Scientific Journal of Impact Factor (SJIF): 3.134

ISSN (Online): 2348-4470
ISSN (Print) : 2348-6406

International Journal of Advance Engineering and Research Development

Volume 2, Issue 4, April -2015

AGRICULTURAL SPRAYER VEHICLE WITH ROUTER WEEDER AND SEED SOWER

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Abstract —*The spraying is traditionally done by labour carrying backpack type sprayer which requires more human effort. The weeding is the generally done with the help of Bulls becomes for small land farmers. Similarly the seed sowing application is also done with the help of bulls, which in the present age is time consuming and laborious. So to overcome these above problems a machine is developed which will be beneficial to the farmer for the spraying and weeding operation along with the seed sowing application. A multifunction device will come in handy that can be put to use in different stages of farmig as per requirement.*

Keywords- *Sprayer, Router Weeder, Seed Sower*

I. INTRODUCTION

A **sprayer** is a device used to spray a liquid. In agriculture, a sprayer is a piece of equipment that spray nozzles to apply herbicides, pesticides, and fertilizers to agricultural crops. Sprayers range in size from man-portable units (typically backpacks with spray guns) to self-propelled units similar to tractors, with boom mounts of 60–151 feet in length.

Types

- Backpack/knapsack
- Foot
- Garden
- Hand compression
- Power
- Stirrup

Need for Project : The figure below shows the conventional hand sprayer

Figure 1.Backpack Sprayer

This type of sprayers has the following features:

a)Very popular amongst the pest control operators.

b)Tanks fabricated from cold rolled brass alloy steels, welded joints tested for 150 pounds pressure.

c)Brass forged fittings , built in air pump

d)Adjustable shoulder straps.

The disadvantages of this system is that it is very heavy , has to be operated by hand and moreover carrying it on the shoulder is very tire some ..hence need of an innovative type of sprayer.

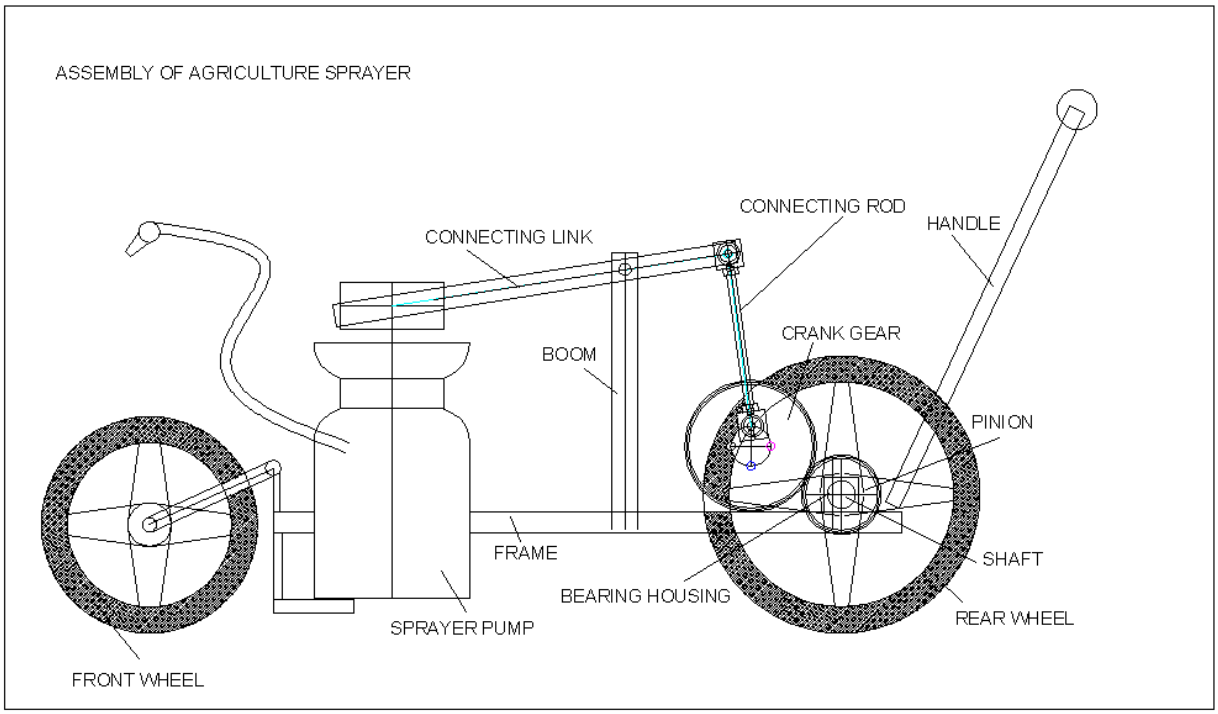

Figure 2. Assembly of Agricultural Sprayer Vehicle

The construction and working of the innovative agricultural sprayers is as follows:

a) Base frame or chasis: The base frame of chasis is an mild steel fabricated structure that holds the entire assembly of the sprayer. The rear side carries the rear wheel shaft that carries the rear wheels., the front wheel steering carries the front wheel bracket which provides the necessary turning effect.

b) Drive Assembly:The drive assembly comprises of the driver pinion on rear shaft, and the spur gear on crank. Thus when the vehicle moves in forward direction the wheels will rotate the rear wheel shaft and thus the driver gear drives the driven gear and there by the intermediate shaft.and the pitman arm which reciprocate the piston of sprayer

c)Pump System: The pump system comprises of sprayer mechansism of 5 litre capacity integrated with inbuilt pump and sprayer,..

d) Air storage and pesticide storage :The compressed air is stored in the air chamber of storage tank and the pesticide is stored in the liquid chamber, the sprayer connected to the tank sprays this liquid pesticide using the compressed air**.**

II. Working

When the handle is pushed the sprayers vehicle moves forward rotating the wheels , hence the spur pinion makes the crank gear to rotate. The Crank gear acts like the crank which in turn drives the connecting rod and makes the connecting link to oscillate about the boom hinge. The connecting link is engaged to the piston of the sprayer pump which moves

forward and backward to give pump action and increase pressure inside the pump which is further used to spray the pesticide when the valve is opened on the sprayer pipe.

III. ADDITIONAL FEATURES

- **Routing arrangement**
- **Weeder arrangement**
- **Seed sowing arrangement**

3.1 Advantages of Agricultural sprayer :

1. Human effort in pumping is saved.
2. Less tiresome as compared to the conventional sprayer as the tank is carried on vehicle.
3. Increases the capacity of spraying.
4. Two pumping outputs per rotation of crank, so tank charging is faster.
5. Cost effective as compared to automatic sprayers.

3.2 Application :

1. Agriculture
2. Florticulture
3. Horticulture
4. Spraying of germicide

3.3MATERIAL USED

MS-MILD STEEL
STD- STANDARD PARTS SELECTED FROM PSG DESIGN DATA/MANUFACTURER CATALOG

INFRASTRUCTURE AND MACHINERY REQUIRED

1.Lathe
2.Milling
3.Drilling
4.Electrical arc welding
5.DRO milling machine

3.4 MAN POWER REQUIRED

1.Turner
2.Miller
3.Machinist
4. Welder.

IV. SELECTION OF INPUT SHAFT MATERIAL

From[1]

Table 1. Allowable S_{ut} & S_{yt}

Designation	Ultimate Tensile Strength N/mm^2	Yield strength N/mm^2
EN 24 (40 N; 2 cr 1 Mo 28)	720	600

Using ASME code of design ;
Allowable shear stress;
Fs_{all} is given stress ;
Fs_{all} = 0.30 syt = 0.30 x 600
=180 N/mm^2
Fs_{all} = 0.18 x Sult = 0.18 x 720
= 130 N/mm^2
Considering minimum of the above values ;

fs_{all} = 130 N/mm^2

As we are providing dimples for locking on shaft ;
Reducing above value by 25%.

$\Rightarrow fs_{all}$ = 0.75 x 130
= 97.5 N/mm^2

a) Considering pure torsional load;
Torque = 200 x 180 x 0.3
Where
Load applied manually for traction of vehicle = 200 N
Radius 0f wheel = 180 mm
Coefficient of friction between road and wheel = 0.3
T = 200 x 180 x 0.3 =10800 = 10.8 M-m

Considering pure torsional load;

$$T_{design} = \frac{\Pi}{16} fs_{all}\ d^3$$

$$\Rightarrow d^3 = \frac{16 \times 10.8 \times 10^3}{\Pi \times 97.5}$$

d = 8.2 mm
Minimum diameter of shaft is taken to be 12 mm for wheel mounting

4.1 Design (selection of shaft bearing)

In selection of ball bearing the main governing factor is the system design of the drive ie; the size of the ball bearing is of major importance ; hence we shall first select an appropriate ball bearing first select an appropriate ball bearing first taking into consideration convinience of mounting the planetary pins and then we shall check for the actual life of ball bearing .

4.1.1BALL BEARING SELECTION.

Series 60

Table 2.Basic & Dynamic Load Capacities

ISI NO	Brg Basic Design No (SKF)	d	D1	D	D2	B	Basic capacity	
							C kgf	Co Kgf
15A C02	6002	15	17	32	30	9	2550	4400

P = X Fr + Yfa.
Where ;
P=Equivalent dynamic load ,(N)
X=Radial load constant
Fr= Radial load(H)
Y = Axial load contact
Fa = Axial load (N)
In our case;

Radial load F_R= 200

P= 200 N
$\Rightarrow L = (C/p)^p$
Considering 4000 working hours

$$L = \frac{60\ n\ L\ h}{10^6} = 336 \text{ mrev}$$

$$\Rightarrow 336 = \left(\frac{C}{140.4}\right)^3$$

$\Rightarrow$ C = 976 N
AS; required dynamic of bearing is less than the rated dynamic capacity of bearing ;

⇒ Bearing is safe.

V. Design Of Wheel Shaft

Power is transmitted to wheel shaft by the wheels 8 " (200 mm) in diameter , assuming that force applied during pushing the vehicle is 200 N
Assuming coefficient of friction between tyres and road to be 0.3
Torque at wheel shaft = 100 x 200 x 0.3 = 6000-Nmm

5.1SELECTION OF WHEEL SHAFT MATERIAL

From[1]

Table 3. Allowable S_{ut} & S_{yt}

Designation	Ultimate Tensile Strength N/mm^2	Yield strength N/mm^2
EN 24 (40 N; 2 cr 1 Mo 28)	720	600

Using ASME code of design ;
Allowable shear stress;
Fs_{all} is given stress ;
Fs_{all} = 0.30 syt = 0.30 x 600
=180 N/mm^2
Fs_{all} = 0.18 x Sult = 0.18 x 720
= 130 N/mm^2
Considering minimum of the above values ;
fs_{all} = 130 N/mm^2
As we are providing dimples for locking on shaft ;
Reducing above value by 25%.
⇒ fs_{all} = 0.75 x 130
= 97.5 N/mm^2

a) Considering pure torsional load;

$$T_{design} = \frac{\Pi}{16} fs_{all}\, d^3$$

$$\Rightarrow d^3 = \frac{16 \times 6 \times 10^3}{\Pi \times 97.5}$$

d = 6.79 mm
Wheel shaft is provided with 12mm shaft end for mounting wheel

5.2Design (selection of RH_wheel shaft bearing)

In selection of ball bearing the main governing factor is the system design of the drive ie; the size of the ball bearing is of major importance ; hence we shall first select an appropriate ball bearing first select an appropriate ball bearing first taking into consideration convinience of mounting the planetary pins and then we shall check for the actual life of ball bearing .

BALL BEARING SELECTION.

Series 60

Table 4. Basic & Dynamic Load Capacities

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							C kgf	Co Kgf
15A C02	6002	15	17	32	30	9	2550	4400

P = X Fr + Yfa.

Where ;
P=Equivalent dynamic load ,(N)
X=Radial load constant
Fr= Radial load(H)
Y = Axial load contact
Fa = Axial load (N)
In our case;
Radial load F_R= weight of system = 20 kg maximum
$F_a = 0$
P= 200 N
$\Rightarrow L= (C/p)^p$
Considering 4000 working hours

$$L = \frac{60\ n\ L\ h}{10^6} = 21.6 \text{mrev}\ldots\text{.assuming 90 rpm wheel speed}$$

$$\Rightarrow 21.6 = \left(\frac{C}{200} \right)^3$$

$\Rightarrow C = 557$ N
AS; required dynamic of bearing is less than the rated dynamic capacity of bearing ;$\Rightarrow$ Bearing is safe.

VI. Design Of Gear Disk Hub:-

Brake disk hub can be considered to be a hollow shaft subjected to torsional load.

Material selection.

Designation	Ultimate Tensile strength N/mm^2	Yield strength N/mm^2
EN 24	800	680

As Per ASME Code;
$\Rightarrow fs_{max} = 108$ N/mm^2
Check for torsional shear failure:-

$$T= \frac{\Pi \times fs_{act} \times}{16} \frac{Do^4 - Di^4}{D}$$

$$6 \times 10^3 = \frac{\Pi \times fs_{act} \times}{16} \left(\frac{26^4 - 17^4}{26} \right)$$

$\Rightarrow fs_{act} = 2.12$ N/mm^2
As; $fs_{act} < fs_{all}$
$\Rightarrow$ Hub is safe under torsional load

VII. Design Of Follower Arm: -

Follower arm is subjected to direct shear failure owing to the load of the cam action,
Follower arm is M10 Stud ….160 mm long
Cam force is give by relation (Cf) = T / r = 6 x 1000 / 60
As the follower touches the cam at maximum radius of 60 mm
(Cf) = 100 N

Material selection.

Table 5. Allowable S_{ut} & S_{yt}

Designation	Ultimate Tensile strength N/mm^2	Yield strength N/mm^2
EN 9	600	480

Shear stress = shear force / area

$$\Rightarrow fs_{act} = (100 / \pi \times 8.5^2 /4) \text{ N/mm}^2$$

fs_{act} =1.76 N/mm^2
As; $fs_{act} < fs_{all}$
$\Rightarrow$ Follower arm is safe

VIII. Design Of Cam Disk Hinge:-

Cam disk hinge is subjected to shear force under the action of cam hence,

Material selection.

Table 6. Table 5. Allowable S_{ut} & S_{yt}

Designation	Ultimate Tensile strength N/mm^2	Yield strength N/mm^2
EN 9	600	480

Shear stress = shear force / area
$\Rightarrow fs_{act} = (100 / \pi \times 6^2 / 4)$ N/mm^2
$fs_{act} = 3.53$ N/mm^2
As; $fs_{act} < fs_{all}$
$\Rightarrow$ Follower arm is safe

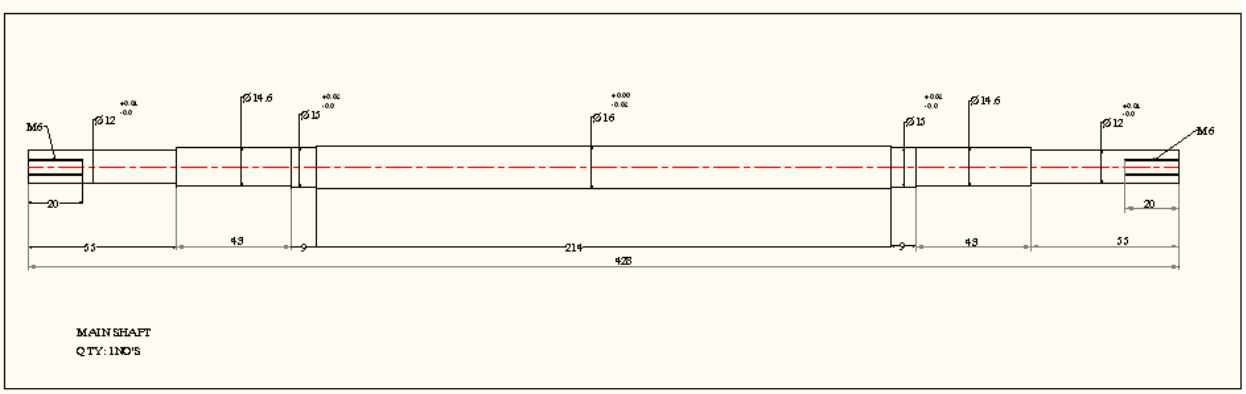

Table 7. Tools Required for Various Operations & Time Required For Each Operation

PART
PART NAME : \

MATERIAL SPECIFICATION : EN24
RAW MATERIAL SIZE: ∅ 25X 435
QUANTITY :- 01 NO'S.

Sr. No	Description of Operation		Tools			Time in minutes		
		Jigs & Fixture	M/c Tools	Cutting Tools	Measuring Instrument	Setting Time	M/c Time	Total Time
1	Clamp stock	Three jaw chuck	Lathe	-	-	20	-	20
2	Facing Both side to total length 428mm	Three jaw chuck	Lathe	Facing tool	Vernier	-	25	25
3	Turning OD Ø 16 mm through length			Turning tool		5	30	35
4.	StepTurning OD to Ø 15mm through length 107	Centers supports & carrier	Lathe	Turning tool	Vernier	-	20	20
5.	StepTurning OD to Ø 14.6mm through length98	Centers supports & carrier	Lathe	Turning tool	Vernier	-	20	20
6.	StepTurning OD to Ø 12mm through length55	Centers supports & carrier	Lathe	Turning tool	Vernier	-	20	20

8.	StepTurning OD to Ø 15mm through length 107	Centers supports & carrier	Lathe	Turning tool	Vernier	-	20	20
9.	StepTurning OD to Ø 17mm through length82	Centers supports & carrier	Lathe	Turning tool	Vernier	-	20	20
10.	StepTurning OD to Ø 16mm through length70	Centers supports & carrier	Lathe	Turning tool	Vernier	-	20	20

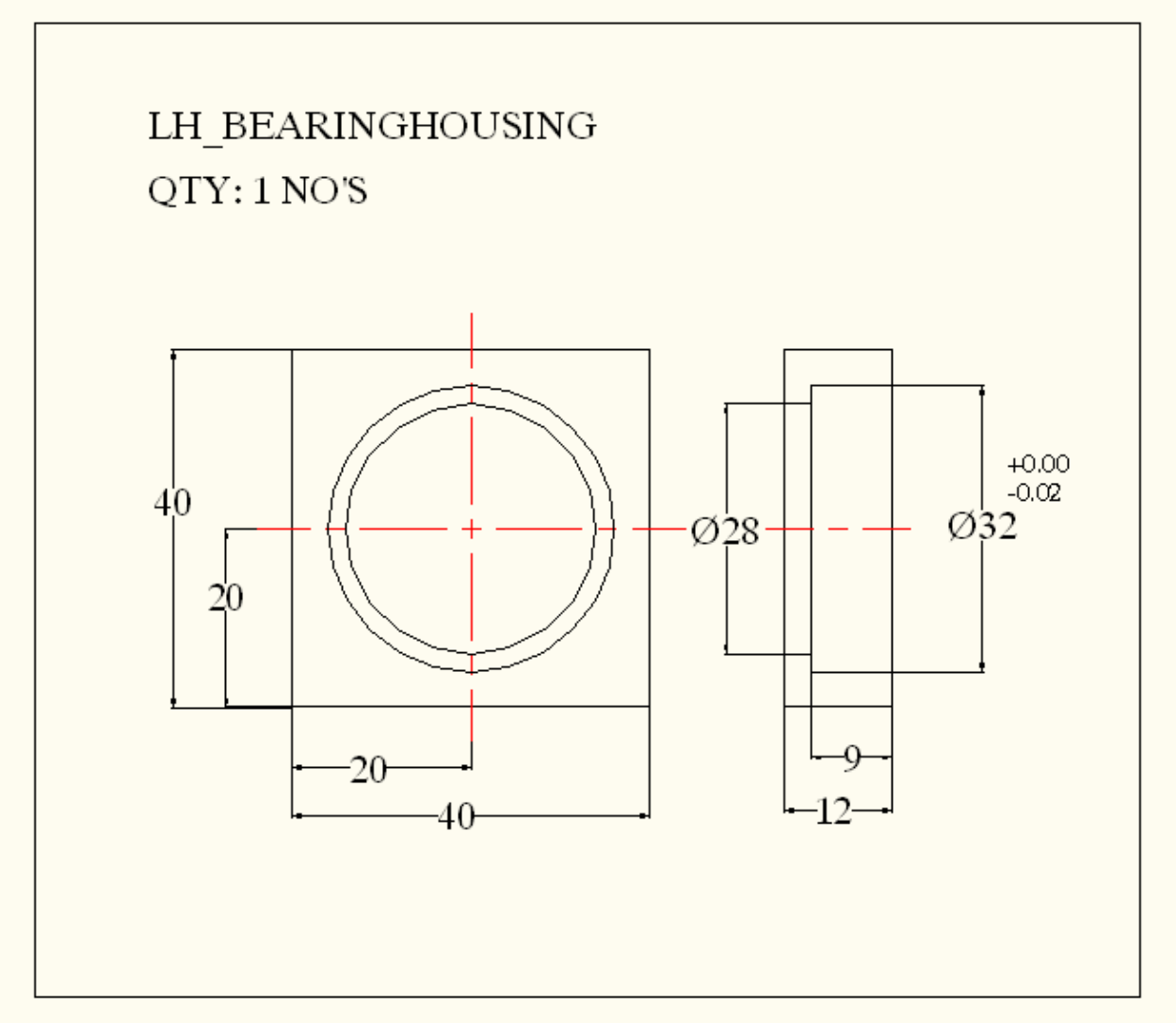

Figure 3. 2-D Fig. of Bearing Housing

Table 8. Tools Required for Various Operations & Time Required For Each Operation

PAR
PART NAME MATERIAL SPECIFICATION : EN 9
RAWMATERIAL SIZE: 50X20X50
QUANTITY :- 01 NO'S.

Sr. No	Description of Operation		Tools			Time in minutes		
		Jigs & Fixture	M/c Tools	Cutting Tools	Measuring Instrument	Setting Time	M/c Time	Total Time
1.	Clamp stock	M/C Vice	Milling	-	-	15	-	15
2.	Facing All Sides Sq. to total length 40x12x40mm	--"--	--"--	Facing cutter	Vernier	5	14	19
3.	Clamp stock on lathe	4 jaw chuck	Lathe	-	-	25		25
4.	Drilling Ø 18.5 through thickness	--"--	--"--	Twist drill	Vernier	15	10	25
5.	Boring Ø 28through thickness	--"--	--"--	Boring tool	Vernier	15	10	25
6.	Counter Boring Ø 32 through 9 thickness	--"--	--"--	Boring tool	Vernier	15	10	25

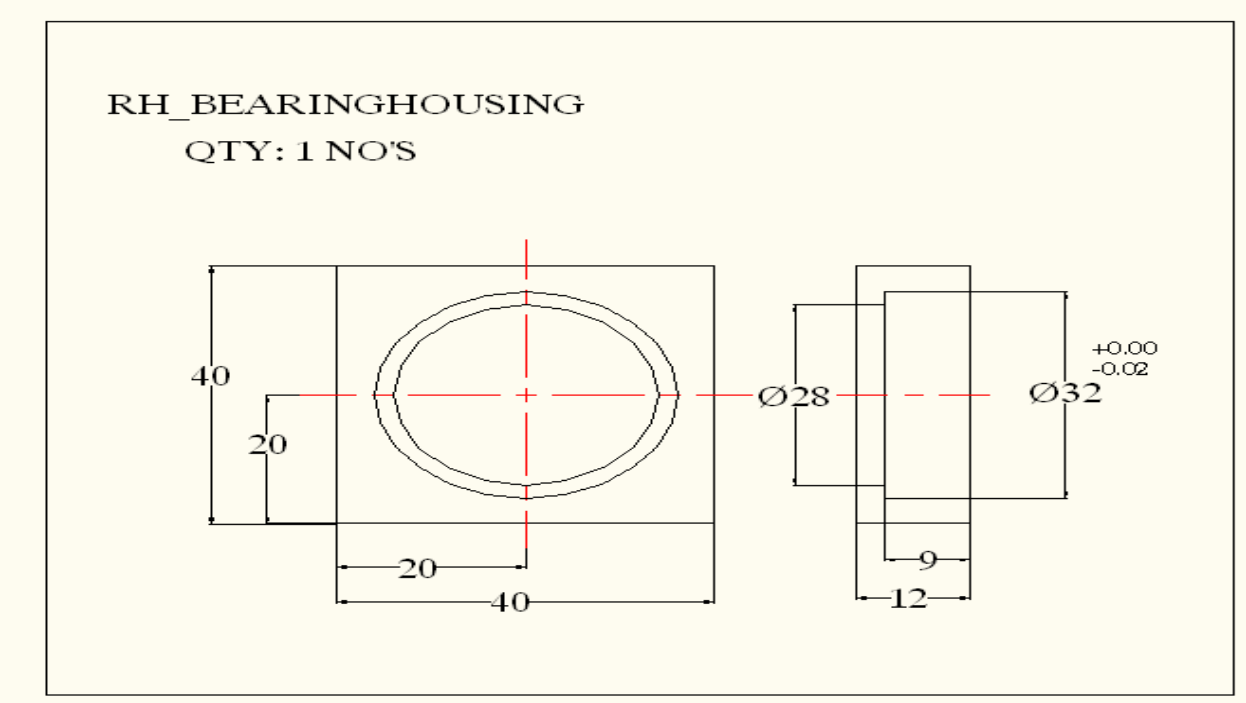

Figure 4. 2-D fig. Of Bearing Housing

Table 9. Tools Required for Various Operations & Time Required For Each Operation

PAR
PART NAME **MATERIAL SPECIFICATION : EN 9**
RAWMATERIAL SIZE: 50X20X50
QUANTITY :- 01 NO'S.

Sr. No	Description of Operation		Tools			Time in minutes		
		Jigs & Fixture	M/c Tools	Cutting Tools	Measuring Instrument	Setting Time	M/c Time	Total Time
1.	Clamp stock	M/C Vice	Milling	-	-	15	-	15
2.	Facing All Sides Sq. to total length 40x12x40mm	--"--	--"--	Facing cutter	Vernier	5	14	19
3.	Clamp stock on lathe	4 jaw chuck	Lathe	-	-	25		25
4.	Drilling Ø 18.5 through thickness	--"--	--"--	Twist drill	Vernier	15	10	25
5.	Boring Ø 28through thickness	--"--	--"--	Boring tool	Vernier	15	10	25
6.	Counter Boring Ø 32 through 9 thickness	--"--	--"--	Boring tool	Vernier	15	10	25

Figure 5. Actual Vehicle

IX. MATERIAL PROCUREMENT

Material is procured as per raw material specification and part quantity. Part process planning is done to decide the process of manufacture and appropriate machine for the same.

9.1GENERAL MATERIAL USED

EN24- ALLOY STEEL
EN9- PLAIN CARBON STEEL
MS-MILD STEEL
STD- STANDARD PARTS SELECTED FROM PSG DESIGN DATA/MANUFACTURER CATALOGUE
Material is procured as per raw material specification and part quantity. Part process planning is done to decide the process of manufacture and appropriate machine for the same.

9.2RAW MATERIAL COST

The total raw material cost as per the individual materials and their corresponding rates per kg is as follows.Total raw material cost = Rs 2600/-

Table 10. Machining Cost

OPERATION	RATE Rs /HR	TOTAL TIME HRS	TOTAL COST Rs/-
LATHE	80	20	1600
MILLING	90	10	900
DRILLING	60	4	240
HOBBING	-	-	1200
TOTAL			3940

Table 11. Miscellaneous Cost

OPERATION	**COST(Rs)**
GAS CUTTER	300
SAWING	120
TOTAL	420

Table 12. COST OF PURCHASED PARTS

SR NO.	DESCRIPTION	QTY	COST
1.	PUMP	01	2150
2.	GEAR PAIR	01	1100
3.	GRUB SCREW	09	70
4.	BEARINGS	04	680
5.			

The cost of purchase parts = Rs 4000-

Cost of Seed sower : 2000/-
Cost of Router: 1200/-

9.3TOTAL COST

TOTAL COST = Raw Material Cost +Machine Cost + Miscellaneous Cost + cost of Purchased Parts +Overheads

Hence the total cost of machine = Rs 15300/-

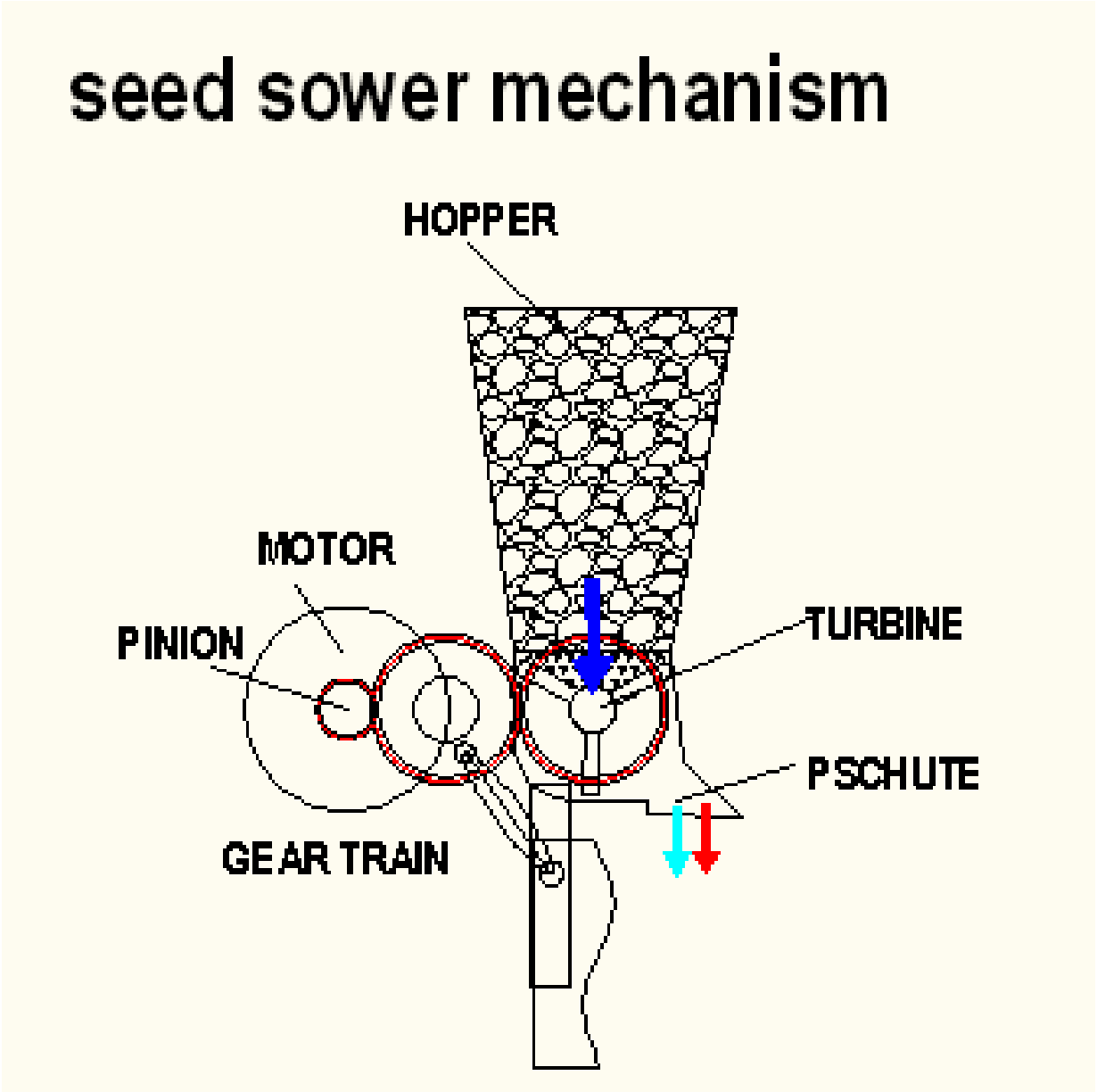

Figure 6. Seed Sower Mechanism

X. Seed sower mechanism comprises of the following parts :

1. Hopper : Hopper holds the seeds to be sown The hopper is sheet metal component made in trapezoidal shape., it drops the seeds into the distributor mechanism, ie in between two blades of the turbine.
2. Turbine or distributor : This mechanism decides the number of seeds to be dropped per turn such that the gap between toe blades is to accommodate only given quantity of seeds. The turbine is rotated with such speed that the gear train will adjust the distance between to droppings. No of blades of turbine will decide the quantity of seeds dropped per turn.
3. Seed sower drive mechanism :
The seed sower drive mechanism comprises of a DC motor 30 rpm, with a gear train in between the motor pinion and the turbine. So also hw gear train drives the earth covering mechanism.

4. Earth covering mechanism:
This comprise of the slider crank mechanism with the gear train gear acting as a crank, the earth covering plank as an piston. Thus the mechanism moves to an fro to cover the seeds after each dropping.

Table 13. Bill Of Materials

SR NO.	PART CODE	DESCRIPTION	QTY	MATERIAL
1.	MLV -1	MACHINE FRAME	01	AL
2.	MLV -2	X- FRAME REAR ARM	01	AL
3.	MLV -3	DRIVE MOTOR	04	STD
4.	MLV -4	STEERING MOTOR	02	STD
5.	MLV -5	PINION	02	EN24
6.	MLV -6	RACK	04	EN9
7.	MLV -7	WHEELS	04	STD
8.	MLV –8	WHEEL SHAFTS	04	MS
9.	MLV –9	WHEEL BEARING	04	STD
10.	MLV –10	TILTABLE COCK PIT	01	AL
11.	MLV –11	TILT GEAR	01	EN24
12.	MLV –12	TILT MOTOR	01	STD
13.	MLV –13	TILT PINON	01	EN9
14.	MLV –14	GEAR SECTOR	01	EN24
15.	MLV –15	HOPPER	-	MS
16.	MLV –16	GEAR TRAIN	03	EN9
17.	MLV –17	SLIDE	02	STD
18.	MLV –16	DP/DT SWITCH	02	STD
19.	MLV-17	PUSH BUTTONS	02	STD

XI. ESTIMATE OF PROJECT (APPROXIMATE)

1. Raw material cost = 5300/-
2. Machining cost = 1400/-
3. Fabrication cost = 1800/-
4. Cost of std. parts : 6000/-
5. Miscellaneous cost = 400/-

Total estimate of project =15900/-

XII. CONCLUSION:

The concept of group project was included in our engineering syllabus with the view to inculcate within us the application ability of the theoretical concept of design and production engineering to practical problems . So also to help us to learn to work more as a team rather than an individual .

In completing our project titled 'AGRICULTURE SPRAYER' as per our time estimate gives us immense pleasure and a feeling of achievement . During the course of project we encountered numerous problems which we overcame with the able guidance of our project guide.

This project report presents a brief mention of our efforts . Project work has given us good exposure to the practical field which in the future is definitely going to help us.

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