

A Project Report on

“ Solar Power Multinozzel Pesticide Sprayer and Grass Cutter”

By,

Mr. Shewale Nayan Balu.

Mr. Gangurde Vaibhav Narayan.

Mr. Gangurde Rakesh Vikram.

Guide: Prof. J. S. Pagar Sir



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Department of Mechanical Engineering

SNJB's Late Sau K. B. Jain College of
Engineering, Chandwad

Savitribai Phule Pune University[2021-22]

SNJB"s
Late Sau K. B. Jain College of Engineering,
Chandwad



ESTD - 1928

CERTIFICATE

This is to certify that Mr. Shewale Nayan Balu, Mr. Gangurde Vaibhav Narayan, & Mr. Gangurde Rakesh Vikram has successfully completed the Project report entitled "Solar Power Multinozzel Pesticide Sprayer And Grass Cutter " under my supervision, in the partial fulfillment of Bachelor of Engineering - Mechanical Engineering of Savitribai Phule pune University.

Date:

Place:

Prof. J. S. Pagar sir
Guide

Mr. R. S. Chaudhari
Project Coordinator

Dr. S. D. Sancheti
HOD

Examiners

Dr. M .D. Kokate
Principal

Seal

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Abstract

As India is horticulture based nation and 70% individuals do cultivating and related work. Horticulture is needed to be blast to upgrade the Gross Domestic Product (GDP) of the country by working on the efficiency. The efficiency of the yields can be expanded with the assistance of irritation control. Pesticide splashing is the important technique in development of the yields. The current thought manages the planning and creating a multi spout pesticide sprayer cum grass shaper which will be valuable and reasonable to the ranchers which will help to expand the usefulness of harvests.

However this venture an endeavor has been done to work on the strategy for showering the pesticide according to crops profile, width and stature of harvests that will improve the usefulness and increment the farmer's pay. Thus, we have planned a multi spout pesticide splashing cum grass shaper machine which won't just expand usefulness yet additionally will decrease the work of the ranchers. The machine will save the hour of the rancher just as effectiveness in showering and grass shaper. This model conveys multi spout pesticides sprayer siphon which will perform splashing at greatest rate in least time. Consistent stream valves can be applied at spout to have uniform spout pressure.

Keywords: Multi Nozzle, Grass cutter, Pesticide Spraying, Machine.

1. INTRODUCTION

To diminish the damage to the climate and individuals the innovative work of plant securing machine center around further developing the mechanical work proficiency and the powerful accessibility of pesticide. This choice has concurred among individuals everywhere, particularly in the created country. Agribusiness is a significant area of the Indian economy, representing 14 % of the nation's GDP. India is set to be a horticulturally based country around 70 % of populace of India is subject to farming straightforwardly or by implication. Our ranchers are involving similar techniques and gear for the ages. Indian farming is an assorted and broad area including countless entertainers. It has been one of the astounding examples of overcoming adversity of the post-autonomy time through the relationship of Green Revolution advances. For the most part, motorization of little structures is truly challenging and non-reasonable however Japanese make it occurs.

One of the most well-known types of pesticides application, particularly in traditional farming, is the utilization of mechanical sprayers. Water driven sprayers comprise of a tank, a siphon, a spear (for single spouts) or blast, and a spout (or various spouts).

Sprayers convert a pesticide plan, of one containing a combination of water (or another fluid substance transporter, like compost) and compound, into beads, which can be enormous downpour type drops or little nearly undetectable particles. This transformation is cultivated by driving the shower combination through a splash spout under tension. The size of drops can be changed using diverse spout sizes, or by adjusting the strain under which it is constrained, or a mix of both. Huge drops enjoy the benefit of being less defenseless to splash float, yet require more water per unit of land covered. The task point is to further develop showering procedures and wipe out the human endeavors, to diminish work cost by propelling the splashing strategy and steady progression of splashing beads. Most of synthetic substances utilized in vegetable

creation are conveyed as beads delivered from various kinds of spouts and shower blasts.

1.1. Need for Project:

The goal of building this multi spout sprayer cum grass shaper machine is to wipe out the actual exhaustion and the wellbeing perils brought about by pesticides. Following disadvantages of different showering methods shows the need of our task.

- 1) In the rucksack showering/sunlight based worked sprayer the work needs to convey all the heaviness of the pesticides filled tank which makes exhaustion work and subsequently diminishes the human ability to splash.
- 2) In customary showering technique just one side splashing is finished. For inverse side it is need to go inverse side for showering.
- 3) The battery-worked splashing and grass shaper hardware not needs fuel for its running and activity which diminishes its functional expense.
- 4) During old splashing technique after at some point hand muscles begin to agony and in this way legitimate strain isn't kept up with. Thus, it influences the bead pressure.
- 5) When utilizing fuel worked vehicles, the exhaust gases freed from the Silencer or suppressor creates a hurtful exertion over the yields.

1.2 Statement of Project:

Synthetic compounds assume a significant part in vegetable creation and are routinely used to control bug nuisances, sicknesses and weeds. While applying synthetics expect to boost the sum arriving at the objective and limit the sum coming to askew regions. In traditional showering technique just one side splashing is finished. For inverse side it is need to go inverse side for splashing. For the rucksack type pesticide sprayer, client needs to convey the weighty tank at the back and sway the switch that necessary more endeavors. As we probably are aware, this is the most kind of pesticide siphon sprayer that client use in cultivating. Client need to hold the spout when splashing

out the pesticide. To diminish time and labor in horticultural field, we will make the multi spout pesticide splashing cum grass drain machine. The assertion of venture is "Plan and Development of sun oriented power multi spout pesticide showering and Grass shaper machine." which accomplished the splashing work for agrarian field according to prerequisites of an Indian rancher.

1.3. Objectives:

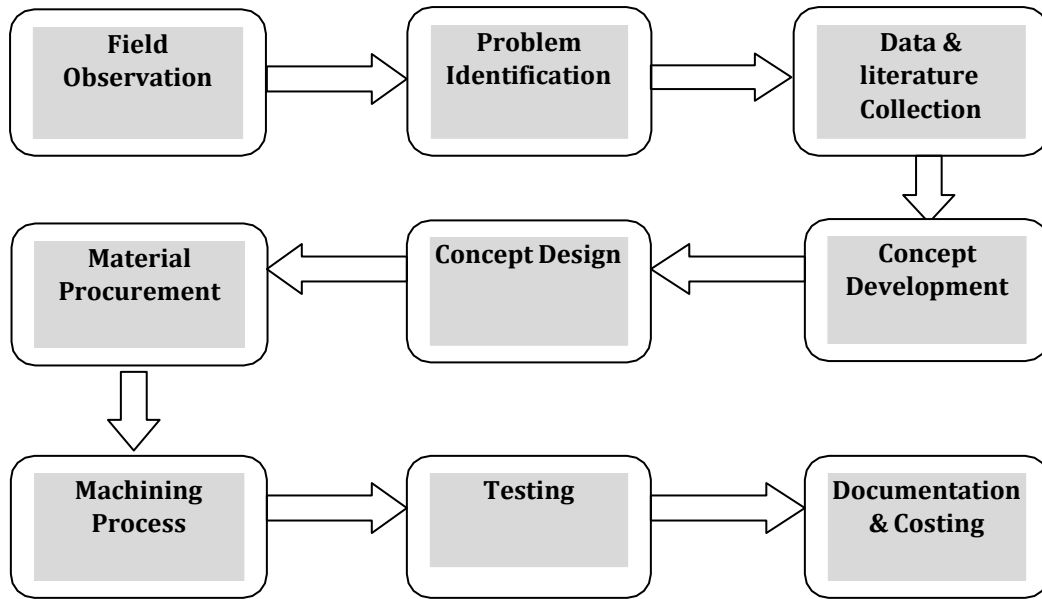
1. To increment the proficiency of showering by utilizing multi spout.
2. To eliminate the knapsack and foot showering strategies.
3. To diminishing the functional expense by involving extraordinary failure cost elective instrument for grass cutting.
4. To diminishing work cost by propelling the ordinary splashing and grass cutting strategy.
5. To increment the usefulness of the yields by saving the hour of the ranchers.
6. To more straightforward the activity of showering at both side of harvests all at once.

1.4. Scope:

By using this solar power multi nozzle sprayer & grass cutting machine will eliminatethe physical fatigue and the health hazards caused by pesticides. Similarly, this machine can work to spraying pesticides for different crops with having probabilities to set nozzles as per crop profile we want, this machine will be low-cost alternatives for all types of spraying cum grass cutting machines.

1.5. Methodology & steps to solve the problem:

The below flow chart shows the sequential operation/steps that will be performed during the project process.



In this chapter introduction of the project as well as the problem definition are discussed. To solve all the problems discussed above we are producing a new machine, as our project under this topic in our academic year 2021 – 2022, we are preparing a working scale model of this machine. We have proposed a methodology to solve the problems. Our methodology is divided in different parts, under different titles.

Sequence of proposed methodology is as follows –

- i. Proposed Methodology 1 – Basic Information & Literature survey.
- ii. Proposed Methodology 2 – Design of Machine Components.
- iii. Proposed Methodology 3 - Selection of Components for Machine.
- iv. Proposed Methodology 4 – CAD modelling & Fabrication of Machine parts.
- v. Proposed Methodology 5 – Assembly, Testing & Documentation of Machine.

➤ **Proposed Methodology 1: Basic Information & Literature survey.**

This project report discusses about how to use literature data & identify the problems from field. By studying the literature of previously available system that help in maximizing the output by minimizing the effort, cost, time & money in future develop new machine.

➤ **Proposed Methodology 2: Identify & Design of Machine Components Available in Market.**

This project work will first introduce the background of the study. Presents the design constraints that influence on the use, efficiency & benefits their impacts on machine. After that machine parts design all different existing machine assembly units will done to make a probable machine model.

➤ **Proposed Methodology 3: Selection of Components for Machine as per design specifications.**

We will discuss the construction & working of system components. Various resources and factors were considered for getting the information on the project: First, the requirement of the field is to identify. The specification of the material is thought according to the need. Then, the allocation of budget is taken into consideration. Different research papers were read, we visited many markets & fields. Guidance was taken from College staff regarding the initial research of project. The Resources/Consumable required are: The main components of machine are to be purchase.

➤ **Proposed Methodology 4: CAD modelling & Fabrication of Machine parts.**

This project work will start to manufacture after purchasing of required specification material & making sample simulations which will be easy for visualization. After that manufacturing procedure of machine will be done, after this cost

estimation of machine will calculate.

➤ Proposed Methodology 5: Assembly & Testing of Machine.

Finally, after complete manufacturing procedure, will test the working model which will satisfy probable objectives or not. After that complete working & satisfied testing will discuss advantages & applications of the machine while performing satisfied operation with complete report writing.

2. LITERATURE SURVEY

Sagar S B, Punith G, Rakesh C N, Prakash M H, Lakshminarasimha N., done the work on , Design and Development of Trolley type Agrochemical Sprayer, According to his work, Majority of the Indian population is solely depends on agriculture, where 60% to 70 % of total population's family income depends on agriculture, in this majority of them are small scale producers. In agriculture, main problem faced is spraying pesticides. Due to advancement in technology many companies have come up with electrical and solar type of pesticide sprayers. But the medium scale farmers cannot afford this type of sprayers, because of its price when compared to manual type. Due to this reason, present project comes up with a new idea which uses slotted lever mechanism for pumping of pesticide. The study comprises on Design, Analysis and Fabrication of pesticide sprayer. Analysis is been carried out for pesticide sprayers components using ANSYS Workbench and also cost estimation analysis for pesticide sprayers is provided considering farmers economy. Project ensures that the Mechanism provided gives better efficiency when compared to other type of sprayers. Results obtained from ANSYS can be used for better improvements in design as future scope and Cost estimation analysis helps in knowing the market for farmers. And also it can be concluded that the present project work becomes a ready reckoner for engineers for future developments in pesticide spraying methods/mechanisms. Present work is no more exhaustive further work can be carried out by modifying the spraying mechanisms. [1]

Joshi Dhruv Bharatbhai, done the work on, Automatic Agriculture Pesticide Spraying Vehicle, According to his work, spraying of pesticides is done to control pest and diseases for that purpose sprayer are used. Sprayer must break liquid in to droplet of effective size, also distribute them uniformly over the plants and regulate the amount of liquid to avoid excessive application controlling pest, diseases is one serious problem facing the farmers everywhere. In the view of these problems field performance evaluation trials of self-propeller boom sprayer were carried out in cotton and chili field. There are many types of pesticides sprayer pump are available in India.

used sprayer is backpack type sprayer which is used by farmers because it is cheaper, easy to use, easily available and main thing about it is cost efficient. With the help of this machine farmer spray pesticides in their farm, but it requires lot of time and thus high operational cost, low efficiency, health problem and low profit. Also, the farmer which is spraying pesticides is affected by it as it is harmful to human health and human also affect by the lumbar pain and shoulder disorder due to weight of equipment and weight of tank on person`s shoulder. [2]

Dhiraj N. Kumbhare, Vishal Singh, Prashik Waghmare, Altaf Ansari, Vikas Tiwari, Prof. R.D. Gorle, done the work on , Fabrication of Automatic Pesticides Spraying Machine, According to his work, There are many types of pesticides sprayer are available in India. But mostly used sprayer is backpack type sprayer which is used by farmers because it is cheaper, easy to use and main thing about it is less costly. With the help of this machine farmer spray pesticides in their farm, but it requires lot of time and thus high operational cost. Also, the farmer which is spraying pesticides is affected by it as it is harmful to human health and human also affect by the lumbar pain due to weight of equipment. This method used lots of time and affects human health adversely. This paper suggests machines which will save time and operational cost. Also saves human from affecting adversely. As the current passes from battery to DC Motor vehicle starts moving. At the same time DC Pump run and sprays pesticides with many nozzles. This machine will be operated by remote with maintaining some distance; therefore no harm effect will occur to human health. Also it covers larger area in less time so lots of time will be saved with this and also labor cost will reduce and money saved. [3]

Anupam Moon, Amar Wairagade, Chaitanya Kakade, Nikhil Pathak, Rahul Moreshiya, Vijay Giradkar & Prof. S.N. Gandhare, done the work on , Design & Fabrication Of Paddle Operated Multi-Point Pesticide Spraying Machine, According to his work, We all know that in today`s scenario the poor farmers are facing many problems in farming. So through this project we want to compensate this problem upto some extent. With the help of these technical syntheses, we have tried to help the

poor farmers of mother land India by reducing their effort. The pedal operated sprayer is fabricated in low cost and easy to handle in the farms and also improves the quality of spraying pesticides. The operator can cover large area without any additional energy by using the bicycle for a spraying purpose by converting its circular motion into reciprocating motion of reciprocating compressor as well as it reduces the fatigue of the operator. This project is ergonomically designed. Ergonomically it is very useful to minimize the effort while spraying the pesticide also the process saves the time & improve the performance.[4]

Siddharth Kshirsagar, Vaibhav Dadmal, Prashant Umak, Govind Munde and P. R. Mahale, done the work on , Design and Development of Agriculture Sprayer Vehicle, According to his work, The population of the world is increasing rapidly. In order to fulfill their diet needs the production of food must be increased, but this must come at a cost affordable to everyone. Mechanization of agriculture enables conservation of inputs by precision in ensuring better distribution, reducing quantity required for better response or prevention of losses or waste of inputs applied. Mechanization reduces unit costs of production through higher productivity levels and the input conservation. The all agriculture equipment's often are hardly modernized due to its low productivity. In India farming is done by traditional ways, besides that there has been large development of industrial and service sector as compared to that of agriculture sector. The spraying of pesticides and insecticides is traditionally done by farm worker carrying backpack type sprayer which requires more human effort. Giving attention to these important problems an attempt is made to develop an equipment which will be beneficial to the farmer for the spraying operations. This equipment is easy to use and operate. It makes use reciprocating pump that creates the required pressure for the spraying action. This multifunction device will come in handy that can be put to use in different spraying stages of farming as per process requirement. The motive behind developing this equipment is to create mechanizations which will help to minimize effort of farming. [5]

Shailesh Malonde, Shubham Kathwate ,Pratik Kolhe, Roadney Jacob ,Nishat Ingole ,Rupesh D. Khorgade, done the work on , Design and Development of Multipurpose Pesticides Spraying Machine, According to his work, As India is agriculture based country and 70% people do farming and related work. Agriculture is required to be boomed to enhance the Gross Domestic Product (GDP) of the country by improving the productivity. The productivity of the crops can be increased with the help of pest control. Pesticide spraying is the necessary procedure in cultivation of the crops. The present idea deals with the designing and fabricating a pesticide sprayer which will be useful and affordable to the farmers which will assist to increase the productivity of crops. Though this project an attempt has been done to improve the method of spraying the pesticide that will enhance the productivity and increase the farmer's income. So we have designed a pesticide spraying machine which will not only increase productivity but also will reduce the effort of the farmers. The machine will save the time of the farmer as well as efficiency in spraying. This model carries multi nozzle pesticides sprayer pump which will perform spraying at maximum rate in minimum time. Constant flow valves can be applied at nozzle to have uniform nozzle pressure. Based on the experiment performs it is found that the solar panel used in the project, provides 17 volt 0.58amp. the scarcity of power can be overcome by this, on the other hand the battery is rechargeable by supply available at homes. The manual labor is eliminated by this module, the constant and effective discharge is achieved which eventually increases the productivity. There are no health hazards to the operator. [6]

Gururaj P. Bhumannavar, Srinivasa, H. S. Lohit, done the work on , Design and Development of a Low Cost Mobile Spray Pump for Indian Middle Class Farmers, According to his work, India is set to be an agricultural based country and approximately 75% of the peoples are dependent on farming directly or indirectly, in this agriculture sector there is a lot of field work, such as weeding, reaping, sowing etc. Apart from these operations, spraying is also an important operation to be performed by the farmer to protect the cultivated crops from insects, pests, fungi and diseases for which various insecticides, pesticides, fungicides and nutrients are

sprayed on crops for protection. In today's world, we use many different spraying technologies involving use of energy like electrical energy, solar energy, and chemical energy of fuels. This fact makes us know that how large amount of energy is getting used at such place where mechanical energy can be used instead of direct energy sources. Farmers are facing enormous problem while spraying the pesticide like tank capacity is very small, high cost and spraying time taken more. In order to reduce these problems many different type of sprayers has been introduced in the market, but these devices do not meet the above problems or demands of the farmers. To solve these difficulties develop a new equipment that is mechanically operated wheel driven sprayer, it is a portable device and does not need any fuel to operate, which is easy to move and spray the pesticide by moving the wheel. This wheel operated pesticide spray equipment consumes less time and achieves uniform nozzle pressure; we used crank mechanism with piston pump, which is driven by the wheel.

This paper aims at developing a low cost mechanically operated sprayer pump for Indian middle scale farmers, Study the literature review, user study and market study. Based on literature and market study develop QFD and PDS char, and generate the many concepts. A final concept has been select for further development and detailing. A full scale working model has been fabricated for design validation. The device has been validated with the user group and got good feedback from the user. No design is ever perfect for all the time; design needs to be changed as per the needs and wants of users. An input for new product development and or design improvements is obtained from the user's feedback and product evaluation with respect to user requirements.[7]

Faijubhai Malek, Dipam Patel , Yash Padia , Mit Kundariya , Varun Jarsania , done the work on ,Mechanically Operated Cart for Pesticide Sprayer for Agriculture, According to his work, The project is intended to help the farmers as India being an Agriculture based country. It is a Pesticide Sprayer mounted on a Cart which is operated mechanically without any external source of energy. The aim of developing such a concept is primarily because of preventing the 3 major drawbacks of the pump

being used currently- Firstly, the farmer has to carry the entire weight of the pesticide spraying (approx. 20+ kg) pump on his shoulder; secondly, he has to continuously use his one hand to pump using the handle; thirdly, the farmers don't take enough precaution which results in fatal diseases because of direct contact with the chemicals. All these factors have been taken care of in this project along with being cost effective, light in weight and good in strength. The pump already available with the farmer can be directly used in this mechanism.

The handle of the sprayer will be mechanically operated through the rotating shaft of the wheels of the cart using an efficient mechanism. This will result into the reciprocating motion of the piston and hence pumping will be done. The user will now just have to pull the cart and the whole mechanism will be operated with ease. This will be a case of Pure Mechanical Automation. Thus it is concluded that the „Mechanically Operated Pesticide Sprayer“ using the „Crank-Slider Mechanism“ is much better as compared to the other different type of options available. It is a case of complete „Mechanical Automation“ as no external power sources will be employed in its operation. Moreover, various materials selected for the entire mechanism will be easily available at a considerably affordable price. The main problem being faced by the farmer was to carry the entire load of the pests on his shoulder and this problem can be very efficiently solved by the adoption of this method. Also, very fewer efforts are needed to be applied for its working on the real-situation fields. In addition to that, no special skills or training is required for the farmer (operator) to operate it. [8]

Mohammed Umair Ahmad, Shrijit Haridas Borkar , S.D. Ghatole , done the work on „Review Manually Operated Multi-Nozzle Pesticide Sprayer Pump, According to his work, Farmers are the heart of Indian culture. Over 70% of the rural household depends on agriculture as their principle mean of livelihood. The farmers come under different levels according to their economic condition like small, marginal, medium and rich farmers. Small scale farmers always prefer manually operated instrument instead of developed instruments.

To protect them from insects, diseases, fungi and pests. Now a days number of technologies are used to spraying pesticide by using solar energy, electric energy and chemical energy. We can simply use mechanical energy instead of these energies and these saved energies can be utilized at appropriate place. Although using these developed instruments farmer suffer from different problems like less capacity of sprayer tank, less working area, more cost as compare to manual, more time consuming etc. To overcome these limitations number of product are launched in market, but they are not able to come over all the limitations at a time. We find a solution over all these limitation by developing mechanically operated multi-nozzle sprayer pump for which any type of energy or fuel is not required except mechanical energy. Motive of this paper is to generate a low cost sprayer pump for India's poor range farmers and reduce the required efforts. An accurate working model has been fabricated. It gives similar nozzle pressure and cover maximum area. We used crank mechanism along with piston pump, which is derived by rotation of wheel.[9]

Asst. Prof. S.T. Nangare S.S.Patil, G.P.Ikile, S.R.Jangate, A.M.Patil, D.K.Nalawade, done the work on , Design and Fabrication of Agricultural Sprayer, According to his work, India is a land of agriculture which comprises of small, marginal, medium and rich farmers. Small scale farmers are very interested in manually lever operated knapsack sprayer because of its versatility, cost and design. But this sprayer has certain limitations like it cannot maintain required pressure; it lead to problem of backpain. This paper suggests a model of manually operated multi nozzle pesticides sprayer pump which will perform spraying at maximum rate in minimum time. We have designed a model running without any fuel and also easy to operate for a user. We tries to develop a new mechanical system which will overcome all the above problems and will help farmers to. While conclusion this paper we fill file quite contended in having completed the project assignment well on time we had enormous practical experience on fulfill of manufacturing schedule of working project module we are therefore happy to state the calculations of mechanical aptitude proved to be very useful purpose agriculture pesticide sprayer is designed to reduce human effort is

used to agriculture field by spray pesticide now a days farmer more used pesticide in farm to get better crop. The motive behind developing this equipment is to create mechanizations which will help to minimize effort of farming. It is suitable for the spraying at minimum costs for the farmers so that; he can afford it of the many product available. Also we will reduce the operator fatigue and cover the maximum area within minimum time as compare to single sprayer. [10]

Sivanainthaperumal.T, Selvam.M, Pandiyaraj.R and Arunraj.S, done the work on , Design And Development Of Wheel Spray Pump, According to his work, India is set to be an agricultural based country and approximately 75% of the peoples are dependent on farming directly or indirectly, in this agriculture sector there is a lot of field work, such as weeding, reaping, sowing etc. Apart from these operations, spraying is also an important operation to be performed by the farmer to protect the cultivated crops from insects, pests, fungi and diseases for which various insecticides, pesticides, fungicides and nutrients are sprayed on crops for protection. In today's world, we use many different spraying technologies involving use of energy like electrical energy, solar energy, and chemical energy of fuels. This fact makes us know that how large amount of energy is getting used at such place where mechanical energy can be used instead of direct energy sources. Farmers are facing enormous problem while spraying the pesticide like tank capacity is very small, high cost and spraying time taken more.

In order to reduce these problems many different type of sprayers has been introduced in the market, but these devices do not meet the above problems or demands of the farmers. To solve these difficulties develop a new equipment that is mechanically operated wheel driven sprayer, it is a portable device and does not need any fuel to operate, which is easy to move and spray the pesticide by moving the wheel. This wheel operated pesticide spray equipment consumes less time and achieves uniform nozzle pressure; we used crank mechanism with piston pump, which is driven by the wheel. This paper aims at developing a low cost mechanically operated sprayer pump for Indian middle scale farmers, Study the literature review, user study and market study. Based on literature and market study develop QFD and PDS char, and generate

the many concepts. A final concept has been select for further development and detailing. A full scale working model has been fabricated for design validation. The device has been validated with the user group and got good feedback from the user. No design is ever perfect for all the time; design needs to be changed as per the needs and wants of users. An input for new product development and or design improvements is obtained from the user's feedback and product evaluation with respect to user requirements. [11]

Krishna Murthy B, Rajan Kanwar, Indrajeet Yadav, Vishnu Das, done the work on , Solar Pesticide Sprayer, According to his work, A Solar Operated Pesticide Sprayer is a pump running on electricity generated by photovoltaic panels or the thermal energy available from collected sunlight as opposed to grid electricity or diesel run water pumps. The operation of solar powered pumps is more economical mainly due to the lower operation and maintenance costs and has less environmental impact than pumps powered by an internal combustion engine (ICE). Solar pumps are useful where grid electricity is unavailable and alternative sources (in particular wind) do not provide sufficient energy. The solar panels make up most (up to 80%) of the systems cost. The size of the PV-system is directly dependent on the size of the pump, the amount of water that is required (m^3/d) and the solar irradiance available. The solar sprayer has many advantages. Besides reducing the cost of spraying, there is a saving on fuel/petrol. Also, the transportation cost for buying petrol is saved. The solar sprayer maintenance is simple. There is less vibration as compared to the petrol sprayer. The farmer can do the spraying operation by himself without engaging labor, thus increasing spraying efficiency. The method used here to build solar powered pesticide pumping system is cost effective comparatively to an electrically operated hydraulic pump. Since here non-conventional energy is used to achieve the required head. Discharge obtained from the observations is .5liters per minute. The reciprocating pump built by us is built with the help of simple and easily available materials still we have successful to demonstrate the worth of a reciprocating pump. This device serves its purpose to some extent, but with proper course of actions, it can perform still better. [12]

Zhihong Zhang , Heping Zhu, , Huseyin Guler , Yue Shen, done the work on Improved premixing in-line injection system for variable-rate orchard sprayers with Arduino platform, According to his work, to reduce the tank mixture leftover problem associated with variable-rate orchard sprayers, an experimental automatic premixing in-line injection system was developed with Arduino platform. This system primarily consisted of a precision fluid metering pump, a water pump, a static mixer, a premixing tank and a buffer tank. The required amounts of water and chemical concentrates were accurately pumped into the premixing tank through a static mixer. The mixture was then transferred into a buffer tank for additional mixing process and for the spray pump to discharge to variable flow-rate nozzles. When the buffer tank neared empty, this process was repeated automatically to maintain the same chemical ratio for all nozzles regardless of their spray output differences and variations. Accuracy of the metering pump was verified with simulated pesticide concentrates (tap water, turpentine oil, prime oil, and four different viscous sucrose solutions) at viscosities between 0.9 and 32.0 mPa·s. With addition of a fluorescent tracer, the sucrose solutions were also used to evaluate the uniformity of spray mixtures discharged from the premixing in-line injection system. Test results demonstrated that the fluid metering pump could accurately dispense desired volume (10–300 mL) of simulated pesticides at different pump rotational speeds with relative errors between measured and desired volumes below 5%. The uniformity of spray mixtures at different chemical-to-water ratios (0.1%–2.0%) was consistent, and the highest relative error and coefficient of variation were 7.6% and 4.5%, respectively. The experimental premixing in-line injection system was proven to have stable and accurate performance, and thus would have great potentials to improve spray application efficiency with minimized tank mixture leftovers for future variable-rate sprayers. [13]

2.1 Various Spraying Techniques:

The strategy you use to splash crops is vital to get great inclusion. It ought to be created to fit the kind of gear that will be utilized. With a hand-held weapon, a general movement over the foliage will permit the shower material to enter and get to the underside of the leaves. A few sorts of splashing methods are as per the following

2.1.1 Motorcycle Driven Multi-Purpose Farming Devices:

This engine cycle driven furrow can be utilized to do different cultivating activities likewrinkle opening, planting, between refined and showering tasks.



Fig.2.1.1 Motorcycle Driven Multi-Purpose Farming Devices.

2.1.2 Aerial Sprayer:

Flying sprayer is one more kind of splashing it is valuable for the ranchers having enormous Farms. This strategy by ranchers isn't reasonable to ranchers having little and medium homesteads. In elevated showering the splashing is finished with the assistance of little helicopter constrained by remote. On that sprayer is joined having numerous spouts and splashed it on the homestead from some elevation.



Fig.2.1.2. Aerial Sprayer.

2.1.3. Compressed Air Sprayer:

The littlest sprayers are hand-conveyed, packed air sprayers. They contain a 1-to 5-gallon tank with a pneumatic machine in the top and a wand with a spout for coordinating the splash. Their best use is for spot treatment of little regions. In activity, the tank must be siphoned up often to keep up with pressure, and the tank should be shaken to foment the compound.



Fig.2.1.3. Compressed Air Sprayer.

2.1.4.Backpack Sprayer:

The tank in this sprayer holds around four gallons of material. A hand-worked siphon compresses the shower material as the administrator strolls along, and the wand with spout guides the splash to the objective. It utilizes is restricted to little regions that canbe reached from a walkway.



Fig.2.1.4 Backpack Sprayer.

2.1.5.Skid-Mounted Sprayer:

With a tank size up to 200 gallons, these sprayers will fit onto an ATV or electric truck. They can likewise be mounted on haggles the hard way or with a minimized farm vehicle. A little electric or gas motor powers the siphon. The unit might contain a hose reel and firearm or a blast with spouts.



Fig.2.1.5. Skid-Mounted Sprayer.

3. DESIGN

Configuration comprises of utilization of logical standards, specialized data and creative mind for advancement of new or ad libbed machine or component to fill a particular role with most extreme economy and productivity. Thus a cautious plan approach must be embraced. The complete plan stir has been separated into two sections;

Framework configuration predominantly worries with different physical compels, choosing essential working guideline, space prerequisites, game plans of different parts and so on Following boundaries are viewed in framework plan. Choice of framework dependent on actual imperatives. The mechanical plan has direct standards with the framework plan henceforth framework is planned to such an extent that qualifications and aspects in this way gotten in mechanical plan can be well fitted in to it. Game plan of different parts simplified to use each conceivable space. Simplicity of support and overhauling accomplished through worked on format that empowers speedy choice gathering of parts

Scope of future improvement.

In mechanical plan the parts are recorded down and put away based on their acquisition in two classes, for planned parts nitty gritty plan is done and aspects there got are contrasted with next aspects which are now accessible in market. This improves on the gathering just as the after creation and upkeep work. The different resistances on work are determined. The cycle graphs are ready and passed to assembling stage. The parts to be bought straightforwardly are chosen from different inventories and are indicated in order to have instance of acquisition. In mechanical planned at the primary stage determination of proper material for the part to be intended for explicit application is finished. This determination depends on standard indexes or information books;

E.g.: - PSG Design Data Books, SKF Bearing Catalog and so on

3.1.1 The materials used for fabrication of project:

A) Mild steel

The machine is basically made up of mild steel.

Reasons:

1. Mild steel is readily available in market
2. It is economical to use
3. It is available in standard sizes
4. It has good mechanical properties i.e., it is easily machinable.
5. It has moderate factor of safety, because factor of safety results in unnecessary wastage of material and heavy selection. Low factor of safety results in unnecessary risk of failure
6. It has high tensile strength
7. Low co-efficient of thermal expansion

3.1.2 Properties of Mild Steel:

M.S. has carbon content from 0.15% to 0.30%. They are effectively weldable consequently can be solidified as it were. They are like created iron in properties. Both extreme pliable and compressive strength of these steel increments with expanding carbon content. They can be effectively gas welded or electric or circular segment welded. With expansion in the carbon rate weld capacity diminishes. Gentle steel fills the need and was consequently was chosen on account of the above reason.

Let we select the wheel having specification given below,

Diameter of wheel **$D=30\text{cm}=0.3\text{m}$** .

Radius of wheel **$r=15\text{cm}=0.15\text{m}$** .

Let to find Linear Velocity of wheel

is, $V=r \omega$

V = linear velocity of wheel (m/s)

r =radius of wheel (m)

ω = angular velocity of wheel.

N = Speed of wheel.(Assume 15 rpm)

$V=r \omega$

$$= r \frac{2\pi N}{60}$$

$$V = 0.15 \times \frac{2\pi \times 15}{60} \text{ m/s.}$$

V=0.235 m/s.(linear Velocity of wheel)

3.1.3 To find the shaft diameter of machine carrying wheels.

Let torque required to transmit the power is,

$$\mathbf{T = F \times r}$$

T = torque (N/m)

F= Load to pull the machine. Assume 30kg. (30 x 9.81 = 294.3N)

Force on each wheel = 75N (Assume)

Radius of wheel r = 15cm = 0.15m.

$$= F \times r$$

$$= 75 \times 0.15$$

$$\mathbf{T = 11.25 \text{ N-m.}}$$

3.1.4 for finding diameter of shaft :For commercial steel shaft,

Actual shear stress $\tau_{act} = 55 \text{ N/mm}$

$$\mathbf{T = \frac{\pi}{16} \times \tau_{act} \times d^3}$$

$$\Rightarrow \tau_{act} = \frac{16 \times T}{\pi \times d^3}$$

$$\pi \times d^3$$

$$11.25 \times 10^3 = \frac{16 \times 55}{\pi \times d^3}$$

$$\pi \times d^3$$

$$d^3 = 2037.18$$

$$d = 10.13 \text{ mm} \quad \mathbf{\text{select } d = 12 \text{ mm.}}$$

3.1.5 Selection of Ball Bearing:

As shaft diameter is 12mm so we have selected a ball bearing having dia-12mm to support the shaft.

For ball bearing 6201 Number.

Total radial load on ball bearing is approx. 30 kg.Fh

$$= 30 \times 9.81 = 294.3\text{N}$$

Total radial load can be divided into four bearings so that,

$$F_r = \frac{F_h}{4}$$
$$= \frac{294.3}{4}$$

$$F_r = 73.57 \text{ N} \quad \text{Radial load on each bearing.}$$

To calculate equivalent dynamic load

$$P_e = (XV F_r + Y F_a) K_a$$

K_a = load factor

P_e = equivalent dynamic load, $N F_r$ = radial load, N

F_a = axial load, $N X$ = radial factor Y = axial factor

V = rotation factor (Assume = 1) For bearing Axial load is zero.

Equivalent dynamic load P_e

$$= V.F_r.K_r$$

$$= 1 \times 73.57 \times 1.5$$

$$P_e = 110.3625 \text{ N}$$

Life of bearing is,

$$L_{10} = \frac{L_h \times 10^6}{60 \times n}$$

$$L = \frac{\quad}{10^6}$$

$$L^{10} = \frac{31500 \times 15 \times 60}{10^6}$$

$$L^{10} = 28.35 \text{ millions of revolutions.}$$

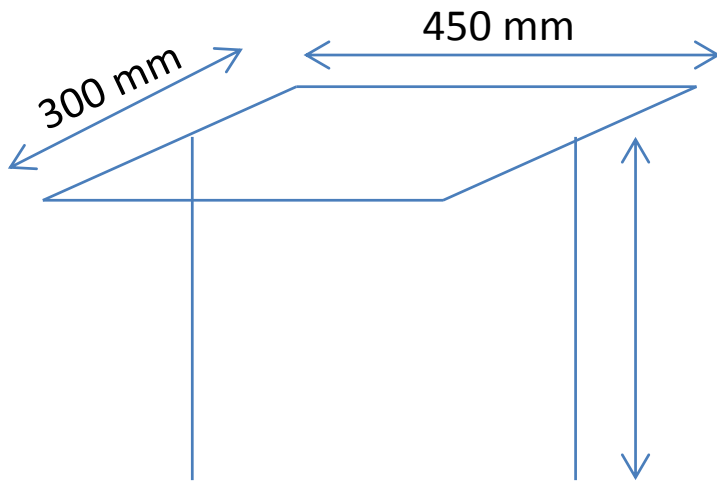
C

$$L^{10} = \left(\frac{C}{P_e} \right)^3$$

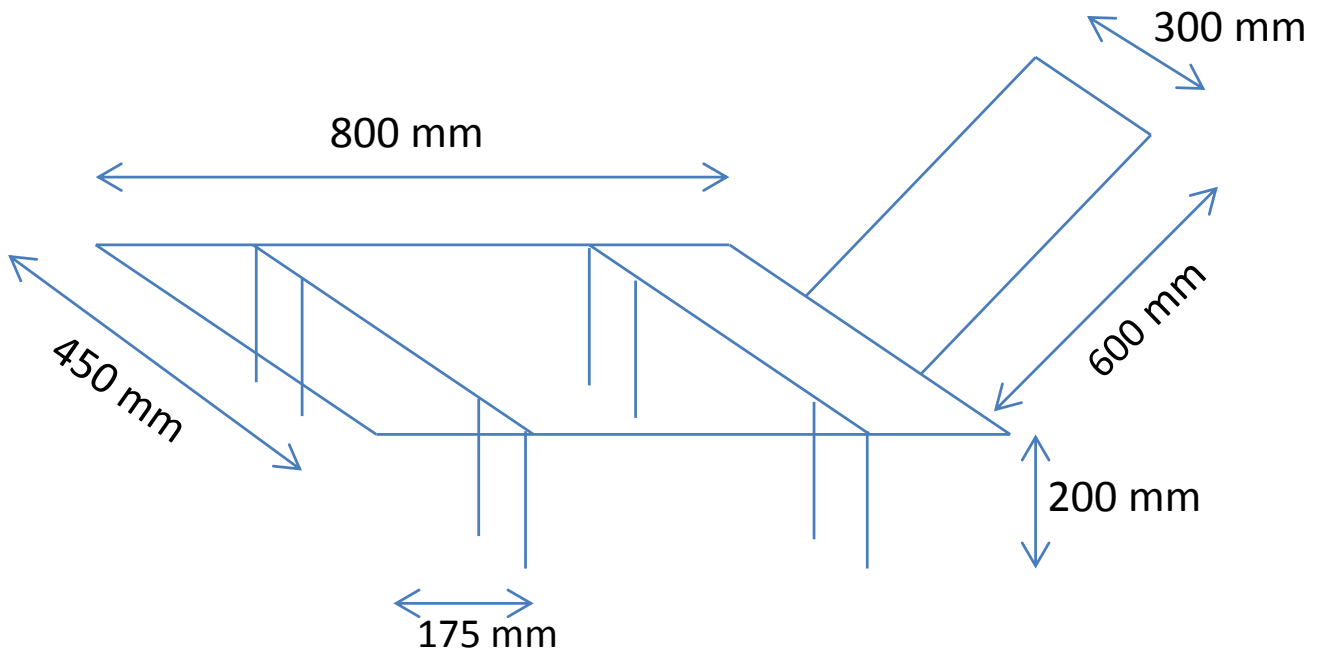
P_e

$$C = (28.35)^{0.33} \times 110.3625$$

$$C = 332.78 \text{ N} \leq 5400 \text{ N (Bearing is safe.) PSG D.D.Book.P.No. 4.13.}$$



Solar Panel



Base Frame

3.2 PROCESS SHEETS

3.2.1. PART NAME: Supporting frame.

Part weight – 15kg

Part material – M.S.

Part quantity – 1

Sr. No.	Operation	Machine	Tool	Time
1	Cutting the material as per our required size.	Cutting machine	Cutting machine	45 min
2	Welding the frame as per required size.	Welding machine	Arc Welding tool	65 min
3	Drilling the frame as per our required size for plywood fittings	Drill machine	Drilling tool	20 min

3.2.2. PART NAME: SPRAYER SHAFT.

Part weight – 1.5 kg

Part material – M.S.

Part quantity – 2

Sr. No.	Operation	Machine	Tool	Time
1	Cutting the M.S. plate material as per our required size.	Cutting machine	Cutting machine	15 min
2	Welding the bolt to the M.S. Bar as per required.	Welding machine	Arc Welding tool	10 min

3.2.3. PART NAME: SPRAYER BUSHES.

Part weight – 0.25 kg

Part material – M.S.

Part quantity – 6

Sr. No.	Operation	Machine	Tool	Time
1	Cutting the bush material as per our required size.	Cutting machine	Cutting machine	10 min
2	Welding the Nut to bush as per required.	Welding machine	Arc Welding tool	25 min

3.2.4. PART NAME: Solar Panel frame.

Part weight – 2kg

Part material – M.S.

Part quantity – 1

Sr. No.	Operation	Machine	Tool	Time
1	Cutting the material as per our required size.	Cutting machine	Cutting machine	25 min
2	Welding the frame as per required size.	Welding Machine	Arc Welding tool	20 min

3.3 COST ESTIMATION

3.3.1. TOTAL COST OF MATERIAL

Part Name	Material	Weight in kg	Rate / kg	Total Rate
Shaft	M.S	2	80	160
Angle	M.S	18	75	1350

TOTAL COST OF MATERIAL: 1,510/- RS.

3.3.2. COST OF MACHINENING

Machine Name	Using Time (min)	Rate /hr	Total Rate Rs/-
cutting	95	400	630
Welding	120	500	1000
Grinding	20	300	100
Drilling	20	300	100

TOTAL COST OF MACHINENING: 1,830/- RS.

3.3.3. COST OF STANDARD PART:

SR NO.	DESCRIPTION	QTY	RATE/UNIT	TOTAL COST
1	NOZZLE	4	50	200
2	BRASS BUSH	4	80	320
3	TANK	1	300	300
4	SOLAR PANEL	1	750	750
5	WIRE	3 mtr.	10	30
6	TUBE	3 mtr.	25	75
7	WHEELS	4	250	1000
8	12 VOLT BATTERY	1	950	950
9	PLYWOOD	1	100	100
10	SWITCH	1	40	40
11	CUTTER MOTOR	1	180	180
12	TANK	1	250	250
TOTAL				4,275/-

TOTAL COST OF STANDARD PART: 4,275/-

3.3.4. COST OF TRANSPORTATION & OVERHEAD = 1000/-Rs.

COST OF PROJECT =

Cost of material + Cost of machining + Cost of STD part + Cost of transportation & overhead

= 1510 + 1830 + 4275 + 1000 = 8,615/-

4. CONSTRUCTION & WORKING

The main components of solar power multi nozzle agricultural pesticide sprayer & grass cutter are as follows:

1. Frame
2. Wheels
3. PVC Tank
4. DC Pump
5. Nozzle pipe
6. Shaft
7. Bearings
8. Fasteners
9. Control Switch
10. Battery
11. Multi nozzles
12. Solar Panel
13. Grass Cutter
14. DC Motor
15. Piston Gun

4.1 DC Pump:

A siphon is a gadget that moves liquids (fluids or gases), or at times slurries, by mechanical activity, regularly changed over from electrical energy into water driven energy. Siphons can be arranged into three significant gatherings as indicated by the strategy they use to move the liquid: direct lift, uprooting, and gravity siphons. A water siphon draws water from the tank and sprinkle on sun powered charger through spout and lines.



Fig.4.1. Water pump.

4.2 Nozzle pipe:

It is a gadget which changes over the strain energy of liquid into dynamic energy; shower spout is an accuracy gadget that works with scattering of fluid into a splash. Spout is utilized for reason to circulate a fluid over an area.



Fig.4.2. Nozzle pipe.

4.3 Wheels:

Wheel is utilized to convey the entire get together and move machine starting with one spot then onto the next by rotating movement of it. A bike wheel is a wheel, most usually a wire wheel, intended for a bike. Bike wheel is intended to squeeze into the edge and fork through nonconformists, and hold bike tire. An average present day wheel has a metal center, wire strain spokes and a metal or carbon fiber edge which holds a pneumatic elastic tire. We utilize a tubeless tire wheel.



Fig.4.3. Wheel.

4.4 Frame:

The fundamental capacity of casing is to convey entire get together on it so it must besufficiently able to hold it. The edge is made of steel point and it is shaped out of gentle steel.

4.5 PVC Tank:

We need our tank to convey however much liquid that it very well may be alongside itsself-weight as less as could really be expected. We have taken a tank which is very nearly 40-liter limit. A material for tank utilized is plastic fiber. Plastic fiber is exceptionally low in weight when contrasted with different materials. It likewise has exceptionally minimal expense.



Fig.4.5. PVC Tank.

4.6 Ball bearings:

This sort of bearing comprises of I) a cast iron platform, ii) weapon metal, or metal shrubbery split into equal parts called "brasses", and iii) a cast iron cap and two gentle steel bolts. The definite drawing of a platform bearing is displayed in picture underneath. The turn of the hedge inside the bearing lodging is captured by a cozy at the lower part of the lower metal. The cap is fixed on the platform block through fasteners and nuts. The pointby point part drawings of another Plummer block with somewhat various aspects are likewise displayed in picture underneath.



Fig.4.6. Ball bearing.

4.7 Shaft:

Shaft is a common and important machine element. It is a rotating member, in general, has a circular cross-section and is used to transmit power. The shaft may be hollow or solid. The shaft is supported on bearings and it rotates a set of gears or pulleys for the purpose of power transmission. Material for Shafts: The ferrous, non-ferrous materials and non-metals are used as shaft material depending on the application.



Fig.4.7. Shaft.

4.8 Washer:

A washer is a meager plate (ordinarily circle molded) with an opening (regularly in the center) that is typically used to appropriate the heap of a strung latch like a screw or nut. Different utilizations are as a spacer, spring (wave washer), wear cushion, preload demonstrating gadget, locking gadget, and to diminish vibration (elastic washer).

Washers typically have an external breadth (OD) about double the width of their inward distance across (ID). Washers are generally metal or plastic. Top notch blasted joints require solidified steel washers to forestall the deficiency of pre-load because of Brinelling after the force is applied. Elastic or fiber gaskets utilized in taps (or fixtures, or valves) to stop the progression of water are in some cases alluded to conversationally as washers; however, while they might seem to be comparable, washers and gaskets are generally intended for various capacities and made in an unexpected way. Washers are likewise significant for forestalling galvanic erosion, especially by protecting steel



screws from aluminum surfaces.

Fig.4.8. Washer.

4.9 Nut and Bolt:

As stray pieces are not completely unbending, but rather stretch marginally under load, the conveyance of weight on the strings isn't uniform. Indeed, on a hypothetically vastly long bolt, the principal string takes 33% of the heap, the initial three strings take 3/4 of the heap, and the initial six strings take basically the entire burden. Past the initial six strings, the leftover strings are under basically no heap by any stretch of the imagination. Subsequently, a nut or fastener with six strings acts a lot of like a vastly long nut or screw.



Fig.4.9. Nut and Bol

4.10 12VDC Battery:

An electric battery is a gadget comprising of at least one electrochemical cells that convert put away compound energy into electrical energy. Every cell contains a positive terminal, or cathode, and an adverse terminal, or anode. Electrolytes permit particles to move between the cathodes and terminals, which permits current to stream out of the battery to perform work.



Fig.4.10. 12VDC Battery.

4.11 DC Cutter Motor:

A DC engine is a precisely commutated electric engine fueled from direct flow (DC). The stator is fixed in space by definition and along these lines its current is as well. The current in the rotor is exchanged by the reporter to likewise be fixed in space. This is the way the overall point between the stator and rotor attractive motion is kept up with almost 90 degrees, which creates the most extreme force. DC engines have a turning armature (twisting in which a voltage is actuated) however non-pivoting armature attractive field and a static field (winding that produce the vitally attractive transition) or super durable magnet. Various associations of the field and armature winding give distinctive inborn speed/force guideline attributes. The speed of a DC engine can be constrained by changing the voltage applied to the armature or by changing the field current. The presentation of variable obstruction in the armature circuit or field circuit permitted speed control. Current DC engines are regularly constrained by power hardware frameworks called DC drives.



Fig.4.11. DC Cutter Motors.

4.12 Direction Control switch:

DPDT switch is utilized to work engine in converse and forward course. The DPDT switch is a class of electrical switches that are physically activated. This is intended to give the synchronous incitation of different arrangements of electrical contacts, or the control of a lot of electric flow or mains voltages.



Fig.4.12. DPDT switch.

4.13 Solar Panel:

The photograph voltaic impact can be seen in nature in an assortment of materials that have shown that the best exhibition in daylight is the semiconductors as expressed previously. At the point when photons from the sun are caught up in a semiconductor, that make free electrons with higher energies than the made there should be an electric field to actuate these higher energy electrons to stream out of the semi-conduit to accomplish helpful work. An intersection of materials, which have diverse electrical properties, gives the electric field in most sun based cells for the photon cooperation in a

semiconductor. A sun based cell comprises of,

1. Semi – guide in which electron opening sets are made by the retention of occurrence sun powered radiation.
2. Region containing a float field for charge detachment.
3. Charge gathering front and back anodes.



Fig.4.13. Solar panel.

Figure 4.13. Shows the concept assembly of the multi nozzle agricultural pesticide sprayer cum grass cutter. The sprayer operator pushes the handle of machine to moves it in forward direction due to the wheel rotation machine move forward. Due to the sprayer application of plants the pump produces rotational motion to compress the liquid to the required pressure is achieved for spraying the chemical by using multi nozzle to the angriified. The pesticide from tank sucks in pump forced the pesticide to nozzle through the pipe; the numbers of nozzles are connected to spray the pesticide. We can adjust the pressure, which is required for spraying with the help of pump discharge & battery-operated pump control switch. Using some adjustments height, position and angle of the nozzle can be adjusted. A pesticide is supply through tank using DC pump from tank & spread with the application of ON/OFF button operation. In conventional spraying method only one side spraying is done. For opposite side it is need to go

opposite side for spraying. This machine can work to spraying pesticides for different crops with having probabilities to set nozzles as per crop profile we want, this machine will be low-cost alternatives for all types of spraying & grass cutter machines.

4.14 Piston Gun :

Spray gun, painting tool using compressed air from a nozzle to atomize a liquid into a controlled pattern. The spray nozzle operates by impinging high-velocity turbulent air on the surface of filaments or films of liquid, causing them to collapse to droplets with a wide range of sizes.



Fig. 4.14 Piston Gun

4.2. Working:

Agriculture Sprayer

We have developed agriculture duster is new RND mechanical project. It is a common type of Sprayer being used by the farmers. The sprayer consists of Dc motor, Nozzle, Tank, Pipes (tubes), Gun, etc . The sprayer has mechanical agitator connected to the gearbox placed in the motor.

In this system the solar energy is captured by solar plate and this solar energy is stored in the 12v battery. This stored energy can be utilized by the Dc motor for mechanical work. Due to rotation or working of motor the water is sucked and by using the nozzle can be spread on crops.

Spray system

This small, high volume, 12v fluid circulation pump is very well suited for circulating water through heat exchangers on water intercooled turbo applications. Magnetic drive motor with sealed pump chamber for long life even with continuous use (up to 3lit per minute.). High temperature capable. Pump can also be replaced in damaged condition.

Cutter system

DC motor shaft connected to sharp blade (grass cutter) .when switched on motor starts that time motor starts and cutting work starts that time pushes the overall system .DC motor is permanent magnet type of DC motor. So, no armature and field winding is there as in conventional DC motor. Only single supply is required. The motor speed can be changed if the voltage is changed. But, in our application the motor has to operate at high torque because, it has lifted the material. So, gear box is incorporated with the existing DC motor. This gear box reduces the speed and increases the torque of the motor.

4.3. ADVANTAGES & APPLICATIONS

4.3.1. Advantages:

1. It is multinozzle sprayer machine for spraying .
2. Machine is easy to design.
3. Multi nozzle sprayer cum grass cutter machine is easy to operate.
4. Multi nozzle sprayer machine is profitable machine for spraying .
5. Maintenance"s cost of multi nozzle sprayer cum grass cutter machine is low.
6. Cost of grass cutter machine is very cheap one so that low land holder farmers can also purchase it.

4.3.2. Applications:

Agricultural Application :-

1. For spraying chemicals & pesticide on crops for protecting them from harmful pesticides & fungicides.
2. For Grass cutting application for farmer.



2) For spraying chemicals on plants & trees.



3) For spraying chemicals on crops for protecting them from harmful pesticides & fungicides.



Industrial application :

Nordson industrial sprayers and parts are designed to improve control and precision within your manufacturing processes so you can apply paint, powder, liquids, adhesives and other materials more efficiently.

Food processing application :

Its versatility makes this sprayer suitable for spraying a wide variety of foods in liquid form: water, oil, vinegar, milk, brine, melted butter, caramel, syrup, egg, hot chocolate etc.

5. CONCLUSION & FUTURE SCOPE

As we know that due to increase in demand for chemical free vegetable crop production, farmers have started using mechanical techniques to control weed. Only difference is that instead of using conventional methods i.e. manual operation of the system farmers have started using automated mechanical machines to achieve the goal. Our project is now manually operated sprayer, but in future we can make it semi/fully automatic. We can use tractor drive to fully automatically actuate the sprayer for its future working. While concluding this Stage-1 report, we feel quite fulfill in having completed the project literature assignment well on time. We are happy to state that the in calculation of mechanical aptitude proved to be a very useful purpose. Although the design criterions imposed challenging problems which, however were overcome by us due to availability of good reference books. The selection of choice raw materials will help us in machining of the various machine parts and thereby minimizing the level of problem. Needless to emphasis here that we had lift no stone unturned in our potential efforts during machining, fabrication and assembly work of the project model to our entire satisfaction to solve the problem in agricultural field for social welfare. As we know that due to increase in demand for chemical free vegetable crop production, farmers have started using mechanical techniques to control weed. Only difference is that instead of using conventional methods i.e., operation of multi nozzle sprayer cum grass cutter will be perform to achieve the objectives.

5.1 EXPECTED OUTCOMES

While concluding this report, we feel quite fulfill in having completed the project literature assignment well on time. We are happy to state that the in calculation of mechanical aptitude proved to be a very useful purpose. Although the design criterions imposed challenging problems which, however were overcome by us due to availability of good reference books. The selection of choice raw materials will help us in machining of the various machine parts and thereby minimizing the level of problem. Needless to emphasis here that we had lift no stone unturned in our potential efforts during machining, fabrication and assembly work of the project model to our entire satisfaction to solve the problem in agricultural field for social welfare. As we know that due to increase in demand for chemical free vegetable crop

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APPENDIX

TYPICAL USES OF CARBON STEEL

Steel Designation	Typical uses
C07, C10	Used for cold forming and deep drawing. Rimming quality used for Automobile bodies, cold heading wires and rivets. Killed quality used for forging and heat treating applications.
C10 and C14	Case hardening steels used for making camshafts, cams, light duty gears, worms, gudgeon pins, selector forks, spindles, pawls, ratchets, chain wheels, tappets, etc.
C15	Used for lightly stressed parts. The material, although easily machinable is not designed specifically for rapid cutting, but is suitable where cold work, such as bending and riveting may be necessary.
C15Mn75, C20, C25 and C25Mn75	General purpose steels for low stressed components.
C30	Used for cold formed levers - Hardened and tempered tie rods, cables, sprockets, hubs and bushes - steel tubes.
C35	Steel for low stressed parts, automobile tubes and fasteners.
C35Mn75	Steel for making low stressed parts in machine structures, cycle and motorcycle frame tubes, fish plates for rails and fasteners.
C40	Steel for crankshafts, shafts, spindles, automobile axle beams, push rods, connecting rods, studs, bolts, lightly stressed gears, etc.
C45	Steel for spindles of machine tools, bigger gears, bolts and shafts.
C50	Steel for making keys, shafts, cylinders, machine components requiring moderate wear resistance. In surface hardened condition it is also suitable for large-pitch worms and gears.
C50Mn1	Rail steel. Also used for making spike bolts, gear shafts, rocking levers and cylinder liners.
C55 and C55Mn75	Steels used for making gears, cylinders, cams, keys, crank shafts, sprockets and machine parts requiring moderate wear resistance for which toughness is not of primary importance.
C60	Steel for making spindles for machine tools, hardened screws and nuts, couplings, crank shafts, axles and pinions.
C65	High tensile structural steel for making locomotive carriage and wagon tyres. Typical uses of this steel in the spring industry include engine valve springs, small washers and thin stamped parts.

CARBON STEELS : PROPERTIES				
Designation	condition	tensile strength N/mm ²	yield strength N/mm ²	Izod Impact value, Nm
C 07	sheets, cold rolled and annealed	300—380		
C 10	—do— Case hardened—refined & quenched	320—400 500		55
	bars, cold drawn upto 20 diam	500		
	20—40 "	460		
	40—63 "	420		
	over 63 "	340		
C 14	Case hardened—refined & quenched tubes, cold drawn and annealed; cold drawn and tempered;	500 340 440	190 380	55
C 15	tubes cold drawn and annealed Cold drawn & tempered sheets, cold rolled & annealed	340 440 320—440	190 380	
C 15 Mn 75	bars, cold drawn upto 20 dia 20—40 " 40—63 " Over 63 " tubes, cold drawn & annealed " & tempered	520 480 440 420 340 440	190 380	
C 20	bars, cold drawn upto 20 diam 20—40 " 40—63 " Over 63 " sheets, cold rolled & annealed tubes, cold drawn & annealed cold drawn & tempered	560 540 480 440 390—510 370 520	220 420	
C 25	tubes, cold drawn & annealed cold drawn & tempered	390 560		250 460
C 25 Mn 75	tubes, cold drawn & annealed " & tempered	390 560		250 460
C 30	bars & forgings: hardened & tempered bars: upto 20 diam 20—40 " 40—63 " Over 63 "	600—750 620 580 540 500	400	55
C 35	tubes, cold drawn & annealed " & tempered	440 620	280 500	

DESIGN DATA—PSG TECH

1.11



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CARBON STEEL : PROPERTIES (Contd.)				
Designation	Condition	tensile strength N/mm ²	yield strength N/mm ²	Izod impact Nm
C 35 Mn 75	bars & forgings			
	hardened & tempered	600—750	400	55
	tubes, cold drawn & annealed	440	280	
	„ & tempered	620	500	
✓ C 40	bars, cold drawn			
	upto 20 diam	680		
	20—40 „	640		
	40—63 „	600		
	Over 63 „	580		
	bars & forgings, hardened & tempered	600—750	380	41
C 45	bars & forgings, hardened & tempered	600—750	380	41
	tubes, cold drawn & annealed	520	340	
	„ & tempered	700	600	
C 50	bars, cold drawn			
	upto 20 dia.	740		
	20—40 „	700		
	40—63 „	680		
	Over 63 „	660		
	bars & forgings, hardened & tempered	700—850	460	—
	tubes, cold drawn & annealed	520	340	
	„ & tempered	700	600	
C 55 Mn 75	bars, cold drawn	720—780		
	bars & forgings, hardened & tempered	700—850	460	—
C 55 Cr 75	Wear resisting, hardened & tempered	900—1050	660	35 (BHN 255 — 311)

TENSILE STRENGTH OF STRUCTURAL STEELS : N/mm ²														
grade	St 30	St 32	St 34	St 37	St 39	St 42	St 44	St 47	St 50	St 52	St 55	St 58	St 63	St 88
tensile strength	300 to 380	320 to 440	340 to 460	370 to 490	390 to 510	420 to 540	440 to 540	470 to 570	500 to 600	520 to 620	550 to 650	580 to 680	630 to 710	880 to 1000



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DEEP GROOVE BALL BEARINGS (Contd.)

Series 62



Series 62

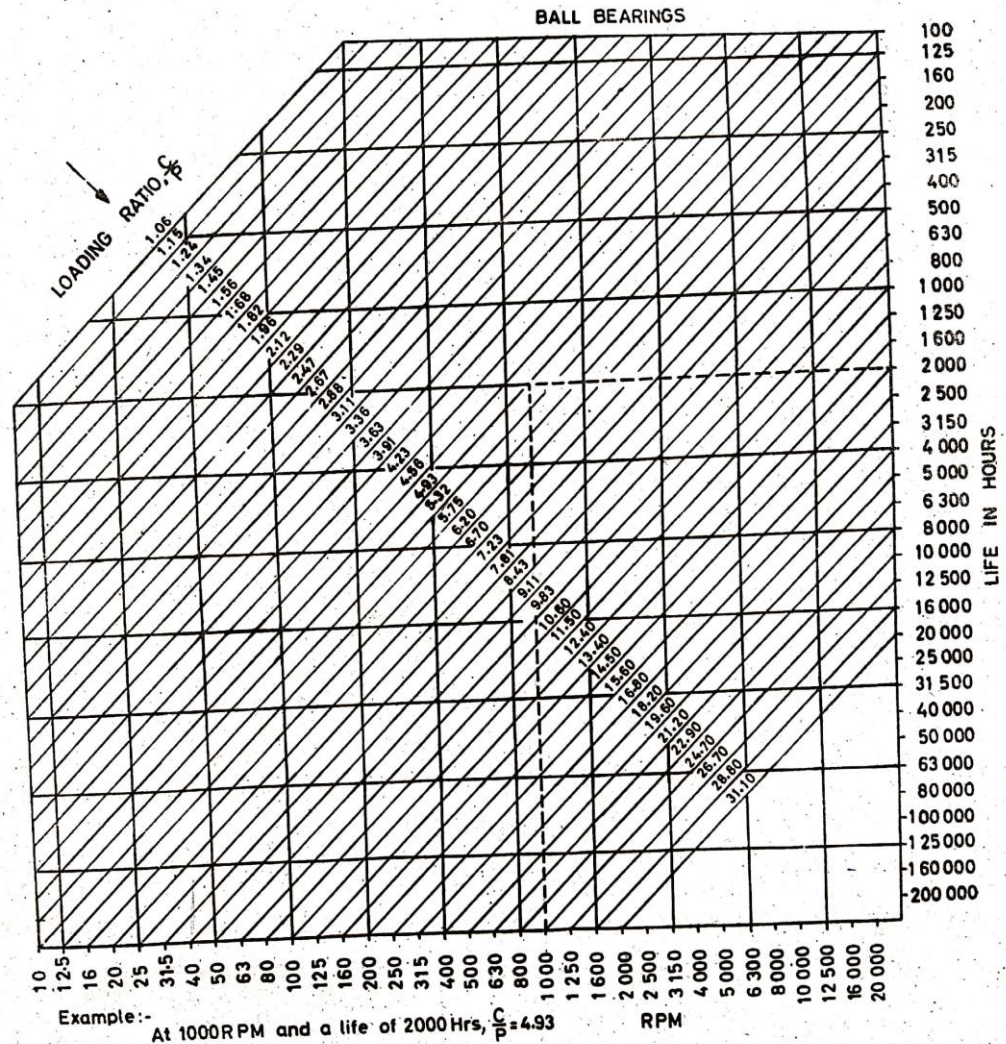
ISI No.	Bearing of basic design No. (SKF)	d mm	D _i min	D mm	D _i max	B mm	r mm	r ₁ mm	Basic capacity, kgf		Max. permissible speed rpm
									Static C ₀	Dynamic C	
10BC02	6200	10	14	30	26	9	1	0.6	224	400	20000
12BC02	01	12	16	32	28	10	1	"	300	540	20000
15BC02	02	15	19	35	31	11	1	"	355	610	16000
17BC02	6203	17	21	40	36	12	1	"	440	750	16000
20BC02	04	20	26	47	41	14	1.5	1.0	655	1000	16000
25BC02	05	25	31	52	46	15	1.5	"	710	1100	13000
30BC02	6206	30	36	62	56	16	1.5	"	1000	1530	13000
35BC02	07	35	42	72	65	17	2	"	1370	2000	10000
40BC02	08	40	47	80	73	18	2	"	1600	2280	10000
45BC02	6209	45	52	85	78	19	2	"	1830	2550	8000
50BC02	10	50	57	90	83	20	2	"	2120	2750	8000
55BC02	11	55	64	100	91	21	2.5	1.5	2600	3400	8000
60BC02	6212	60	69	110	101	22	2.5	"	3200	4050	6000
65BC02	13	65	74	120	111	23	2.5	"	3550	4400	6000
70BC02	14	70	79	125	116	24	2.5	"	3900	4800	5000
75BC02	6215	75	84	130	121	25	2.5	"	4250	5200	5000
80BC02	16	80	91	140	129	26	3	2.0	4550	5700	5000
85BC02	17	85	96	150	139	28	3	"	5500	6550	4000
90BC02	6218	90	101	160	149	30	3	"	6300	7500	4000
95BC02	19	95	107	170	158	32	3.5	"	7200	8500	4000
100BC02	20	100	112	180	168	34	3.5	"	8150	9650	3000
105BC02	6221	105	117	190	178	36	3.5	"	9300	10400	3000
110BC02	22	110	122	200	188	38	3.5	"	10400	11200	3000
120BC02	24	120	132	215	203	40	3.5	"	10400	11400	3000
	6226	130	144	230	216	40	4	2.5	11600	12200	2500
	28	140	154	250	236	42	4	"	12900	12900	2500
	30	150	164	270	256	45	4	"	14300	13700	2500
	32	160	174	290	276	48	4	"	15600	14300	2000
	6234	170	187	310	293	52	5	3.0	19000	16600	2000
	36	180	197	320	303	52	5	"	20400	17600	1600
	38	190	207	340	323	55	5	"	24000	20000	1600
	40	200	217	360	343	58	5	"	26500	21200	1600

D_i, abutment diam. on shaft
D_h, abutment diam. on housing
r₁, corner radii on shaft & housing.



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PHOTOGRAPHS



















