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# Mechanical Agriculture Sprayer Vehicle (MASV)

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## ABSTRACT

***There is an increase in population every year. With this rise in population, the demand for food is rapidly increasing. But agriculture is still done by the traditional method. Spraying is done by labour carrying back type sprayer. These traditional spraying is not so profitable and is also time-consuming. To increase the productivity the agricultural advancement is inescapable. But using bulky and expensive electrical sprayers is expensive and inefficient. To overcome these problems a mechanism mounted on a vehicle for spraying is introduced which can increase productivity and also is inexpensive compared to the electrical sprayers.***

***Keywords***— *Mechanism mounted on vehicle, Backpack type sprayer, Traditional methods*

## 1. INTRODUCTION

Developing countries in the Asian continent have the problem of the increase in population and demand rise in agricultural products. But still, the advancement in agriculture is not present at the farmers' still use traditional methods for agriculture.

Largely seen in India the farmers still use the traditional technique for agriculture. By using such a method the production amount cannot keep up with demand. The earning from such method is not enough and using such method are expensive. These problems are seen in developing countries rather than in developed countries. The time required for cultivation and harvesting is also more when used traditional methods. The use of the modern machine in agriculture is important to increase the productivity of agriculture.

So modernization and mechanization in agricultural techniques are inescapable. There is a need for mechanical equipment to come in light for the use in production. Using such equipment will increase production and also will improve efficiency. But using bulky and high power consuming system has been seen as our first priority. But these machines are expensive and not very efficient to use in a point of view through agriculture.

So a system inexpensive enough and does not require any external source Rather than mechanical energy is to be introduced.

## 2. PROBLEM STATEMENT

An experimental investigation of setup is done to advance the spraying method and to increase the spraying efficiency with the help of a mechanism.

## 3. METHODOLOGY

- Analysis of problem statement.
- Study of the mechanism.
- Material selection.
- A prototype of the mechanism.
- Actual Experimental setup.
- Testing and Simulation of mechanism on the working parameter.

## 4. OBJECTIVES

- Decrease the operational cost by using a new mechanism.
- Work reliably under different working condition.
- Decrease labour cost by advancing the spraying method.
- The machine can be operated in small farming land (5 acres).
- A machine that can do two times the working of single labour operating a back type sprayer.
- Decrease the cost of the machine.
- To have low cost as compared to the electrical sprayer and tractor type sprayer.
- To be compact and not bulky.

## 5. EXPERIMENTAL LAYOUT

The experimental layout is shown in figure 1.

## 6. WORKING PRINCIPLE

- As shown in figure 1 the MASV system works on the principle of push force. The vehicle is pushed by the operator and the push force tends the vehicle to move on the trolley wheels.

 

- It is based on the principle of beam engine for the development of the pressure in the cylinder.
- The final outcome of the machine is that the push force of the operator is converted finally to the pressure energy and the fluid is sprayed.

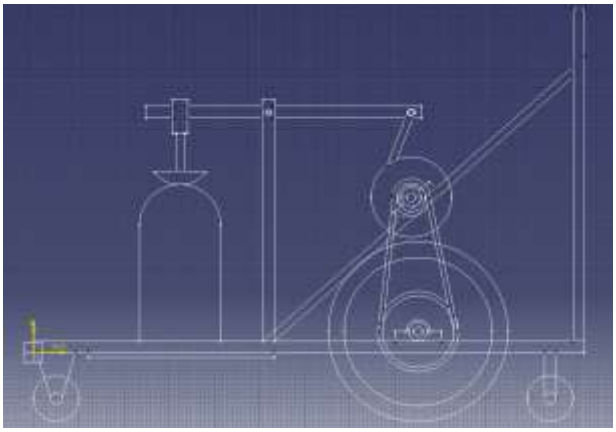

**Fig. 1: CAD Diagram of MASV**

## 7. COMPONENTS

### 7.1 Main chassis

**Fig. 2: Main chassis**

The main chassis is the frame of the vehicle. It is made up of 1 inch thick MS square pipe. It the base of the vehicle on which the mechanism is to be mounted. It has horizontal flat plywood block of 1.5 ft × 2.5 ft × 12mm, fixed on the chassis on which the sprayer is to be mounted. The trolley wheels are to be bolted on the iron plate of 6mm welded to the chassis. The dimension of chassis is 4 ft. length × 2.5 ft. width × 3 ft. height.

### 7.2 Main plastic wheel

**Fig. 3: Main plastic wheel**

Main plastic wheel is the first link in the mechanism. The power is transmitted through the wheel to the shaft. It is made of plastic and has a foam tire. Its dimensions are about 16-inch diameter 1.5-inch width.

### 7.3 20mm MS shaft

**Fig. 4: 20mm MS shaft**

The shaft is the power transmitting component in the mechanism. It gets the rotary moment from the tire and transfers to the big sprocket. It's made of mild steel. Diameter is of about 20mm. Two shafts are used, one is the driver and another is driven. The driven shaft has a small sprocket. The shaft has the maximum yield stress of about 247 Mpa (247 $N/mm^2$) and can bear the maximum load of 77 KN. The crank is fitted on both the end of the driven shaft. And with help of connecting rod, the arm oscillates.

### 7.4 Chain drive mechanism

**Fig. 5: Chain drive**

Chain drive is the power transmitting element of the system. It consists of a big sprocket, small sprocket and roller chain. The big sprocket is mounted on the driver shaft and small is mounted on the drive shaft. The distance between the two sprockets is 12 to 12.5 inch approx. The diameter of the big sprocket is 7 inch and small sprocket is 3.25 inch.

### 7.5 Block bearing

**Fig. 6: Block Bearing**

Block bearing is used to ensure the smooth rotation of the shaft. Four block bearings are used with 20mm ID and 42 mm OD. The casing is made of cast iron and bearing material is chrome steel. The bearing is bolted with chassis.

 

### 7.6 Sprayer

**Fig. 7: Sprayer**

The sprayer is the component which converts the mechanical movement into hydraulic energy. The piston is moved into the cylinder and with the help of diaphragm, the pressure in the tank is increased. It has a nozzle and hose and also a pressure relief valve to relief the exceeded pressure. The maximum pressure that can be built in the sprayer is 2 bar. It has 5-litre storage for agricultural fluid which can be water or pesticide solution and also fertilizers solution. It is fixed with the chassis and can be removed easily for refilling. Two sprayers are used for high efficiency.

### 7.7 Trolley wheels

**Fig. 8: Trolley wheels**

The trolley wheels are used to propel the vehicle with balance. Four wheels are used in which two are fixed direction and two are 360º rotational. The rotational set is bolted at the front with an iron plate and fixed are bolted at the rear. The wheels are made of stainless steel and have a rubber tire.

## 8. DETAILED EXPLANATION

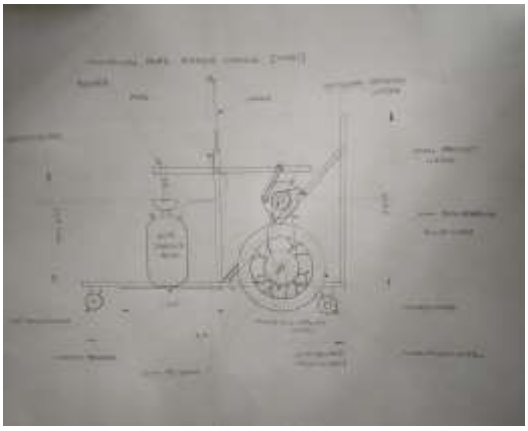

**Fig. 9: Actual sketch of MASV**

### 8.1 Construction

- As shown in figure 9 Main chassis is made of 1-inch box pipe. The driver shaft is mounted on the chassis and the main plastic moulded wheel is mounted on the shaft.
- The shaft is free to rotate on the bearing which is bolted on the chassis. The set of two bearing is used for the complete support of the driver shaft.
- The chain drive mechanism is provided in the system to transfer the rotation of the driver shaft to the driven shaft. The chain drive mechanism consists of a big sprocket and a small sprocket and a roller chain. The big sprocket is mounted on the driver shaft and small sprocket is mounted on the drive shaft.
- The driven shaft is also free to rotate on bearing, bolted on the chassis. The bearings are in a set of two to support the driven shaft.
- The driven shaft is provided with two cranks at each end. The cranks are used to transmit the rotating motion to the arms of sprayer through the connecting rod.
- It work's on the principle of beam engine to transmit power. The arms are a pivot at the centre with the chassis. The arms are further connected to the sprayer piston or plunger.
- The sprayer is a device which converts mechanical energy into pressure energy and the liquid in the sprayer container is sprayed with the help of nozzle. 2 sprayers are used to increase the efficiency of the machine.
- The whole assembly is supported by the trolley wheels. The trolley wheel is classified as the fixed and 360º wheels and 2 fixed wheels are used at the back of chassis for straight ahead movement and 360º wheels for steering the vehicle.

### 8.2 Working

- As shown in figure 9 the MASV system works on the principle of push force. The vehicle is pushed by the operator and the push force tends the vehicle to move on the trolley wheels.
- As the vehicle moves the main moulded plastic wheel also rotates with respect to the ground which further rotates the driver shaft. The shaft rotates in the bearings.
- The driver shaft gives its motion to the driven shaft with the help of a chain drive mechanism.
- The driven shaft rotates the crank and crank gives the motion to the connecting rod. The crank converts the rotary motion of the shaft to oscillating motion of the arm.
- The arm is pivoted at the middle with chassis to provide oscillating motion of the arm. The arm further transmits its motion to the piston or plunger of the sprayer.
- The oscillating motion of the arm is converted to reciprocating motion of the piston. As the piston moves, the pressure in the container increases and the fluid in the sprayer container is sprayed with the help of a nozzle as the pressure is released.
- The fixed trolley wheels support the chassis and the front 360 wheels are used to steer the vehicle.
- The final outcome of the machine is that the push force of the operator is converted finally to pressure energy and the fluid is sprayed.

## 9. OPERATIONS

**Table 1: Operations done**

| S. no | Operations required | Operator required |
|---|---|---|
| 1. | Cutting | Cutter |
| 2. | Drilling | Driller |
| 3. | Spot welding and arc welding | Welder |
| 4. | Turning | Turner |

| | | |
|---|---|---|
| 5. | Fitting | Fitter |
| 6. | Paint job | Painted |
| 7. | Assembly | Assembler |

## 10. APPLICATION

- The machine or mechanism can be used successfully in farms of fruits such as Orange, pomegranate, mangoes, grapes, cheery, peers, watermelon, etc.
- It can be used in farms of dry fruits as cocoa, walnut, olives, etc.
- It is used in vegetable farms also such as pumpkin, tomatoes, etc.
- Floriculture.
- Horticulture.
- The mechanism can be used in underdeveloped countries for the advancement of agricultural techniques.

## 11. SPECIFICATIONS

**Table 2: Specifications of MASV**

| S no. | Component | Material | Value (MM/Inch) |
|---|---|---|---|
| 1. | Frame or chassis | Ms | 4ft × 2.5ft ×2.5ft |
| 2. | Shaft | Ms | 20mm × 38 inch |
| 3. | Plastic moulded wheel | Rubber and plastic body | 16 inch |
| 4. | Block Bearing | Chrome steel | 20 mm inner diameter 42 mm outer diameter |
| 5. | Main driver sprocket | CI | 7 Inch |
| 6. | Driven sprocket | CI | 3.25 Inch |
| 7. | Connecting rod | CI | 8.25 inch |
| 8. | Back type sprayer | Plastic | 5 litre |
| 9. | Trolley wheels | Rubber and SS | 6 Inch tall, 4 Inch wheel diameter |

The Specification of the machine is not accurate but is approximate to the given value.

## 12. RESULTS

**Fig. 10: Actual Experimental Layout**

The working of the machine has been tested on many surfaces such as:

**Table 3: Surface results**

| Surfaces | Results |
|---|---|
| Concrete | Excellent working |
| Fruit farms | Good working |
| Land with big stones | Satisfactory working |
| Wetland | Poor working |
| Tar road | Excellent working |

The machine is tested on the farming land and got satisfactory results and then it is compared with the traditional method.

## 13. FUTURE SCOPE

- The mechanical Agriclutre Sprayer vehicle [MASV] has a future scope in agricultural technology.
- The vehicle can be operated by an electrical system for avoiding mechanical power loss.
- The system has the potential of being upgraded in a multipurpose machine which can do more than two work at a time.
- For use of MASV on harsh terrain its trolley wheels can be further upgraded.
- A weeder and cutter mechanism can be used as it has the capacity to hold it.
- It can be equipped with a space to carry agricultural tools and equipment.

## 14. CONCLUSION

- The mechanism or vehicle is designed and made to increase the advancement in agriculture.
- It is designed to overtake the traditional spraying methods by introducing advanced methods for spraying.
- Its working is smooth on even land and moderate movement is achieved on the harsh land.
- It can help farmers to increase agricultural productivity by increasing the output and decreasing the labour cost and also spraying time can be decreased.
- It is made to be used for the purpose of gardening and floriculture.
- Vertical gardening is possible.

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