61. As far as Indian scenario is concerned, more than 75 per cent farmers are belonging to small and marginal land carrying and cotton is alone which provide about 80 % employment to Indian workforce. So any improvement in the productivity related task help to increase Indian farmer's status and economy. The current backpack sprayer has lot of limitation and it required more energy to operate. The percentage distribution of farm holding land for marginal farmers is 39.1 percentage, for small farmers 22.6 percentage, for small and marginal farmers 61.7 percentage, for semi-medium farmers 19.8 percentage, for medium farmers 14 percentage and for large farmers 4.5 percentage in year 1960- 61.Clearly explain that the maximum percentage of farm distribution belonged to small and marginal category.

- Distances (horizontal & Vertical) and height of crop:

Sr. no.	Name of crop	Distance between plants (horizontal/vertical)	Height of crop
1.	Sorghum	15 inch /3-4 inch	5.5-7 feet
2.	Pearl millet	15 inch /3-4 inch	5.5-7 feet
3.	Sugarcane	15 inch /3-4 inch	5.5-7 feet
4.	Soybean	15 inch /2 inch	5.5-7 feet
5.	Corn	15 inch /3 inch	5.5-7 feet
6	Groundnut	15 inch / 3 inch	1.5 feet
7.	Cotton	24-36 inch /24-36 inch	2-5 feet
8.	Pigeon Pea	15 inches / 6 inches	3-4 feet

TABLE 1: CROP DISTANCE AND HEIGHTS

1.2 Problem Summary:

The farmers who use these types conventional backpack sprayer faces many types of problems like fatigue, tiredness, pain in spiral cord and muscles etc. Following problems can take place by use of this conventional type of pump.

1.3 Common Problems:

1. Heavy in weight causes difficulty in lifting manually.
2. Fatigue to the operator due to heavy weight.
3. Due to heavy weight during spraying, operator feel very tiredness and fatigue which reduces his efficiency.
4. Big size of pump cause inconvenience to the operator.
5. Poor selection and quality of equipment.
6. These problems combined with a lack of awareness and technical knowledge and inadequate maintenance and poor field use of equipment has led to unacceptable risks to environment and human health.

CHAPTER-2

LITERATURE REVIEW

2. Literature Review

2.1 About Pumps:

The pump, at its recommended rotational speed, should have sufficient capacity to ensure that the sprayer operates efficiently when fitted with the largest recommended size of nozzles operating at the maximum rated pressure plus an additional 20% to account for nozzle tolerances and to provide tank agitation.

It should be possible to remove the pump from the sprayer without draining the tank(s).

The pump should be permanently marked with:

- Maximum flow rate and operating pressure
- Recommended and maximum rotational speed
- Name and address of manufacturer
- Model/type and year of manufacture

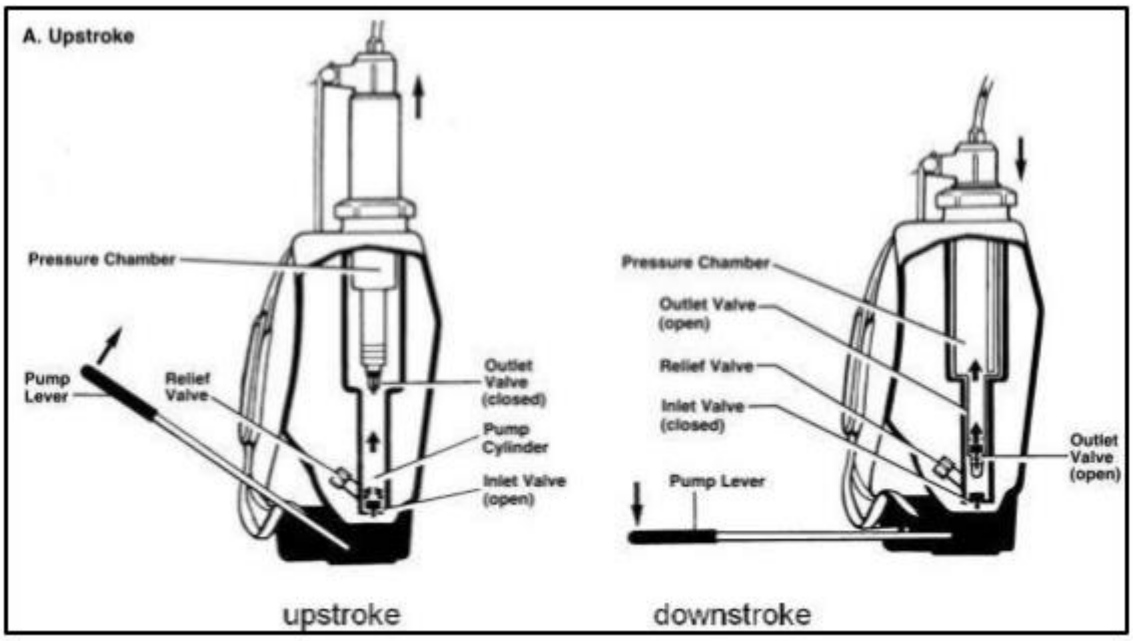
2.2 Hand-Operated Sprayers:

There are various types of hand-operated sprayers, but they can be broadly categorized into two groups:

2.2.1 Sprayers with hydraulic nozzles

Designed with systems to generate pressure at the Nozzle to achieve correct atomization. With lever-operated sprayers the main tank is not pressurized, but spray pressure is generated in a Pressure chamber by constant pumping. With compression sprayers, the whole tank is pressurized prior to spraying.

Mechanism Lever-Operated Knapsack Sprayer:



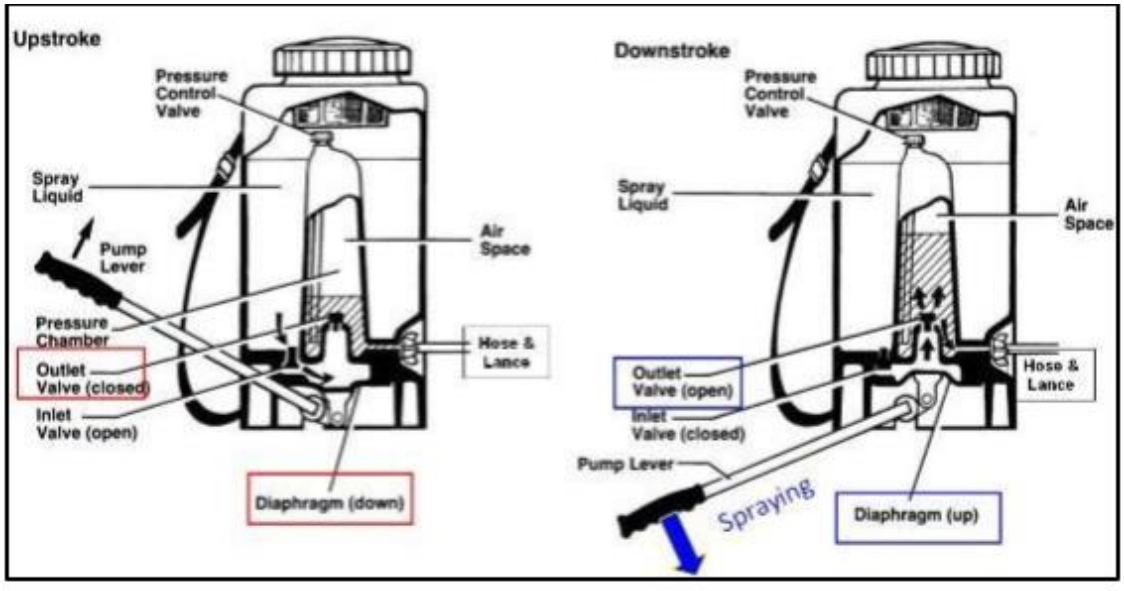


Fig.1: Lever operated knapsack sprayer

2.2.2 Rotary atomizers:

Which generate spray droplets from a spinning disc or cup. These types typically apply low volumes of spray liquid per hectare. These Low volumes mean that higher concentrations of spray liquid are applied; this makes them unsuitable for some products. In particular they should never be used for parquet application as the concentrations are likely to exceed recommended dilution rates.

1. Sprayer with centrifugal-energy nozzles
2. Electrostatic spraying equipment
3. Rope-wick herbicide applicators

2.3 Supplementary Points:

Hand-operated, hydraulic sprayers or hand-held spinning disk sprayers are commonly use in Asian countries in applying pesticides. Sprayers with centrifugal-energy nozzles are also termed "controlled droplet application (CDA) sprayers" Rope-wick herbicide applicators were developed specifically to apply low volumes of highly concentrated herbicides, to weeds that grow taller than crops. The herbicide solution is rubbed on any weeds that come into contact with the rope wick.

2.4 Selection of Sprayer:

First of all, it is important that buying agencies should select the type of sprayer which is most appropriate for the purpose intended. The notes below will assist in selection. When selecting a sprayer, it is good to identify the range of uses to which it will be put. Certain types of sprayers are suitable for certain types of pesticides. For example, diaphragm pump type lever-operated knapsack sprayer is ideally suited for herbicide application. For safety, it is also very important to investigate the particular make of machine. For example, stainless steel tanks are better than galvanized metal since they are not subject to corrosion.

2.4.1. Lever-operated knapsack sprayers:

Diaphragm pumps - are suitable and are a durable option where applications are made through a single nozzle. They are also suitable for multi-nozzle booms where relatively low spraying pressures are adequate (1 bar). Piston pumps - are suitable for single nozzle use and are preferred to diaphragm pumps for multi-nozzle use where higher pressures are required (to 4 bars). 13 Push Operated Spray Pump. Underarm levers are preferred to over-arm levers except where crop conditions impede the movement of the lever.

2.4.2 Motorized hydraulic knapsack sprayers:

These units can make good sense in high value crops for use with multi-nozzle booms where prolonged pumping, even with a piston machine, is not practical.

2.4.2.1 Compression Sprayers:

Compression sprayers are necessary where field conditions make lever-operated machines impractical, for example on steep slopes and in dense crop foliage. They are also used in grain stores to treat wall surfaces.

NOTE: The output from this type of sprayer declines during the pressure cycle unless a flow control valve is fitted to the sprayer.

2.4.2.2 Motorized Mist blowers:

Motorized mist blowers are used where the spray cloud needs to be projected vertically to treat trees, but may be used to spray horizontally for multi-row and bush crop spraying. They can also be adapted for granule application. They are not recommended for herbicide application.

2.4.2.3 Nozzle Choice:

The provision of the correct nozzle for the job enables safer and more efficient spraying. Appropriate nozzles for the intended task should be supplied with the equipment. A minimum of one nozzle type suitable for herbicide application and one for fungicide/insecticide application shall be supplied with the equipment. Deflector nozzle (also called impact, flood or anvil nozzles) is used for single nozzle application of soil applied herbicides. Flat fans are best for spraying products onto flat surfaces: for foliar applications, the application of herbicides to soil and insecticides onto walls for control of stored product pests. Hollow cone nozzles are used for general spraying of foliage and give good coverage of the outer parts of a canopy (used to apply insecticides and fungicides). Solid cone nozzles are used for spot and band spraying. Adjustable multipurpose nozzles are not recommended for crop protection use. Spray quality is difficult to reproduce and this type of nozzle encourages operators to adjust and touch nozzles contaminated with pesticide.

2.4.2.4 Knapsack Sprayers:

Fig. 2: Knapsack sprayers

- Any sprayer which is carried on the back of the operator is called a knapsack sprayer
- The commonly used manually operated knapsack sprayer will have one hydraulic pump working inside the container
- The plunger works inside the replacement well attached at the bottom of the container, for easier maintenance
- The pump can be operated through the appropriate linkages by oscillating the handle, with the sprayer carried on the back
- An agitator is also provided with the pressure chamber to agitate the fluid so that the particles in suspension will not be allowed to settle down
- A delivery tube is attached on the other end of the pump which carries the pressurized fluid to the spray lance

The knapsack sprayer develops 30 - 40 psi pressure

Pump Type	Plus Point	Minus Point
1.Compreesion	Free hand Compact	Pressure drop
2. Piston	Constant pressure Big pressure range Easy service Easy cleaning	High wear rate
3.Diaphragm	Constant pressure Wear resistant More volume/stroke	Small pressure range More parts

TABLE 2: PUMP ADVANTAGES AND DISADVANTAGES

2.5 Application Method and Choice of Equipment:

Insecticides and fungicides are usually applied as foliar sprays, and herbicides are mostly sprayed either onto the foliage or the soil. Thus spraying of liquid and wet table powder formulations is the most common method of application and consequently a wide variety of hand-operated and power-driven spray apparatus has been developed over the years. Other formulations such as granules, dusts and fumigants require different equipment for their application or none at all. For example, granules can either be applied by mechanical spreaders or broadcast by hand. In Asian countries, most pesticides are applied with small, hand operated, hydraulic sprayers or hand-held spinning disc sprayers.

Depending on the type of agricultural practices and economic development of the area, mist-blowers and power-operated hydraulic or rotary cage sprayers mounted on tractor or aircraft may also be used extensively.

CHAPTER-3

DIFFERENT TYPES OF SPRAYERS

3.1 Manually operated sprayers:

3.1.1 Plastic Pesticide Sprayer:

Fig. 3: Plastic pesticide sprayer

Pesticides are ideal for spraying on fields for protecting the crops against many deadly diseases. They are offered at competitive prices and have the following features:

3.1.1.1 General Features:

- 13 to 16 litres tank capacity
- Plastic Pump Barrel with brass Sleeve
- Centrally mounted pump assembly
- Minimum metal parts to avoid corrosion
- Diaphragm valves for efficient performance

3.1.1.2 Limitations:

- Low delivery pressure compare to HI-TECH sprayer
- Little Heavy in weight
- Maintenance cost is high
- Bigger size

3.1.2 HI-TECH Sprayer:

Fig. 4 : HI-TECH Sprayer

3.1.2.1 General Features:

- Recommended as "Most Efficient & Comfortable Sprayer"
- Economically designed.
- 16 Litres capacity blow moulded tank from High Density Polyethylene.
- Pump is centrally placed outside the tank and has smaller piston diameter, hence easy for operation as balance is perfectly maintained.
- Adjustable shoulder straps
- Right or left operation
- Replaceable tubular frame
- Shoulder strap hanger & Tubular frame moulded on tank
- Strong construction and easy operation
- Majority of parts coming into contact with chemical are made from durable plastic material
- Develops sufficient pressure with a few strokes
- Bigger filler hole and Breather hole in strainer allows filling of spray solution without Spilling
- Competitive price

3.1.3 Knapsack Sprayer:

Fig. 5 : Knapsack sprayer

3.1.3.1 General Features:

- 16 litters tank capacity, brass tank and base metal
- It can be operated both ways with the change of handle
- Brass forged parts, brass pressure chamber
- Brass trigger cut off device
- Brass triple action nozzle
- Delivery hose pipe 110 cm long
- Spare part kit (piston, bushes, fitting & rubber washers etc.)
- Total net weight: 6.2 kg

3.1.3.2 Limitations:

- Low delivery pressure compare to HI-TECH sprayer
- Heavy in weight
- Maintenance cost is high
- Bigger size
- Hydraulic pump is extreme left or right side of pump so Load develops left or right side during oscillating the handle.

3.1.4 Foot sprayers:

Fig. 6 : Foot sprayer

- The pump in the foot sprayer consists of a pump barrel and a pressure chamber
- The pump is fixed in a vertical position with necessary braces
- The plunger moves up and down when operated by the pedal
- A ball valve is provided in the plunger assembly itself to allow the fluid to cross the plunger and getting pressurized in the pressure vessel
- During the upward motion of the piston fluid is sucked in and pressurized into the pressure vessel and during downward movement, the sucked fluid crosses the plungers and enter the pump
- The sprayer develops a pressure of 60 - 80 psi and has a provision for attaching two discharge lines

3.1.5 Rocker sprayers:

Fig. 7: Rocker sprayer

- The rocker sprayer has a pump assembly, fixed on a wooden platform with an operating lever, a valve assembly with two ball valves, a pressure chamber, suction hose with strainer, and delivery hose with spray lance
- When the plunger is pulled behind by pulling the lever way from the pump, the spray fluid from the container is sucked through the strainer and pushes the bottom ball valve above and enters the pump
- The movement of the lower ball valve is arrested by the upper valve seat
- When the lever is pushed towards the pump, the sucked fluid is forced to enter the pressure chamber by opening the upper ball valve
- The operation is continued till the entire suction pipe, ball valve assembly, delivery hose and a portion of pressure vessel is fitted with spray fluid and the pump operator finds it difficult to push the piston forward, due to the downward pressure developed by the entrapped compressed air in the pressure vessel
- Thereafter, the trigger cut off valve will be opened to allow the spray fluid to rush through the nozzle and get atomized
- Usually 60 - 80 psi pressure can be built in the pressure chamber and hence can be conveniently used for tree spraying

3.1.6 Hand Compression sprayers:

Fig. 8 : Hand compression sprayer

- The tank is a pressure vessel in which the liquid is filled to two - third capacity
- It is then pressurized to 60 psi by means of the air charge pump
- A pressure gauge or safety valve may optionally be fitted to the tank
- A pressure regulator may also be used when the discharge pressure needs to be strictly controlled

3.1.7 Stirrup Sprayers:

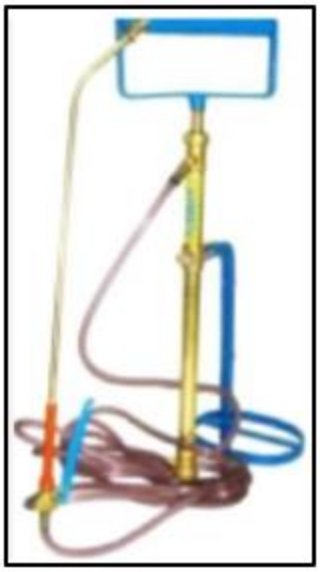


Fig.9 : Stirrup sprayer

- The stirrup sprayer is designed to pump the spray fluid directly from, the open container, usually a bucket

- The hydraulic pump will be put inside the bucked and held properly with the help of foot rest
- As the plunger is pulled up, the fluid enters through the suction ball valve assembly and when the plunger is pressed down, the suction valve closes and the fluid enters the pressure chamber through a ball valve assembly
- As the plunger is continuously worked, pressure is built in the pressure chamber and the delivery hose
- As soon as the required pressure is built up, the spraying will be done
- A stirrup sprayer develops 30-40 psi pressure

3.1.8 Nursery sprayers

Fig. 10 : Nursery sprayer

- It has a hydraulic pump inside the container, with cylinder, plunger and a plunger rod
- By operating the plunger up, the spray fluid in the container is sucked into the cylinder through a ball valve assembly and then pressurized during the downward stroke
- The pressurized fluid is then let out through a nozzle, and sprayed into fine droplets
- These are small, simple sprayers, generally recommended for use in a nursery or private garden
- They produce a fine mist spray and can be effortlessly operated.

3.2 Power Operated Sprayers:

3.2.1 Knapsack Power Sprayer:

Fig. 11: Knapsack power sprayer

Knapsack Power Sprayer easy to use and highly durable. Designed in sync with the industrial standards, these sprayers are immensely used for garden spraying-weed, pest control, liquid fertilizing and plant leaf polishing. General Technical Specifications:

3.2.1.1 General Features:

- Spraying Capacity - 8 litres/min
- Capacity of Chemical tank - 25 litres
- Capacity of Fuel tank - 1.1 litres
- Net Weight - 10.5 Kg
- Engine Type - 2 Stroke
- Petrol Displacement - 22 cc

3.2.1.2 Limitations:

- Heavy in weight
- Maintenance cost is high
- Big in size
- Cost of fluid is very high
- Service life is low
- Initial cost is high
- Maintenance is complicated
- Due to heavy weight during spraying one will feel very tiredness and fatigue
- Make environment pollute
- Corrosion can take place on parts

3.2.2 Motorized Knapsack Mistflower cum duster:

Fig. 12: Motorized knapsack mistflower cum duster

- This sprayer cum duster is fitted with a two-stroke air cooled engine of 35 or 70 cc capacity, connected to a centrifugal fan by a direct drive
- The spray liquid is first pressurized by air generated by the blower. This air current achieves a velocity of over 275 kmph at the nozzle, and sprays the chemical in fine particles than can be measured in microns
- The nozzle design enables even spraying at maximum efficiency

- When dusting, the air blast enters the tank from an air inlet, which is connected, to a tube with several holes on its surface
- This agitates the powder which is then thrust out by the velocity of the air coming out of the blower, through the pleated hose and out through the nozzle.

3.3 Boom sprayers:

Fig. 13: Boom sprayer

These apply the spray liquid through nozzles which are normally directed downwards and mounted on a horizontal structure (boom) and are generally used to spray low-growing arable (field) crops and weeds. Some models employ air to aid downward penetration of droplets into low-growing cereals and other crops.

3.4 Tree and bush crop sprayers:

These machines are designed to treat taller crops and commonly incorporate a fan to create an air stream, which is directed "sideways and upwards" to propel the droplets into the crop canopy from nozzles mounted on a boom positioned in or beside the air stream. Some models do not use an additional air stream but an arrangement of nozzles on the boom directed towards the target.

3.5 Airless Sprayers:

Airless spray systems atomize coating by forcing a fluid through a small orifice at high pressure. (Think garden hose water sprayer.) They are prized for their high reduction rates that can exceed 2 gallons per minute for larger models. Airless sprayers provide pressure from either a diaphragm or piston pump unit driven by an electric, gasoline, or air power motors.

Some models use a hydraulic driven pump powered by electricity or gasoline power. The hose is an integral part of the system. Its expansion and contraction provides volumetric cushioning of the fluid to provide steady paint flow at the tip. It also conducts static electricity build up

back to the sprayer where it can be grounded. Two things primarily determine the capacity of an airless sprayer: Horsepower and valve Openings.

Many companies use one pump on a variety of models. The difference comes from the motor and power train with changes in horsepower or motor type. Bigger pumps have bigger valves and bigger valves mean more heavily fluids can pass through. One of the most important rules with airless sprayers is to keep the pump clean. A dirty or rusted piston pump will quickly destroy itself by eroding its pickings, rod, cylinder and or valves. Greco sprayers are some of the best known on the market. They have a selection of pumps that fill just about every niche one can think of for spraying liquid coatings. Their recent homeowner line, the "Magnum" series is an attempt to bring piston pump sprayers to the homeowner/DIY buyer. These are different than their professional equipment because they are made with less durable materials and a sport only a single action pump. They feature some of the desirable properties of their larger brethren such as upright carts, hose reel on the handle, manifold filters etc. However, much of this is light duty from a usage point of view and these were not made for continuous use. In fact, parts for the Magnum series are limited with pump repack kits not made at all. Stronger motors can push higher loads of paint through larger orifices and increase production for professional users. Bigger pumps with larger valves are required for heavier viscosity liquids or for fulfilling the needs of large volume users and these take bigger and bigger motors. Sprayers can be powered with electric, gasoline, hydraulic or air motors. The professional painting contractor usually uses portable electric motor equipment but for areas where electricity may not be available such as on large warehouse projects, high rises, or new construction, gasoline power is preferred. Air motors are typically used inside factories or shop application where large compressors can keep them going without threat of fire or heat build up.

Hydraulic units are actually powered by gasoline or electric motors but produce more power in a more compact design with less wear than if an equivalent electric or gas motor. Of course, the hydraulics adds complexity to the overall package and cost at the time of purchase. Specialty units include texture sprayers for application of wall finishes such as spatter coat or knockdown. These combine a specialty pump designed for heavy liquids and an air compressor to spray the material on the wall.

3.6 Tractor mount sprayers/Piston Power sprayer:

Fig. 14 : Tractor mount sprayer

- As the name indicates, this sprayer is attached to a tractor for use
- The pump is driven by the PTO shaft of the tractor, and the sprayer unit sucks the chemical and discharges it through the spray boom, or through the discharge line consisting of a delivery hose and spray guns
- The sprayer unit alone is ideal for feeding pressurized fluids into boilers & for other industrial purposes.

CHAPTER-4

PARTS OF SPRAYER PUMP

4.1 Every Spray pump must have:

- A cut-off valve
- An extension rod-straight or goose-neck
- An appropriate nozzle

4.1.1 Cut-off Valves:

Fig. 15: Cut-off valves

- These are spring-activated (trigger control) or operated by means of a simple knob or trap.

4.1.2 Extension Rod:

Fig. 16: Extension rod

Comes in varying lengths, according to customer requirements but lengths longer than 90 cm are difficult to handle.

- For tree spraying, bamboo lances i.e. brass tubes inserted into a hollow bamboo are recommended

The larger diameter of the bamboo helps to off-set the length of the lance (up to 2.5 meters, making it easier to handle).

4.1.3 Nozzles:

4.1.3.1 Hollow Cone Nozzles-Disc and Core type:

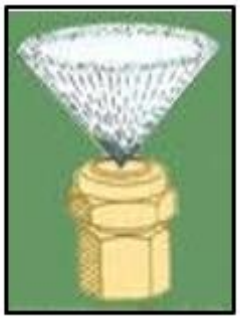


Fig 17 : Hollow cone nozzle

- These are used primarily where plant foliage penetration is essential for effective insect and disease control, and where drift is not a major consideration
- At pressures of 40 - 80- psi hollow cone nozzles give excellent spray coverage to the undersides of reduces penetration correspondingly

4.1.3.2 Flat Fan nozzle:

Fig. 18: Flat fan nozzle

- These are used largely for broadcast spraying, where foliar penetration and coverage

The best operating pressure for flat fan nozzles is 15 - 30 psi, which produce coarser droplets that are not susceptible to drift.

4.1.3.3 Adjustable nozzles:

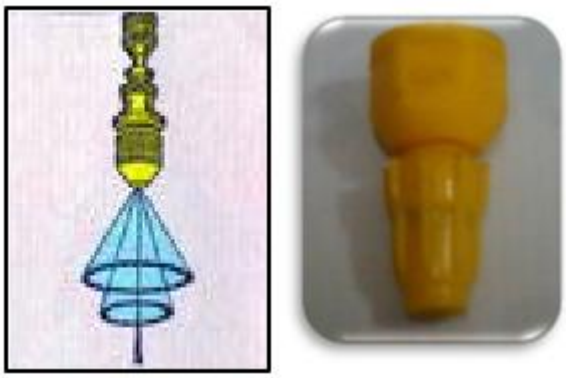


Fig. 19 : Adjustable nozzle

- This model is capable of producing a cone spray in various angles, and also a solid or broken jet spray.

4.1.3.4 Double swivel nozzles:

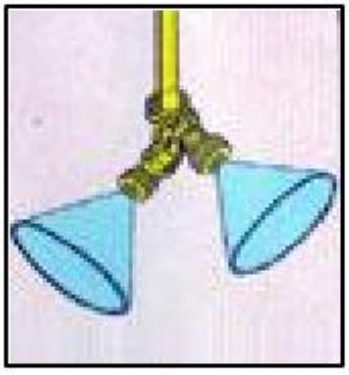


Fig. 20 :Double swivel nozzle

This has two swivel nozzles instead of one, capable of independent movement are not essential

4.1.3.5 Solid-cone Nozzle :

- This nozzle sprays a circular (conical) pattern of droplets, which are evenly distributed over the whole circle with the centre being filled too. It typically produces smaller spray angles and larger droplets and so is used for spot treatments of herbicides or situations where greater downward penetration of spray is required, but tends to be used mainly for tractor boom spraying.

4.1.3.6 Even Flat-fan Nozzle:

- This nozzle with an even spray-tip provides uniform distribution across the entire width of the spray band. The even pattern makes it suitable for band spraying in pre- and post-emergence herbicide application and for the spraying of walls.

4.1.3.7 Flood-jet Nozzle:

Also called as deflector, impact or anvil, produces a wide-angle flat-fan spray pattern. More droplets land at the outer edges of the fan and the pattern is rather uneven. Impact nozzles are operated at low pressure for preened post-emergence herbicide and liquid fertilizer applications. At high pressure, very small droplets can be produced.

CHAPTER-5

FABRICATION

5.1 MATERIALS REQUIRED FOR FABRICATION

Solid characteristic screening solid composition and cost of materials influences the choice of material to be used in sieve mesh. The sieve is made of some kinds of steel and aluminium to avoid corrosion of such equipment. Since it operates on open space and consumable substance. Other materials like stainless steel, nickel, galvanized metal and copper, could be used but were disregarded due to their high cost and some other characteristics which they could not make up for, by this, their usage was limited.

5.1.1 Shaft

A shaft is a rotating machine element, usually circular in cross section, which is used to transmit power from one part to another, or from a machine which produces power to a machine which absorbs power. The various members such as pulleys and gears are mounted on it.

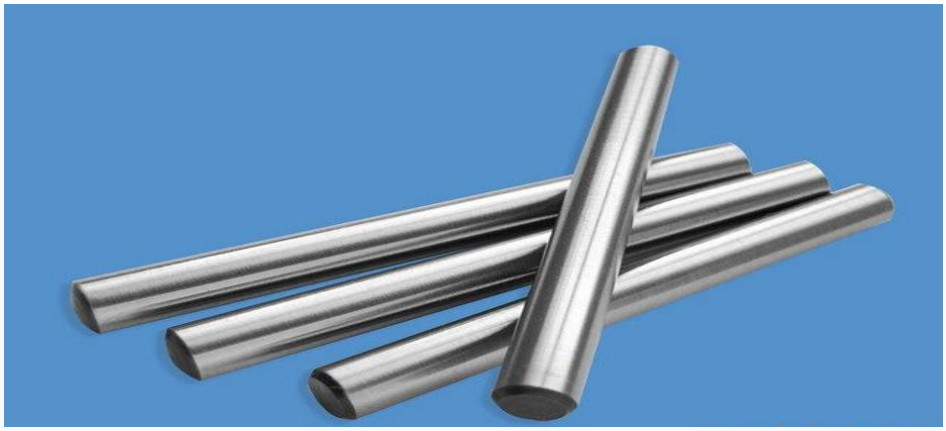


Fig- 21: shafts

Contents

They are mainly classified into two types.

- Transmission shafts are used to transmit power between the source and the machine absorbing power; e.g. counter shafts and line shafts.
- Machine shafts are the integral part of the machine itself; e.g. crankshaft.

5.1.2 Material

The material used for ordinary shafts is mild steel. When high strength is required, an alloy steel such as nickel, nickel-chromium or chromium-vanadium steel is used.

Shafts are generally formed by hot rolling and finished to size by cold drawing or turning and grinding.

The following stresses are induced in the shafts.

1. Shear stresses due to the transmission of torque (due to torsional load).
2. Bending stresses (tensile or compressive) due to the forces acting upon the machine elements like gears and pulleys as well as the self weight of the shaft.
3. Stresses due to combined torsional and bending loads.

Design stresses

The maximum permissible (design) stresses in bending (tension or compression) may be taken as:

1. 112 N/mm^2 for shafts with allowance for keyways.
2. 84 N/mm^2 for shafts without allowance for keyways.

The maximum permissible (design) shear stresses may be taken as:

1. 56 N/mm^2 for shafts with allowance for keyways.
2. 42 N/mm^2 for shafts without allowance for keyways.

5.1.3 HOLLOW STRUCTURAL SECTION

A hollow structural section (HSS) is a type of metal profile with a hollow tubular cross section. The term is used predominantly in the United States, or other countries which follow US construction or engineering terminology.

HSS members can be circular, square, or rectangular sections, although other shapes such as elliptical are also available. HSS is only composed of structural steel per code.

HSS is sometimes mistakenly referenced as hollow structural steel. Rectangular and square HSS are also commonly called tube steel or structural tubing. Circular HSS are sometimes mistakenly called steel pipe, although true steel pipe is actually dimensioned and classed differently from HSS. (HSS dimensions are based on exterior dimensions of the profile pipes are also manufactured to an exterior tolerance, albeit to a different standard.) The corners of HSS are heavily rounded, having a radius which is approximately twice the wall thickness. The wall thickness is uniform around the section.

In the UK, or other countries which follow British construction or engineering terminology, the term HSS is not used. Rather, the three basic shapes are referenced as CHS, SHS, and RHS, being circular, square, and rectangular hollow sections. Typically, these designations will also relate to metric sizes, thus the dimensions and tolerances differ slightly from HSS.

Use in structures

HSS, especially rectangular sections, are commonly used in welded steel frames where members experience loading in multiple directions. Square and circular HSS have very efficient shapes for this multiple-axis loading as they have uniform geometry along two or more cross-sectional axes, and thus uniform strength characteristics. This makes them good choices for columns. They also have excellent resistance to torsion.

HSS can also be used as beams, although wide flange or I-beam shapes are in many cases a more efficient structural shape for this application. However, the HSS has superior resistance to lateral torsional buckling.

The flat square surfaces of rectangular HSS can ease construction, and they are sometimes preferred for architectural aesthetics in exposed structures, although elliptical HSS are becoming more popular in exposed structures for the same aesthetic reasons.

In the recent past, HSS was commonly available in mild steel, such as A500 grade B. Today, HSS is commonly available in mild steel, A500 grade C. Other steel grades available for HSS are A847 (weathering steel), A1065 (large sections up to 50 inch sq made with SAW process), and recently approved A1085 (higher strength, tighter tolerances than A500).

Fig 22 : Hollow structural section (HSS)

FABRICATION

The process used in fabrication:

5.2 Welding:

5.2.1 Introduction to Arc Welding

Arc welding is one of several fusion processes for joining metals. Arc welding is a process that is used to join metal to metal by using electricity to create enough heat to melt metal, and the melted metals when cool result in a binding of the metals. Since the joining is an inter-mixture of metals, the final weld joint potentially has the same strength properties as the metal of the parts. This is in sharp contrast to non-fusion processes of joining (i.e. soldering, brazing etc.) in which the mechanical and physical properties of the base materials cannot be duplicated at the joint.

In arc welding, the intense heat needed to melt metal is produced by an electric arc with the help of a welding power supply. The arc is formed between the actual work and an electrode (stick or wire) that is manually or mechanically guided along the joint. The electrode can either be a rod with the purpose of simply carrying the current between the tip and the work. Or, it may be a specially prepared rod or wire that not only conducts the current but also melts and supplies filler metal to the joint. Most welding in the manufacture of steel products uses the second type of electrode. The welding region is usually protected by some type of shielding gas, vapour, or slag.

Basic Arc Welding Circuit

The basic arc-welding circuit is illustrated in Figure 1. An alternating current (AC) or direct current (DC) power source, fitted with whatever controls may be needed, is connected by a work cable to the work-piece and by a "hot" cable to an electrode holder of some type, which makes an electrical contact with the welding electrode.

An arc is created across the gap when the energized circuit and the electrode tip touches the work-piece and is withdrawn, yet still with in close contact. The arc produces a temperature of about 6500ºF (or 3600ºC) at the tip. This heat melts both the base metal and the electrode, producing a pool of molten metal sometimes called a "crater." The crater solidifies behind the electrode as it is moved along the joint. The result is a fusion bond.

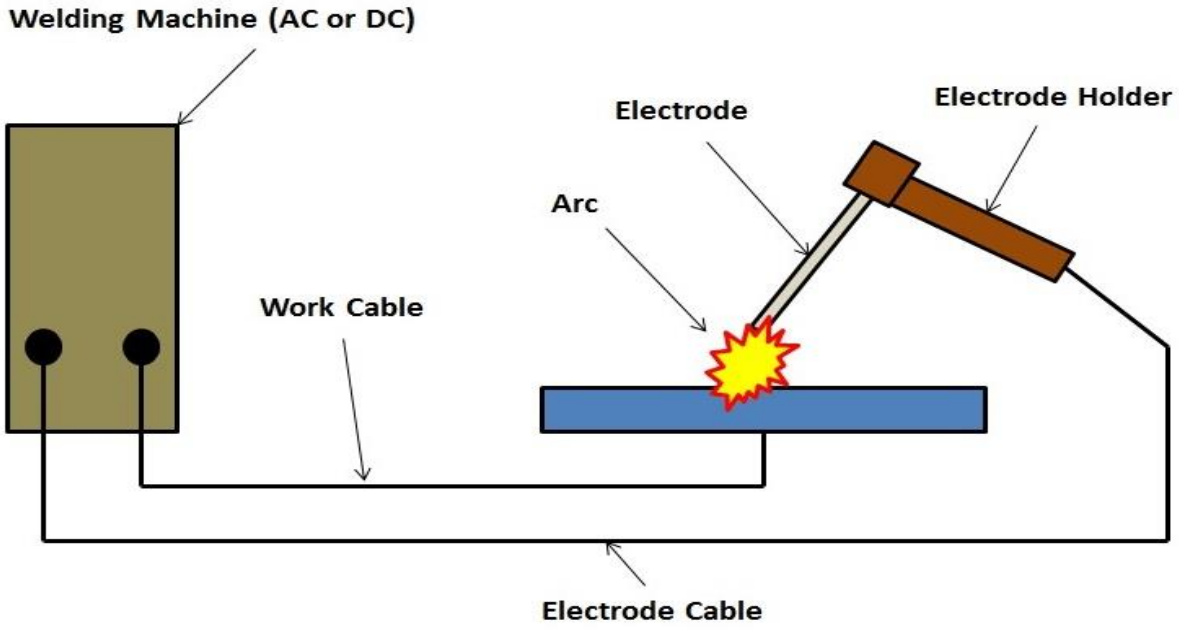


Fig.23 : Basic Arc Welding Circuit Diagram

5.2.2 Arc Shielding

However, joining metals requires more than moving an electrode along a joint. Metals at high temperatures tend to react chemically with elements in the air – oxygen and nitrogen. When metal in the molten pool comes into contact with air, oxides and nitrides form which destroy the strength and toughness of the weld joint. Therefore, many arc-welding processes provide some means of covering the arc and the molten pool with a protective shield of gas, vapour, or slag. This is called arc shielding. This shielding prevents or minimizes contact of the molten

metal with air. Shielding also may improve the weld. An example is a granular flux, which actually adds deoxidizers to the weld.

Figure 4 shows how the coating on a coated (stick) electrode provides a gaseous shield around the arc and a slag covering on the hot weld deposit. The slag protects the fresh weld from the air.

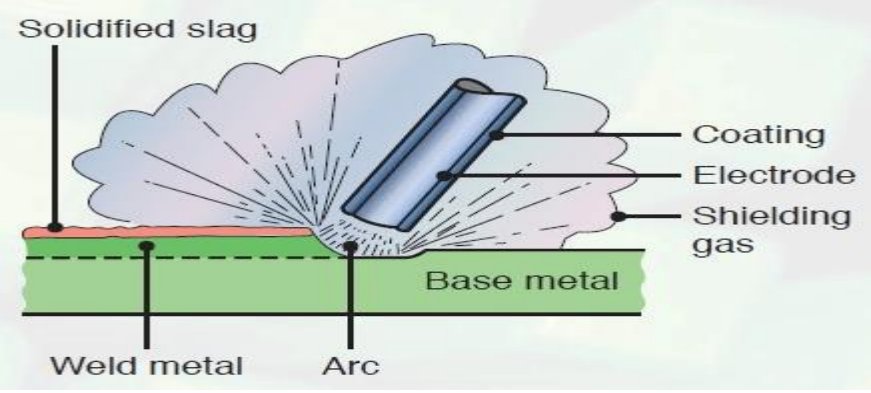


Fig.24 : Shielding of Welding Arc

5.2.3 Basics of the Arc

The arc itself is a very complex phenomenon. In-depth understanding of the physics of the arc is of very little value to the welder, but some knowledge of its general characteristics can be useful.

An arc is an electric current flowing between two electrodes through an ionized column of gas. A negatively charged cathode and a positively charged anode create the intense heat of the welding arc. Negative and positive ions are bounced off of each other in the plasma column at an accelerated rate.

In welding, the arc not only provides the heat needed to melt the electrode and the base metal, but under certain conditions must also supply the means to transport the molten metal from the tip of the electrode to the work. Several mechanisms for metal transfer exist. Two (of many) examples include:

1. **Surface Tension Transfer –** a drop of molten metal touches the molten metal pool and is drawn into it by surface tension.
2. **Spray Arc –** the drop is ejected from the molten metal at the electrode tip by an electric pinch propelling it to the molten pool.

Since there must be an ionized path to conduct electricity across a gap, the mere switching on of the welding current with an electrically cold electrode posed over it will not start the arc.

The arc must be ignited. This is caused by either supplying an initial voltage high enough to cause a discharge or by touching the electrode to the work and then withdrawing it as the contact area becomes heated.

Arc welding may be done with direct current (DC) with the electrode either positive or negative or alternating current (AC). The choice of current and polarity depends on the process, the type of electrode, the arc atmosphere, and the metal being welded

5.2.4 Electrodes

In arc welding, an electrode is used to conduct current through a work-piece to fuse two pieces together. It is made out of materials with a similar composition to the metal being welded. There are a variety of factors that go into choosing the right electrode for each project. Electrode selection is critical to ease of cleanup, weld strength, bead quality and for minimizing any spatter. Electrodes need to be stored in a moisture free environment and carefully removed from any package.

Depending upon the process, the electrode is either consumable, in the case of gas metal arc welding or shielded metal arc welding, or non-consumable, such as in gas tungsten arc welding.

5.2.5 Consumable Electrodes

Consumable electrodes are those which melt away or consumed during the welding process. These electrodes are of low melting point materials. When electrode and work-piece is struck the arc starts to melt the end of the electrode. The molten electrode is transferred to the work-piece in the form of metal droplets. These are made up of different materials depending upon the need and the chemical composition of metals to be joined. Most commonly used core material is mild steel, low alloy steel and nickel steel. A consumable electrode can aid in the process of better elimination of impurities.

Consumable electrodes can be classified in the following groups:

1. **Bare electrodes –** They don't have any flux coating. Only the alloy or the metal wire.
2. **Light coated electrodes –** These are electrodes having coating factor of 1.25. (coating factor = diameter of the electrode / diameter of the core wire*).*
3. **Medium coated electrodes –** These have coating factor of about 1.45.
4. **Heavily coated electrode –** Coating factor is between 1.6 and 2.2.

5.2.6 Non Consumable Electrodes

Non-consumable electrodes are those which do not melt away or consumed during the welding process. These electrodes involve the use of high melting point materials. While welding with these electrodes a filler metal is needed to fill up the gap between the two metal parts. Most commonly used core material is carbon (Melting Point 6700ºF), pure tungsten (MP 6150ºF), or alloy tungsten. Tungsten electrodes are much costlier than carbon or graphite electrodes. Tungsten alloy electrodes are also costlier.

5.3 Drilling

Drilling is the operation of producing circular hole in the work piece by using a rotating cutter called drill.

- The machine used for drilling is called drilling machine.
- The drilling operation can also be accomplished in lathe, in which the drill is held in tailstock and the work is held by the chuck.
- The most common drill used is the twist drill.

5.3.1 Drilling Machine

- It is the simplest and accurate machine used in production shop.
- The work piece is held stationary i.e. Clamped in position and the drill rotates to make a hole.

5.3.2 Types

1) Based on construction:

Portable,
Sensitive,
Radial,
up-right,
Gang,
Multi-spindle

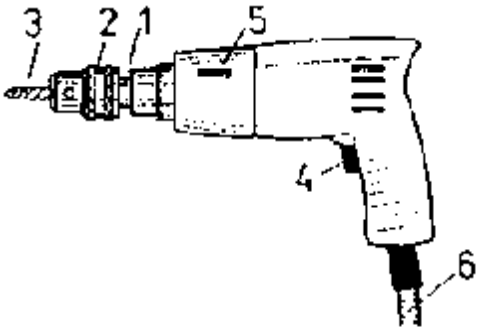
2) Based on Feed:

Hand driven,
Power driven

5.3.3 Portable Drilling Machine

The hand drilling machine serves for drilling round holes and is mainly used on building sites and for erection work.

5.3.4 Construction



1 drilling spindle, 2 drill chuck, 3 drilling tool, 4 control handle, 5 speed switch, 6 electric cable

Fig.25 : Portable drilling machine

In most cases the driving element is a universal motor which can be used for direct and alternating currents. The prolonged motor shaft is simultaneously the carrier and is provided with a chuck. The motor is enclosed by a light-metal casing with handle.

Components of drilling machine

Spindle

The spindle holds the drill or cutting tools and revolves in a fixed position in a sleeve.

Sleeve

The sleeve or quill assembly does not revolve but may slide in its bearing in a direction parallel to its axis. When the sleeve carrying the spindle with a cutting tool is lowered, the cutting tool is fed into the work: and when it's moved upward, the cutting tool is withdrawn from the work. Feed pressure applied to the sleeve by hand or power causes the revolving drill to cut its way into the work a fraction of an mm per revolution.

Column

The column is cylindrical in shape and built rugged and solid. The column supports the head and the sleeve or quill assembly.

Head

The head of the drilling machine is composed of the sleeve, a spindle, an electric motor and feed mechanism. The head is bolted to the column.

Worktable

The worktable is supported on an arm mounted to the column. The worktable can be adjusted vertically to accommodate different heights of work or it can be swung completely out of the way. It may be tilted up to 90 degree in either direction, to allow long pieces to be end or angle drilled.

Base

The base of the drilling machine supports the entire machine and when bolted to the floor, provides for vibration-free operation and best machining accuracy. The top of the base is similar to the worktable and may be equipped with t- slot for mounting work too larger for the table.

Hand Feed

The hand- feed drilling machines are the simplest and most common type of drilling machines in use today. These are light duty machine that are operated by the operator, using a feed handled, so that the operator is able to "feel" the action of the cutting tool as it cuts through the work piece. These drilling machines can be bench or floor mounted.

Power feed

The power feed drilling machine are usually larger and heavier than the hand feed ones they are equipped with the ability to feed the cutting tool in to the work automatically, at preset depth of cut per revolution of the spindle these machines are used in maintenance for medium duty work or the work that uses large drills that require power feed larger work pieces are usually clamped directly to the table or base using t –bolts and clamps by a small work places are held in a wise. A depth –stop mechanism is located on the head, near the spindle, to aid in drilling to a precise depth.

5.3.5 Drill Materials

The two most common types are

1. HSS drill - Low cost
2. Carbide - tipped drills
   - high production and in CNC machines

Other types are

Solid Carbide drill, Tin coated drills, carbide coated masonry drills, parabolic drills, split point drill. Fig. shows various types of drills

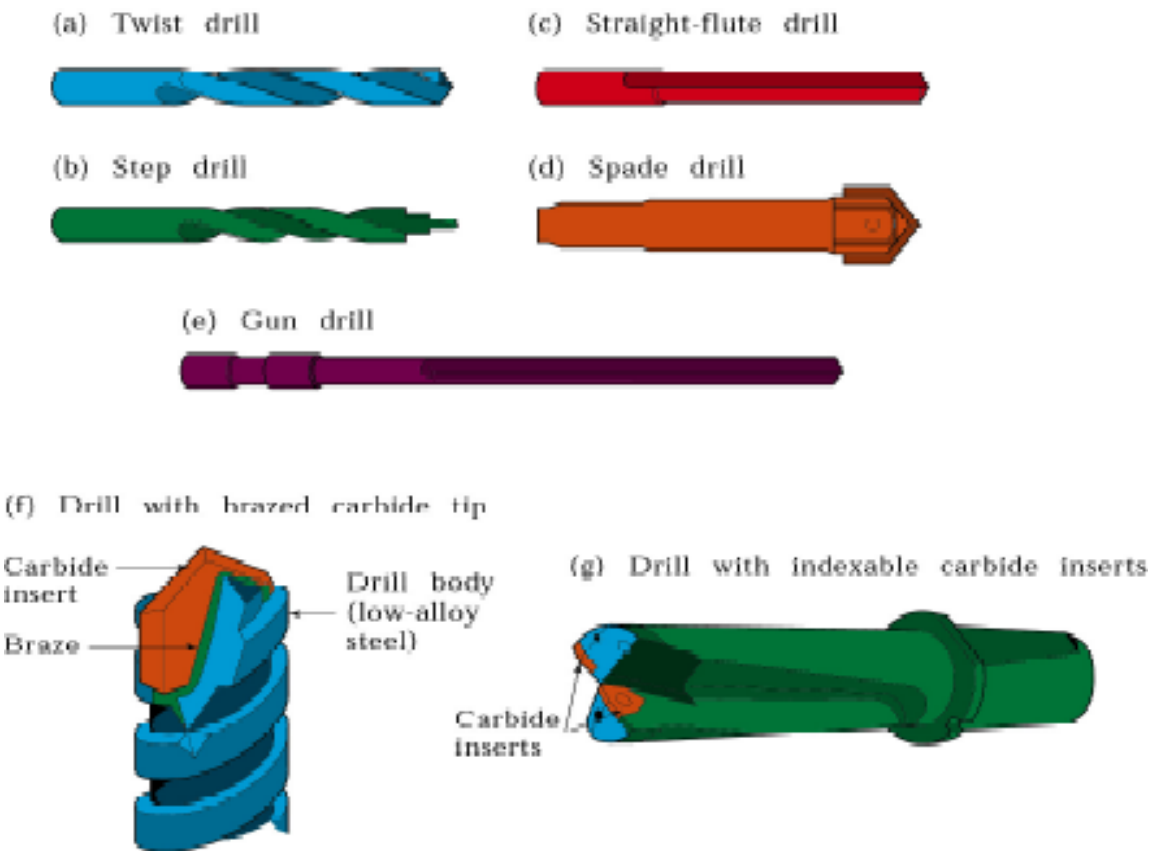


Fig 26 : various types of drill

5.3.6 Tool Nomenclature

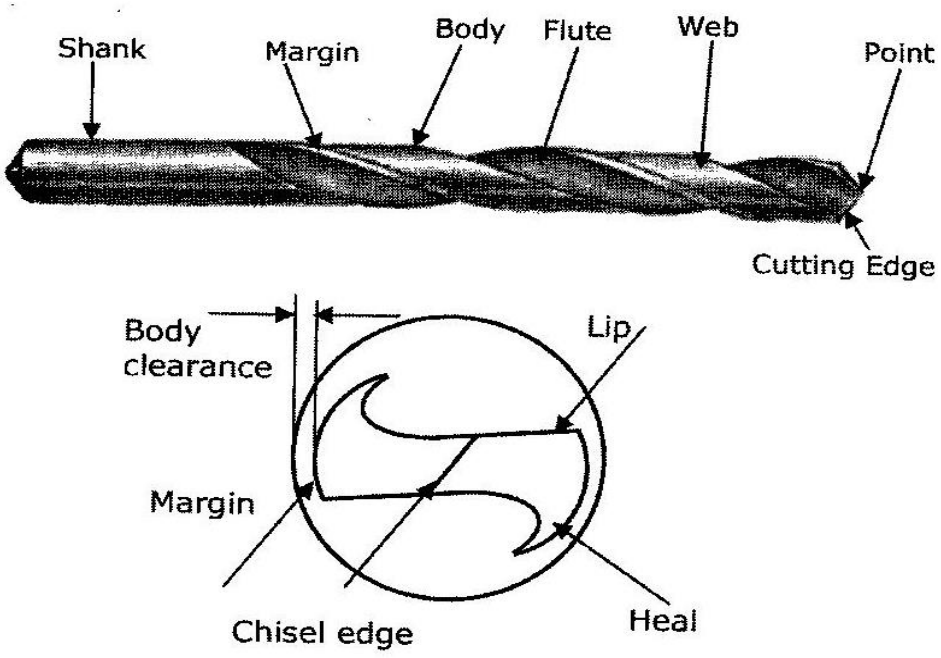


Fig 27 : Nomenclature of twist drill

5.3.7 Disc cutter

An abrasive saw, also known as a cut-off saw or chop saw, is a power tool which is typically used to cut hard materials, such as metals, tile, and concrete. The cutting action is performed by an abrasive disc, similar to a thin grinding wheel. Technically speaking this is not a saw, as it does not use regularly shaped edges (teeth) for cutting.

These saws are available in a number of configurations, including table top, free hand, and walk behind models. In the table top models, which are commonly used to cut tile and metal, the cutting wheel and motor are mounted on a pivoting arm attached to a fixed base plate. Table top saws are often electrically powered and generally have a built-in wise or other clamping arrangement. The free hand designs are typically used to cut concrete, asphalt, and pipe on construction sites. They are designed with the handles and motor near the operator, with the blade at the far end of the saw. Free hand saws do not feature a vise, because the materials being cut are larger and heavier. Walk-behind models, sometimes called flat saws are larger saws which use a stand or cart to cut into concrete floors as well as asphalt and concrete paving materials.

Abrasive saws typically use composite friction disk blades to abrasively cut through the steel. The disks are consumable items as they wear throughout the cut. The abrasive disks for these saws are typically 14 in (360 mm) in diameter and $^{7}/_{64}$ in (2.8 mm) thick. Larger saws use 410 mm (16 in) diameter blades. Disks are available for steel and stainless steel. Abrasive saws can also use super abrasive (i.e., diamond and cubic boron nitride or CBN) blades, which last longer than conventional abrasive materials and do not generate as hazardous particulate matter. Super abrasive materials are more commonly used when cutting concrete, asphalt, and tile; however, they are also suitable for cutting ferrous metals.

Since their introduction, portable cut-off saws have made many building site jobs easier. With these saws, lightweight steel fabrication previously performed in workshops using stationary power band saws or cold saws can be done on-site. Abrasive saws have replaced more expensive and hazardous acetylene torches in many applications, such as cutting rebar. In addition, these saws allow construction workers to cut through concrete, asphalt, and pipe on job sites in a more precise manner than is possible with heavy equipment.

Fig.28 Disc cutter

5.3.8 Lathe Machine

A lathe machine is a machine tool which is used to remove metals from a work piece to give a desired shape and size. In other words it is a machine that is used to hold the work piece to perform various metal removing operations such as turning, grooving, chamfering, knurling, facing, forming etc with the help of tools. It is also called as mother of machine.

5.3.9 Lathe Working Principle:

The lathe is a machine tool used principally for shaping pieces of metal (and sometimes wood or other materials) by causing the work piece to be held and rotated by the lathe while a tool bit is advanced into the work causing the cutting action.

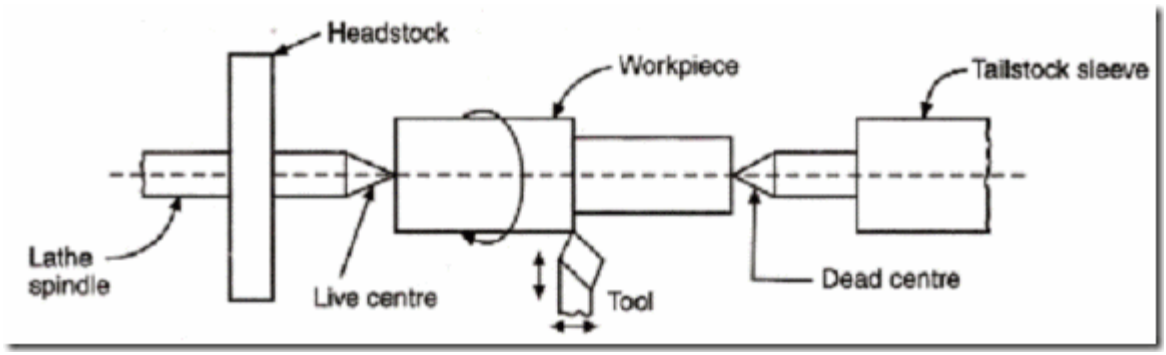


Fig.29 : Lathe working principle

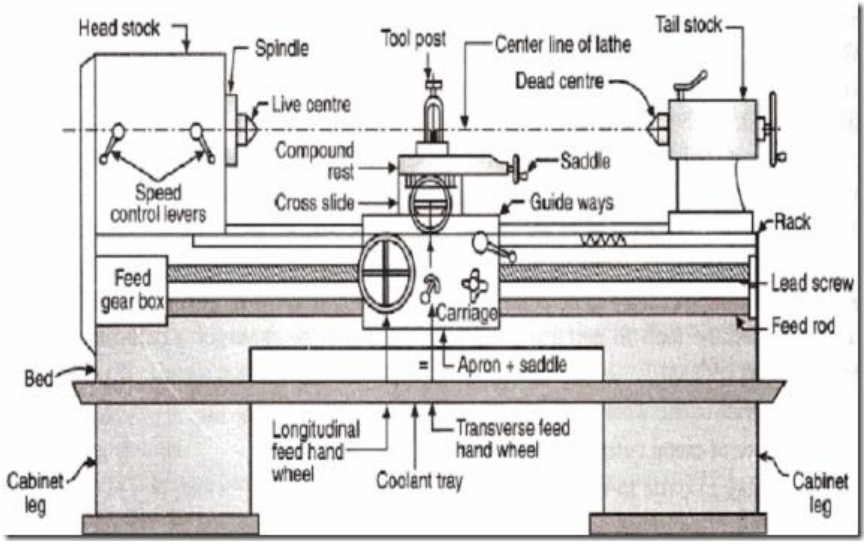


Fig.30 : Schematic layout of lathe

5.3.10 LATHE OPERATIONS

The engine lathe is an accurate and versatile machine on which many operations can be performed. These operations are:

1. Plain Turning and Step Turning
2. Facing
3. Parting
4. Drilling
5. Reaming
6. Boring
7. Knurling
8. Grooving
9. Threading
10. Forming
11. Chamfering
12. Filling and Polishing
13. Taper Turning

CHAPTER-6

MAIN COMPONENTS OF THE SYSTEM

MAIN COMPONENTS OF THE SYSTEM

- Frame
- Pump
- Tank
- Pressure Regulator
- Agitator
- Strainer
- Nozzle
- Sprockets
- Chain
- Connecting rod
- Crank

6.1 Frame:

It's the main part of the system which acts as base to hold the whole setup of the machine. The material of the frame is mild steel.

6.2 Pump:

Pump is used to transfer the liquid from one place to another place by creating mechanical energy difference

Fig. 31 : Pump

6.3 Tank:

Tank carry more fluid with less weight. A tank with 15 liter capacity is taken. The Tank is made up of plastic.

Fig.32 : Tank

6.4 Pressure Regulator:

A Pressure regulator is a control valve that reduces the input pressure of a fluid to a desired value at its output. Regulators are used for gases and liquids, and can be an integral device with an output pressure setting, a restrictor and a sensor all in the one body, or consist of a separate pressure sensor, controller and flow valve.

Fig 33 : Pressure regulator

6.5 Agitator:

An agitator is a device or mechanism to put something into motion by shaking or stirring. There are several types of agitation machines, including washing machine agitators (which rotate back and forth) and magnetic agitators (which contain a magnetic bar rotating in a magnetic field). Agitators can come in many sizes and varieties, depending on the application.

In this operation the device is used to mix the chemical and water homogeneously per every stroke.

Fig.34 : Agitator

6.6 Strainer:

Strainers are devices for mechanically removing unwanted solids from liquid, gas or steam lines by means of a perforated or wire mesh straining element. They are used in pipelines to protect pumps, meters, control valves, steam traps, regulators and other process equipment. Strainers are important components of piping systems to protect equipment from potential damage due to dirt and other particles that may be carried by the process fluid.

6.7 Nozzles:

A nozzle is a device designed to control the direction or characteristics of a fluid flow (especially to increase velocity) as it exits (or enters) an enclosed chamber or pipe.

A nozzle is often a pipe or tube of varying cross sectional area, and it can be used to direct or modify the flow of a fluid. Nozzles are frequently used to control the rate of flow, speed, direction, mass, shape, and the pressure of the stream that emerges from them. In a nozzle, the velocity of fluid increases at the expense of its pressure energy.

Fig. 35 : Nozzles

6.8 Sprocket:

A sprocket or sprocket-wheel is a profiled wheel with teeth, or cogs, that mesh with a chain , track or other perforated or indented material. The name 'sprocket' applies generally to any wheel upon which radial projections engage a chain passing over it. It is distinguished from a gear in that sprockets are never meshed together directly, and differs from a pulley in that sprockets have teeth and pulleys are smooth.

Sprockets are used in bicycles, motorcycles, cars, tracked vehicles and other machinery either to transmit rotary motion between two shafts where gears are unsuitable or to impart linear motion to a track, tape etc. Perhaps the most common form of sprocket may be found in the bicycle, in which the pedal shaft carries a large sprocket-wheel, which drives a chain, which, in turn, drives a small sprocket on the axle of the rear wheel.

Early automobiles were also largely driven by sprocket and chain mechanism, a practice largely copied from bicycles.

Sprockets are of various designs, a maximum of efficiency being claimed for each by its originator. Sprockets typically do not have a flange. Some sprockets used with timing belts have flanges to keep the timing belt centred. Sprockets and chains are also used for power transmission from one shaft to another where slippage is not admissible, sprocket chains being used instead of belts or ropes and sprocket-wheels instead of pulleys. They can be run at high speed and some forms of chain are so constructed as to be noiseless even at high speed.

Fig.36 : Sprocket

6.9 CHAIN:

A bicycle chain is a roller chain that transfers power from the pedals to the drive-wheel of a bicycle, thus propelling it. Most bicycle chains are made from plain carbon or alloy steel, but some are nickel-plated to prevent rust, or simply for aesthetics.

A bicycle chain can be very energy efficient, one study reported efficiencies as high as 98.6%. The study, performed in a clean laboratory environment, found that efficiency was not greatly affected by the state of lubrication. A larger sprocket will give a more efficient drive because it moves the point of pressure farther away from the axle, placing less stress on the bearings, thus reducing friction in the inner wheel. Higher chain tension was found to be more efficient. "This is actually not in the direction you'd expect, based simply on friction".

Fig.37 : Chain

6.10 Connecting Rod:

A connecting rod is a rigid member which connects a piston to a crank or crankshaft in a reciprocating engine. Together with the crank, it forms a simple mechanism that converts reciprocating motion into rotating motion.

A connecting rod may also convert rotating motion into reciprocating motion, its original use. Earlier mechanisms, such as the chain, could only impart pulling motion. Being rigid, a connecting rod may transmit either push or pull, allowing the rod to rotate the crank through both halves of a revolution. In a few two-stroke engines the connecting rod is only required to push.

Today, the connecting rod is best known through its use in internal combustion piston engines, such as automobile engines. These are of a distinctly different design from earlier forms of connecting rod used in steam engines and steam locomotives.

Fig. 38 : Connecting rod

6.11 Crank:

The crank set (in the US) or chain set (in the UK), is the component of a bicycle drive train that converts the reciprocating motion of the rider's legs into rotational motion used to drive the chain or belt, which in turn drives the rear wheel. It consists of one or more sprockets, also called chain rings or chain wheels attached to the cranks, arms, or crank arms to which the pedals attach. It is connected to the rider by the pedals, to the bicycle frame by the bottom bracket, and to the rear sprocket, cassette or freewheel via the chain. The two cranks, one on each side and usually mounted 180° apart, connect the bottom bracket axle to the pedals.

Cranks are constructed of either an aluminium alloy, titanium, carbon fibber, chromoly steel, or some less expensive steel. Tubular steel cranks (such as Tioga's Revolver) can be light and very strong, are usually found on BMX bikes, and are slowly finding their way to mountain bikes (dirt jumping and urban assault). Aluminium cranks may be cast, hot forged or cold forged ("cold" in this context means the billet from which the crank is to be made is heated to a specified temperature well below the melting point, not room temperature). Cold forging gives the metal additional strength, and the cranks can therefore be made lighter without increasing the risk of breakage. Shimano "Hollowtech" aluminium cranks are made by forging the main arms around a hard steel insert which is then withdrawn, leaving an internal void to save weight. They are then welded up before final machining.

Fig.39: Crank

CHAPTER-7

WORKING

WORKING

When we push the system the wheel rotates and the sprockets is rigidly mounted on it & there is no relative motion between wheel & sprocket , and this sprocket is connected with another sprocket called driven sprocket by the rollers, chain, and this sprocket is fixed on the driven shaft by with the help of the bush mechanism. The shaft is connected with a crank, therefore the rotary motion of the wheel is converted into reciprocating motion.

For every one revolution of wheel the driven sprocket rotates 2.5 revaluations due to the crank & chain mechanism. The velocity of the driven shaft varies according to the following theorem.

T_1 = No. of Tooth's on the driver sprocket

T_2 = No. of Tooth's on the driven sprocket

N_1 = Speed of the driven in rpm

N_2 = Speed of the driven in rpm

Velocity ratio

$N_2/N_1 = T_1/T_2$

$N_2/N_1 = 42/14 = 3$

Due to above velocity ration, for every revolution of the driver sprocket the driven sprocket rotates 3 times as driver sprocket.

For every revolution of driven shaft the crank makes two reciprocated motions like forward & backward , due to this the connecting rod on the crank makes two reciprocating movement & this crank is connected to the piston of the pump cylinder , so due to this movement the piston move up & down motion & the creates the suction & compression strokes .

In suction stroke, the low pressure is created in the pump cylinder that is below the atmospheric pressure (760 mm of Hg)

Due to that low pressure the liquid is suck into the pump cylinder through agitator, where the fluids are mixed homogeneously according to the ratio 1:1.

In compression stroke the high pressure is created & inlet valve closes automatically due to such high pressure the outlet valve is opened, due to mechanical energy (potential, kinematic & datum energy) difference the fluid is transferred from pump outlet to the required destination through varies intermediate connections, By using sprinklers the water will spray drop wise so spreading of the liquid will reach the required position.

Fig 40 : Wheel based agriculture fertilizer sprayer

WHEEL AND CRANK TYPE MECHANISM:

A crank is an arm attached at a right angle to a rotating shaft by which reciprocating motion is imparted to or received from the shaft. It is used to convert circular motion in to reciprocating motion, or vice versa.

CHAPTER-8

CALUCATIONS

Distance covered in one stroke of pump:

Diameter of tyre = 650 mm

Distance covered in one revolution of driving side = 650 × π = 2042 mm

So using ratio = driving side / driven side = 42 / 14

Distance covered in one stroke of piston = 6 cm

Specification of main parts of push operated spray pump:

Specification of tyre:

Specification of tyre 1 & 2:

Diameter = 650 mm

Material = Aluminium & it's alloy

Specification of Driver crank

No. of tooth's = 42

Width = 0.5 cm

Material = Stainless steel

Specification of Driven sprocket

No. of tooth's = 14

Width = 0.5 cm

Material = Stainless steel

Specification of shaft :

Diameter = 25.4 mm

Length = 300 mm

Material = Mild Steel

Specification of Pipe:

Diameter = 5 mm

Thickness = 3 mm

Material = Plastic

Length = As per Requirement

Specification of Crank :

Length of the crank = 30 mm

Material = Mild Steel

Specification of Bearing :

Inner Diameter = 25.4 mm

Outer Diameter = 50 mm

Material = Brass & Cast Iron

Specification of tank :

Length = 350 mm

Height = 600 mm

Width = 150 mm

Capacity = 15 Ltr.

Material = Plastic

Specifications of connecting rod :

Length = 370 mm

Diameter = 5 mm

Material = Mild steel

CHAPTER-9

TABLES OF PRODUCT DESIGN & COST ESTIMATION

PRODUCT DESIGN SPECIFICATION TABLE:

SL.NO.	Factors	Specifications
1.	Performance (technical specifications)	Tank capacity :15 litres Pump: Piston pump Working pressure : 2 - 3 bar Maximum pressure : 4 bar Nozzle type : Multi nozzle Power source : Mechanical power
2.	Environment	Easy installation , easy to detach and attach, Light weight and cleanable
3.	Life span	5 – 8 years
4.	Maintenance	Once in a season
5.	Major materials used	Base frame : Mild steel Tank :HDPE Plastics
6.	Process	Design , Detailing , Fabrication and validation
7.	Weight	20 – 25 kgs
8.	Ergonomics	Gripping , Reach for control and accessibility
9.	Colour	Ecofriendly
10.	Cost	6,000/-
11.	Transport	Easy to transport
12.	Appearance	Good appearance , easy to use
13.	Type	Portable
14.	Safety	Safe and smooth operation

TABLE 3 : PRODUCT DESIGN SPECIFICATION TABLE

Estimation

SL.NO	COMPONENTS	QUANTITY	COST
1	PIPES	3 NOS	600
2	SPROCKETS	2NOS	300
3	BEARINGS	2 NOS	200
4	SHAFTS	1 NO	1,200
5	TANK	1 NO	1,500
6	CHAIN	1NOS	100
7	SUPPORT WHEELS	3 NOS	500
8	CONNECTING ROD	1 NO	100
9	CRANK	1 NO	100
10	NUTS N BOLTS	6 NO	100
11.	NOZZLES	2 NO	100
12.	TWO WAY COUPLING	1 NO	100
13.	MISCELLANEOUS		1,600
		TOTAL	6,500

TABLE 4 : ESTIMATION TABLE

CHAPTER-10

APPLICATION & ADVANTAGES

Application:

- For the insecticides application to control insect pests on crops and in stores, houses, kitchen, poultry farms, barns, etc.
- For the fungicides and bactericides application to control the plant diseases.
- For the herbicides application, to kill the weeds.
- For the harmony sprays application to increase the fruit set or to prevent the premature dropping of fruits.
- For the application of plant nutrients as foliar spray.
- For applying the powdery formulation of poisonous chemicals on the crops and for any other purposes.
- Pesticides Sprinkling.

Advantages:

- Less Initial and Maintenance cost
- Does not require any External Source of Energy
- Safe for Operation
- No Fatigue to Operator
- Pressure of the system is uniform
- Can work Efficiently during all Seasons
- Portable & Ergonomic
- Continuous discharge
- No Running cost

Conclusion:

- The suggested model has removed the problem of back pain, since there is no need to carry the tank (pesticides tank) on the back.
- As suggested model has more number of nozzles which will cover maximum area of spraying in minimum time & at maximum rate.
- The c.f. valves can also be applied which help in reducing the change of pressure fluctuation and c.f. Valves helps to maintain pressure.
- Proper adjustment facility in the model with respect to crop helps to avoid excessive use of pesticides which result into less pollution.
- Imported hollow cone nozzles should be used in the field for better performance.
- Muscular problems are removed an there is no need to operate the lever.
- This alone pump can used for multiple crops

References

1. MANDHI KONDA PULLA REDDY –"Small farmer in India"

2. J.Founk Research Station, "Modification of a Knapsack Sprayer for more Efficient use Agriculture.