Walker Sprayer Pump

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Abstract— India is the land of agriculture and about 70% of people depend on it. Therefore, there is a need to develop an efficient and economical sprayer pump. The project topic is Walker Sprayer Pump, which is designed in such a way that it can spray the fertilizers or pesticides by the movement of our legs. When we generally walk, we move our legs up and down so by this movement or motion of the leg's pesticides can be sprayed on a farm. It has two merged pistons and cylinder So when the legs move (when we walk) the nut connected to the bell crank also rotate because of bearing and when the bell crank rotate it tends to reciprocate the piston in the cylinder and by the suction and compression fertilizer can be spray with high pressure in the farm. This sprayer reduces the hand power required at the time of spraying and reduces the problem of fuel or energy required to run the sprayer in an electrical pump. The main objective of this paper is to generate a low-cost, environment-friendly, efficient sprayer pump for India's poor range farmers and reduce the required efforts.

Keywords: Fertilizer sprayer, Sprayer Pump, leg operated, knapsack sprayer pump, leg mechanism, and pesticide sprayer

I. INTRODUCTION

In agriculture, the use of beneficial and cost-effective spraying equipment is key to increase the productivity of a farm. Because of conventional pump uses kerosene, farmers face the problem due to fumes, which releases while spraying. This process is hazardous to the environment and causes an imbalance in the natural ecosystem. This paper suggests a model of leg operated pesticide-spraying pump. Small-scale farmer uses manually lever-operated knapsack sprayers, which causes problems of pain in arms. To avoid these entire problems, we have made walker sprayer pump, which does not need the working of hand. The mechanism is simply attached to our legs, so while walking fertilizers are spray.

We have merged two pistons and cylinders in one sprayer pump by putting the other cylinder from a different pump so it can develop two times pressure than commercial pump and also compression stroke should not get empty.

This pump the same as a commercial pump but the difference is that mechanism eliminates the moment of hand. The end of the hand lever of pump is joined with a bell crank (crank that changes motion through an angle) at one end and the other end with nut through welding. A nut is attached with cushions to our legs. At the centre of the bell crank, it has a bearing that is welded to C-clamp through a solid shaft (C-clamp is attached to the west). When we walk the moment of legs causes the nut mechanism to rotate with a bell crank. As the bell crank rotates it causes the hand lever to rotate. Piston in-cylinder reciprocates because of all these motions and high-pressure fluid is passed through the nozzle. In nozzle, pressure energy of the fluid is converted into kinetic energy. The principle is a motion of leg is transmitted to piston in a cylinder for pumping action through bell crank. In this pump, both pistons reciprocate one after one from TDC to BDC and vice versa.

II. LITERATURE REVIEW

Sakthivel M. and Satish J, [1] The creators have developed fertilizer sprayer pump which can store fertilizers in the trolley so farmers need not carry pump on the shoulder but there is a problem that it cannot gives efficiency while the farmer is spraying in mud area and need to bend while spraying. Akshaya C., et al [2] The Creators has developed a Mechanically Operated Pesticide Sprayer & Fertilizer Dispenser in which farmers did not need to carry pump but for small scale farmers this mechanism gets costly as their land is small. Varikuti Rao, et al [3] have developed Multiple Power Supplied Fertilizer Spray which is operated by the electrical energy stored in the battery attached to the unit through the motor and charged by the solar panel but this mechanism is more costly due to the cost of a battery, solar panel, and motor. Abhishek B, et al [4] have developed Multi Nozzle Wheel Spray Pump through which fluid can be sprayed by 3-4 nozzle effectively.

The references, which are listed above, has some limitation that they are not economical and some are operated by trolley. In our project, we used a leg mechanism that is attached to legs through nuts and cushions and another end with a bell crank mechanism. Bell cranks are used to change the direction of motion through 90 degrees. Another end of bell crank is attached to hand lever. So, the motion of leg is converted into the reciprocating motion of piston in a cylinder pump. It reduces hand power and not required any fuel to operate the pumps.

III. OBJECTIVE OF PROJECT

The scope of this project is to make this pump can operate on leg moment and increase human comfort. We aim to make a model or machine which can perform the following function.

- To reduce the cost required and make it available to small-scale farmers economically.
- To reduce the effort required to the farmer while spraying to hand.
- No fuel is required for spraying fertilizers in the walker in the sprayer pump.
- To increase the efficiency of the sprayer by installing two pump mechanisms (combining two pistons and cylinder in one) into one pump.
- To reduce pollution, which can produce through a commercial pump.

IV. METHODOLOGY

This project would be consisting of the following chronological step and methods of working

A. Survey

We start finding shops related to the agriculture field like fertilizer shop, sprayer pump shop and equipment is related to the agriculture/sprayer pump. We search many shops like Gargi Agro Services, Shiv Agro Agency, Krushna Trading Fertilizers, Sujalam Crop Care, Mekal Group in Nashik, Maharashtra. We search these shops for getting an idea about the construction and outer design of the sprayer pump, and how to remove the lever and install the leg mechanism. We also searched the industries, which help us to get manufacturing process details. We visited the industries like Godavari Pump, GNP AGROSCIENCES PVT. LTD. We have seen the manufacturing of the pump like piston and cylinder arrangement, lever and fertilizer tank from this we get the idea about the project.

B. Design calculations

Tank
L = Length of the Tank = 300 mm, W = Width of the Tank = 140 mm, H = Height of the Tank = 350 mm
Volume or Capacity of the Tank = 14.7 litre
Diameter of piston =55mm, Height of piston= 400mm
Volume of piston = 9, 49,850 mm^3
Stroke length of piston = 70mm
Cylinder diameter =56mm, Cylinder height= 75mm
Discharge per rev. = Area of piston * Stroke length
= $51.7*10^4$ mm^3/rev.
Working pressure = 0.2-0.3 Mpa
Bell Crank
Length of bell crank = 150 mm
Height of bell crank = 150 mm
Width of bell crank = 40 mm
Thickness of bell crank = 2 mm
Bearing diameter = 35 mm
C- clamp and Nut
C_{waist} = 160 mm
C_{Thigh} = 130 mm
C_{knee} = 100 mm
Bolt length = 650mm, Diameter =10mm
Nozzle
Diameter of nozzle = 0.4 mm
Five holes of 0.4 mm

C. Development CAD Model

Fig. 1: CAD Model of Project

Fig. 2: CAD Model of Project (F.V)

V. Details

A. Components of Walker Sprayer Pump.

Different components of the Walker Sprayer Pump are given below.

1) Tank

The tank is the main component of a pump, which is used to store fertilizers. It has a storage capacity of 15 liters and it made up of plastic. It consists of piston and cylinder assembly, which is used for suction and compression of fluid. We have inserted two assemblies of piston and cylinder to increase pressure. It has a rectangular hole at the top to fill the fluid in the tank.

2) Bell Crank

The bell crank is a mechanism, which is to change the direction of motion of force through 90 degrees. At the center of the bell crank, ball bearing is welded to provide a smooth flow of force or motion. At the upper end of the crank handle or liver of pump is welded and at the lower end leg mechanism (nut and bolt) is welded to change the direction of motion through 90 degrees.

3) Leg Mechanism

It consists of a nut, bolt, cushions, and c-clip, it is joined to the lower end of the bell crank. Nut and bolt arrangement are provided for adjustable setting in leg mechanism. Cushions are used for comfortable adjustment with legs.

Fig. 3: Bolt and cushions of the leg mechanism

4) Sprayer nozzle

The nozzle is the last part of the assembly of pump, it is commonly used to increase the kinetic energy by decreasing the pressure energy. Two outputs of the pump (through two cylinders) are given to the nozzle for high-pressure energy.

5) C-clamp

C-clamp is attached to the waist and connected to the bearing of the bell crank through a solid shaft. It is used to hold bell crank and leg mechanism.

B. Working of Pump

When we start to walk at that time our leg moves up and down, so this motion is transfer to bell crank through the bolt. When bell crank rotates, it transfers force through some angle to the handle of pump. By this moment piston reciprocates in the cylinder and the pressure of fluid generated is given towards nozzle through hoses. Pressure energy of the fluid is converted into Kinetic energy when fluid reaches near nozzle and fluid is sprayed. It has two working cylinders when one pump sucks the fluid at that time another compresses the fluid. It has a working pressure of 0.2 to 0.3 Mega pascal. The overall weight of the pump is near 6 to 7 kilograms.

Fig. 4: Walker sprayer pump

Fig. 5: Tank Mechanism

C. Fabrication Process

The first step in manufacturing is designing. Design of pump, leg mechanism, C-clamp and bell crank is done at first. After that second step is purchasing material of pump like bolt and nut for leg mechanism, C-clips and cushions for cushioning, iron plate for bell crank and C-clamp, bearing and pump. The various operations are performed like

1) Lathe operation is performed for cutting the bolts and c-clamp.
2) Drilling operation is done at bell crank for installing ball bearing.
3) Welding operation is performed at bell crank bearing, bolt and bell crank, handle and bell crank and at c-clamp joined.

VI. Cost Estimation

Sr. No.	NAME OF ELEMENT	QUANTITY	COST (RS)
1	Spraying Pump	1	600
2	Bell Crank Lever	2	300
3	Big Bolt	2	250
4	Pump Fitting	1	350
5	Bearing	2	60
6	Cushions	1	150
7	C- Clamp	4	100
8	Clamping C-channel	2	200
9	Clamping Nut-Bolt	2	50
10	Wire Tie	50	100
11	Workshop Rent	NA	800
TOTAL		2960 /-	

Table 1: Bill of Material

VII. Advantages and Disadvantages

A. Advantages

1) No fuel is required for spraying in the walker sprayer pump.
2) Its cost is less than an electrically and solar operated pump.
3) It does not require any kind of non-renewable energy like fuel energy, electrical energy, and solar energy.
4) It does not cause air pollution problems.
5) It reduces the effort required for spraying compare to a conventional pump.

B. Disadvantages

1) It is not possible to spray fluid without walking.
2) In an irregular area of land, it can difficult to operate.
3) In a muddy environment, it is difficult to operate.

VIII. Result and Discussion

These walker sprayer pumps are commonly used on farms to spray pesticides, herbicides, fungicides, and defoliants as a means of crop quality control. This model reduces the problem of fuel and eliminates the pollution because of the absence of fuel and the cost is less about 2960 rupees compare to other pumps, this cost can also be reduced after mass production to near 1960 rupees.

The walking pesticide spraying machine is fitted on the leg activated by kinetic force being applied on it, when we stamp our foot on the ground, pushing the assembly to pump air into the tank, the force is less but sufficient enough to use the pressure for pesticide spraying. Since we are using two numbers of pumps that suck the fluid into the tank and have one jet sprayers, thereby cut down the operation cost and time by half. This machine helps the farmers to boost up the performance. Proper adjustment construction within the model regarding crop helps to avoid excessive use of pesticides, which result in less pollution. Hollow cone nozzles should be utilized in the sector for better performance. Muscular problems are removed as the lever assembly is eliminated and not need to operate the lever (handle). This alone pump can be used for multiple crops.

IX. CONCLUSION

The mechanically operated sprayer using leg mechanism and bell crank mechanism is much better as compared to the other types of pumps available. In the end, we have concluded that this pump is simple, cost-effective, and reduces the effort of farmers. Various raw materials that are selected for the manufacturing will be easily available at a considerably affordable price. In addition to that, no skilled operator is required to operate it. In this way, a sprayer is going to be a very convenient and feasible product for the farmers. The suggested model has a nozzle which is used for spraying crops, the sprayer will cover a maximum area of spraying in a minimum time & at a maximum rate. Proper adjustment facility in the model with respect to crop helps to avoid excessive use of pesticides which results in less pollution. Muscular pain is removed and there is no need to operate the lever.

X. FUTURE SCOPE

1) The belt position can be improved in such a way that it will be more comfortable for the user.
2) After spraying pesticide if we want to spray fertilizer again then there is a possibility that some contents of pesticide may remain in the tank so we can improve tank by providing a removable storage tank for fertilizer and pesticide to avoid harm to crops.
3) We design and fabricate this pump for small-scale farmers at an affordable price but in the future, we can produce equipment by taking other operations for large-scale farmers.
4) When storage is filled with fertilizer there are chances of blockage at the outlet so we can attach the component which in continuous rotation to avoid blockage.

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