

Modification and Development Of Two Wheel Pesticide Spray Pump To Overcome the Limitation In Traditional Pesticide Spray Pump

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ABSTRACT –

The main aim of this paper is to make modification in traditional spray pump which is run by manual power i.e, hand operated spary pump. In hand operated spay pump found lot of limitation and we have try to overcome these limitation by making some modification in spray pump . Small scale farmers are very interested in manually lever operated knapsacksprayer because of its versatility, cost and design. But this sprayer has certain limitations like it cannot maintain required pressure; it lead to problem of back pain. We have proposed equipment that is wheel driven spray, it is a portable device and no need of any fuel to operate, which is easy to move and sprays the pesticide by moving the wheel.This wheel operated pesticide spray equipment consumes less time and avoids the pesticide coming from front of the nozzles which will in contact of the person who sprays pesticides. The mechanism involved in this spray is reciprocating pump, which is driven by the wheel.

Keywords- Manual operated spray pump, Two wheel operated, reduced back pain, wastage of pesticide.

INTRODUCTION

India is set to be an agricultural based country. Approximately 75% of population of India is dependent on farming directly or indirectly. Our farmers are using the same methods and equipment for the ages. E.g. seed sowing, spraying, weeding etc.

Agriculture sector is facing problems with capacity issues, labour shortages and increasing consumer demands. In addition, most formers are desperately seeking different ways to improve the equipment quality while reducing the direct overhead costs (labour) and capital. There is need for development of effective spraying and weeding machine for increasing productivity. Thus, a significant opportunity rests with understanding the impact of a pesticide spray pump in an agriculture field.

A pesticide spray pump has to be portable and with an increased tank capacity as well as should result in cost reduction, labour and spraying time. In order to reduce these problems, there are number of sprayer introduced in the market but these devices do not meet the above problems or demands of the farmers.



Fig 1 .Existing Spraying Method

The conventional spray pump having the difficulties such as it needs lot of effort to push the liver up and down in order to create the pressure to spray. Another difficulty of petrol sprayer is to

need to purchase the fuel which increases the running cost of the sprayer. In order to overcome these difficulties, I have proposed a wheel driven sprayer, it is a portable device and no need of any fuel to operate, which is easy to move and sprays the pesticide by moving the wheel. The mechanism involved in this spray pump is reciprocating pump, and nozzles which were connected at the front end of the spraying equipment. Agriculture sector is facing problems with capacity issues, shrinking revenues, and labour shortages and increasing consumer demands.

The prevalence of traditional agriculture equipment intensifies these issues. In addition, most farmers are desperately seeking different ways to improve the equipment quality while reducing the direct overhead costs (labour) and capital. Thus, a significant opportunity rests with understanding the impact of a pesticide sprayer in an agriculture field. A pesticide sprayer has to be portable and with an increased tank capacity as well as should result in cost reduction, labour and spraying time. In order to reduce these problems, there are number of sprayer introduced in the market but these devices do not meet the above problems or demands of the farmers.

The volume of spray liquid required for certain area depends upon the spray type and coverage, total target area, size of spray droplet and number of spray droplets. It is obvious that if the spray droplets are coarse-size then the spray volume required will be larger than the small size spray droplets. Also if the thorough coverage (e.g. both the sides of leaves) is necessary then the spray volume requirement has to be more.

The multi-point operated spraying machine is basically for crop spraying in the farm. The design should be strong and sturdy which implement work effectively. For spraying farms in present era, a person use hand operated pumping machine which is time consuming & costly, which needs more human efforts. It is difficult to treat field crops by foot sprayers because the sprayer is kept on ground and pesticide solution tank is also kept on ground separately and so movement of the long delivery hose becomes very difficult. If large area can be covered for spraying, using less efforts & time, this implants new concept in design engineering.

LITERATURE REVIEW OF THE PESTICIDE SPRAY PUMP

1. Sandeep H. Poratkar, Dhanraj R. Raut, "Development of Multi-nozzle Pesticides Spray Pump" International Journal of Modern Engineering Research (IJMER), Vol.3, Issue.2, March-April 2013 pp-864-868 ISSN: 2249-6645.

This paper suggests a model of manually operated 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.

2. Shivaraja Kumar, "Design and development of wheel and pedal operated sprayer" D2, IPASJ International Journal of Mechanical Engineering (IJME), Web Site: <http://www.ipasj.org/IJME/IJME.htm>, Volume 2, Issue 6, June 2014, ISSN 2321-6441.

This paper suggests equipment that is wheel and pedal operated spray pump, it is a portable device and no need of any fuel to operate, which is easy to move and sprays the pesticide by moving the wheel and also peddling the equipment. In this equipment using reciprocating pump and there is a accumulator provided for the continuous flows of liquid to create necessary pressure for the spraying action.

3. Varikuti Vasantha Rao, Sharanakumar Mathapati, Dr. Basavaraj Amarapur Multiple Power Supplied Fertilizer sprayer, Department of Electrical and Electronics Engineering, PDACE, Gulbarga. India, International Journal of Scientific and Research Publications, Volume 3, Issue 8, August 2013 ISSN 2250-315

In this paper, the design and implementation of multiple power supplied fertilizer sprayer has been presented. The proposed system is the modified model of the two stroke petrol engine powered sprayer which minimizes the difficulties of the existing power sprayer such as operating cost, changing of fuel etc. The two stroke petrol engine has been replaced by a direct current motor and operated by the electrical energy stored in the battery attached to the unit. The battery can be charged by solar panel during the presence of sun. It could also be operated on direct current during rainy and cloudy weather conditions. This system can be used for spraying pesticides fertilizers.



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These fertilizers are applied to agricultural crops with the help of a special device known as a "Sprayer," sprayer provides optimum performance with minimum efforts. By the invention of sprayers, this enables farmers to obtain the maximum agricultural output.

A pesticide sprayer has to be portable and with an increased tank capacity as well as should result in cost reduction, labour and spraying time. In order to reduce these problems, there are a number of sprayer introduced in the market, but these devices do not meet the above problems or demands of the farmers.

1. Plan of work to overcome limitation in traditional pesticide spray pump and modification

Development and fabrication of pesticide spray pump, it consists of spray tank, nozzles, freewheel, gear pair, chassis (frame), solar panel and battery. In this project motion of wheel provided to the gear pair which mounted on axel to the spray tank with the help of crank link, by the use of crank link rotary motion is converted into reciprocating motion, this motion gives to spray tank piston. Nozzles mounted on front of the spray tank, the distance of nozzles spray adjusted vertically up word and down word direction.

Spur gear mounted on middle of the wheel axel and below the spray tank. All the load of system comes on wheel axel and also wheel. Chassis constructions are design in such way that, when the person push the system, he feel comfortable and easy to move. We arrange the solar plate top of the system, look like the shed to the person which protect person from sun rays, also this is used for charging purpose which turn the project in multi-purpose.

3.1 The major components of the pesticide spray pump are as follows,

Spur Gear, Storage tank, Bearing, Axel (Shaft), Wheel, Solar panel with battery and charging kit, Nozzle, Pipe.

Problem formulation

1. Drawbacks in Existing backpack Sprayer Pump Lever operated backpack sprayer. A backpack sprayer consists of tank 10-20 litter capacity carried by two adjustable straps, this may causes the back pain to the operator due to constant pumping which result in muscular disorder.
2. The conventional spray pump having the difficulties such as it needs lot of effort to push the liver up and down in order to create the pressure to spray.
3. Developing adequate pressure in hand operated spray laborious and time consuming.
4. Another difficulty of petrol spray pump is to need to purchase the fuel, which increases the running cost of the spray pump.
5. Pumping to operating pressure is also time consuming moreover, very small area is covered while spraying.
6. The pesticide coming from front of the nozzles which will in contact of the person who sprays pesticides it harms person's eyes.

Working principle

Two wheel manually operated spray pump, it require only manual force (193.733N) to run the wheel, and normal human applying capacity 300N (newton) force. The wheel and the gear are mount on the same axel(1), the wheel is rotate that time the gear also rotate, the one more axel(2) is connect with the help of bearing above the axel(1), and the pinion is fitted on the axel(2) and this gear mesh with the pinion.

The tank lever connect to the link and this link connect to the axel(2) due to that mechanism, the rotary motion converted into the reciprocating motion. The tank lever gives the reciprocating

motion to the piston (in the tank) and piston is reciprocate in the cylinder due to this reciprocation the piston create the pressure (0.814 bar) at the one stroke. This pressurized fluid goes to the nozzle and spray the dilute pesticide on the crop and it cover the more area than conventional spray pump.

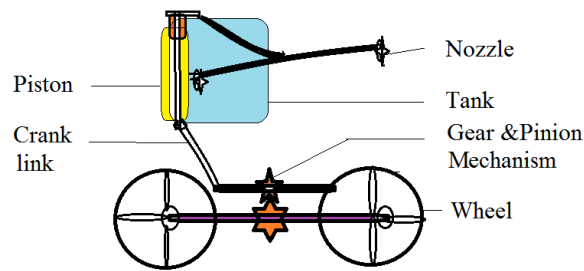


Fig. 2 Working Mechanism of Two Wheel Operated Spray Pump

4.2 WORKING OF MODIFIED SPRAY PUMP

Hand lever operated sprayer having the mechanical energy for spraying pesticides. The input is given through the lever to the hand lever operated sprayer and in purpose model input is manual force as soon as the wheel is drive. This portable spraying system consist of a tank and piston arrangement, gear pair, and crank shaft mechanism for converting rotary motion into reciprocating motion.

The assembly can be mounted on the chassis also spraying tank is mounted on chassis containing spraying solution. When hole assembly push forward, the wheel rotated and rotary motion of wheel transfer to connecting links trough the gear pair, connecting link attached to piston of pump, provides reciprocating motion to pump which compress the fluid in tank there is a circular cross section on the bottom of the tank which compress the fluid in the tank by piston, due to this created a pressure which flows the fluid through the pipe contain inside the piston to the outlet and passes to the nozzle and create a spray of pesticide.

This sprayer has energy sufficient and easy to operate and maintain as it is flexible product with adjustable height of spraying nozzle thereis a greater flexibility for using it various crop. Since the two wheel required less space to move it can be used in a more versatile manner as compare to power sprayer and conventional hand operated spray pump.

Network Of Working pesticide spray pump

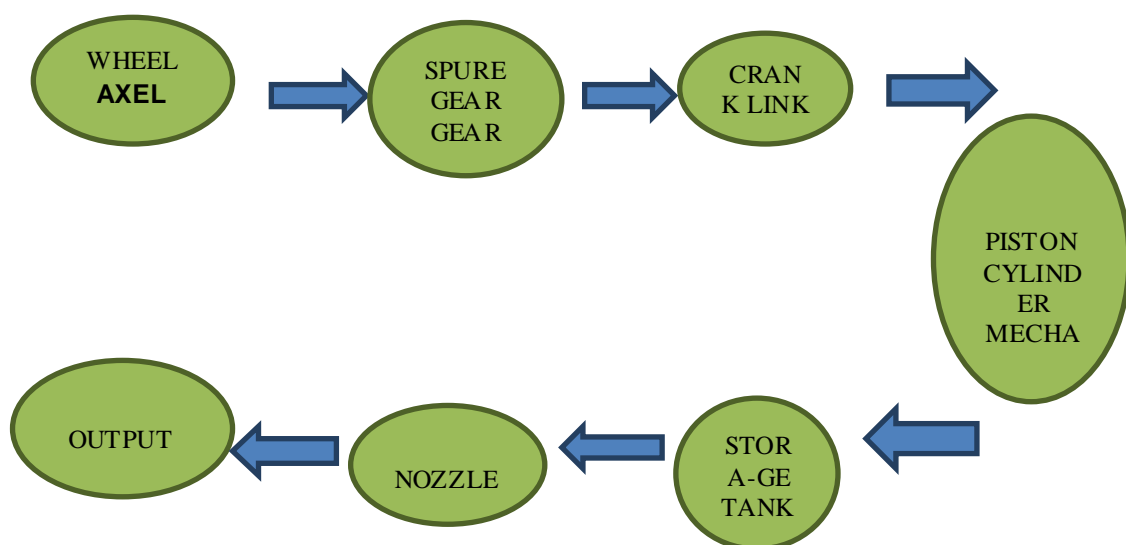


Fig.3 Flow Diagram of Two Wheel Operated Pesticide Spray Pump

Steps involved in working of spraying machine

1. It works on the principle of compression of fluid by reciprocating motion of piston in cylinder.
2. Reciprocating motion of piston is achieved by rotating wheel axel with gear mechanism, as the piston and cylinder is connected with crank link.
3. In piston cylinder, the fluid from storage tank is sucked in cylinder.
4. The reciprocating motion of piston increases the pressure of fluid.
5. The high pressure fluid is discharged through nozzle.
6. The nozzle is provided to increase the fluid velocity and convert the fluid into spray.

CAD MODEL OF MODIFIED PESTICIDE SPRAY PUMP

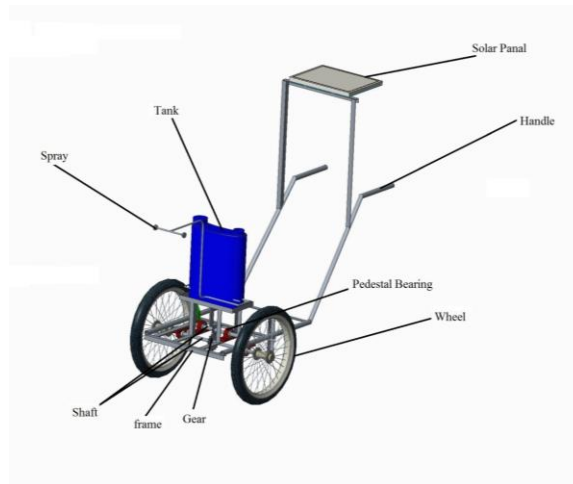


Fig 4. CAD Model Of Modified Spray Pump

DISCUSSION

We have developed and fabricated manually operated spray pump which is wheel driven. For this the detail analysis of the mechanism and the fabrication of the above said model is designed and developed. We have successfully tested this model and found the fare results as compare to the existing hand operated pesticide spray pump.

Technical features	Existing Pump	Modified Pump
Pressure	0.68 bar	0.814 bar
Discharge	1.2 lit/min	5 lit /min
Area cover	68 min/acre	35 min/acre
Number of full tanks required per acre	5.39	2.7
One single full tank cover area	750 sq.m.	1100 sqm.
Crop	1 row	2 row

Conclusion

In this way we have used the two wheels for a spraying purpose by converting its circular motion into reciprocating motion of reciprocating piston in order to fulfill the needs of our farmers. The two wheel operated sprayer pump is ergonomically very useful to minimize the effort while spraying the pesticide, improve the performance and it reduces the fatigue of the operator. The operator can cover large area in a short time without any additional energy by using

the two wheel system. The manual energy can transfer to mechanical energy which conform the resources can be saved and system can be developed.

References

- Sandeep H. Poratkar, Dhanraj R. Raut, entitled “Development of multi nozzle pesticides sprayer pump” Volume 2, March-April. 2013.
- Paul E. Sumner “Hand-held and Backpack Sprayers for Applying Pesticides” May 1997.
- Shivaraja kumar & Parameswaramurthy “Design and Development of Wheel and Pedal Operated Sprayer” Volume 2, Issue 6, June 2014.
- Joginder Singh “Scope, Progress and Constraints of Farm Mechanization in India” volume 3, Issue , sept 2002
- David McAuliffe and Vanessa P. Gray “Application technology: Problems and opportunities with Knapsack sprayer, Including the CF valves or Constant Flow Valves.” in 2000.
- Joe Evan, Ph. D “Pump ED-101, Positive Displacement pump-Part I Positive Displacement”
- Robert N. Kelin, (Extension western Nebraska Crops Specialist) Creg R. Kruger (Extension cropping system specialist) “Nozzle- Selection And Size”
- By Billjones of Forest Research “Mechanised Spraying Systems for Herbicide Use in Forestry” Sept 2006
- B. D. Shiwalkar, “Design Data For Machine Elements” Nagpur: Denett Publication, 2013.