

Lever Operated Sprayer using Rotary Pump

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ABSTRACT

The Mechanism comprises lever operated knapsack sprayer provided with rotary pump, which is placed outside the tank and have separate pressure chamber. Rotary pump is operated by lever through gear arrangement. When the lever moves downward, the rotary pump completes its one rotation and by means of this complete one rotation the suction and compression occurs in rotary pump. When the lever is operated in upward direction, there is no operation in rotary pump because the lever is attached to the vane pump by means of a freewheel (lock and up bearing).

Keywords: Agricultural, Ergonomics, Farming Sprayers, Knapsack and Lever Operated etc.

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I. INTRODUCTION

The lever-operated knapsack sprayer is a portable unit which is extensively used for farm spraying work. With the appropriate arrangement and assembly of the fittings, it can apply herbicides, insecticides, fungicides and other compounds to the plants. It absolutely permits its application anywhere in the farm where a person can walk, or in the areas inaccessible to vehicle mounted motorized sprayers. Though there are several fuel operated sprayers commercially available in the market, those are less efficient and uneconomical. On the contrary, the rotary type LOK sprayers are portable, light in weight, easy to handle and proves to be economical for wide area spraying as well as for spot spraying. The invented rotary type of LOK sprayer shows better result in terms of increasing optimal output, reducing efforts and leads to the increase in efficiency and performance. These facts highlight the importance of developing an efficient and friendly product for the agriculture growers. The present invention intends to substantially enhance the performance and reduce the cost in manufacturing of knapsack sprayers.

II. OBJECTIVES OF ROTARY TYPE

- Mechanism of more efficient lever operated knapsack sprayer.
- To reduce human efforts during spraying operation.
- To reduce the cost of lever operated sprayer.

III. ROTARY TYPE LOK SPRAYER

The rotary type of LOK sprayer consists of a tank and a rotary pump. It also consists of a lever, a pressure chamber, lance with an on-off trigger valve and the nozzle. Rotary pump is operated by lever through the gear arrangement. The gear assembly connects a shaft of rotary pump to the lever. This gear arrangement has several advantages, like it can be easily replaced and speed of pump can be varied by changing the gears. After the spray, liquid is filled in the tank; initially the pressure chamber is occupied by air at atmospheric pressure.

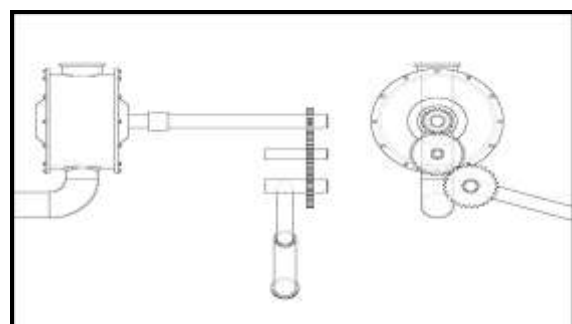


Fig. 1: Lever-gear mechanism for LOK sprayer with rotary pump

When the lever moves downward, the rotary pump completes its rotation and by means of this complete rotation the suction and compression occurs in rotary pump. When the lever is operated in upward direction, there is no operation in rotary pump because the lever is attached to the vane pump by means of a free wheel (lock and up bearing) and this stroke acts as the idle stroke causing a suction.

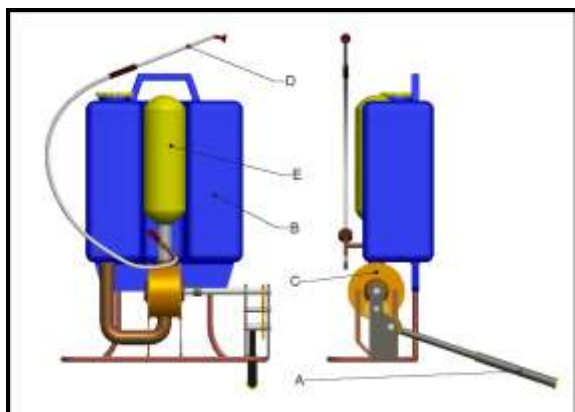


Fig. 2: Side & front views of LOK sprayer with rotary pump

Where,

- A- Lever
- B- Fluid tank
- C- Rotary pump with gear mechanism.
- D- Spray lance
- E- Pressure chamber.

During this compression stroke at rotary pump, liquid in the pump is forced past through valve into the pressure chamber. Air is trapped in upper portion of the pressure chamber and compressed as liquid forced into the pressure chamber. The outlet of pressure chamber is connected to T-pipe and this T-pipe is connected at one end of the spray lance. When the operator opens trigger in the lance, the compressed air forces liquid from the pressure chamber to flow past the valve, through the lance and exit through the nozzle (into atmosphere) as a spray.

IV. ADVANTAGES OF ROTARY TYPE

1. The Rotary type LOK sprayer considers ergonomic aspects in sprayer mechanism and operation. It ensures the comfort in spraying, decreases postural discomfort and safeguard operator's health.
2. The several ergonomic principals are applied for optimal mechanism of invented sprayer, which gives better interaction between human and product.
3. Rotary type LOK sprayer produces a steady stream of spray materials in the desired fineness of the particles so that the plants to be treated covers uniformly.
4. Rotary type LOK sprayer delivers liquid with sufficient pressure. This causes liquid to reach to all the foliage and spreads entirely over the sprayed surface.
5. A rotary mechanism for its basic function, called as the rotary pump. Because of using a rotary pump, the increase in pressure built-up inside the pressure chamber is ensured and the lever strokes required to create a requisite

pressure has been reduced. The operator requires comparatively less effort and he can spray comparatively larger area with minimum effort.

6. Higher pressure is built up inside the pressure tank than the conventional piston –cylinder types of sprayers.
7. The sprayer model is suitable for treating large areas as well as the small areas such as nurseries, greenhouses and vegetable gardens.

V. DISADVANTAGES OF ROTARY TYPE

1. The weight of machine slightly increases.
2. The machine should be operated carefully because the gear arrangement in the assembly offers slip when extra force is applied.

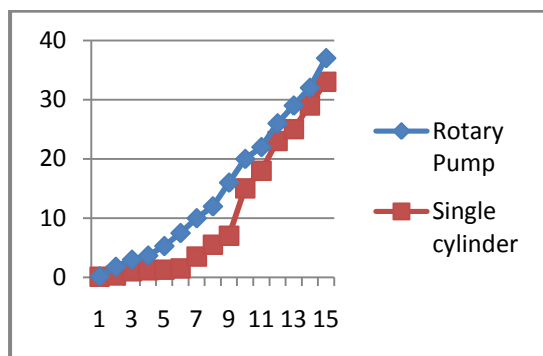
VI. PRELIMINARY TRIALS ON LOK SPRAYER

1. Procedure for pressure Vs number of strokes study

Each sprayer was mounted on a test rig and filled with clean water up to its full capacity. A pressure gauge of 0 to 7 kgf/ cm² range was fitted in the lance just before the controlling valve (trigger). A Subject operated the handle lever giving full stroke each time, The pressure built up in the number of strokes were observed. The same procedure is applied for all three types of sprayer. Twelve replication were taken.

Table-1: Pressure Vs Number of Stroke

Sr.No.	No. of Stroke	Pressure (Psi)	
		Single Cylinder	Rotary Pump
1	1	0.1	0.1
2	2	0.3	1.5
3	3	1	2
4	4	1.2	2.5
5	5	1.3	4
6	6	1.5	6
7	7	3.5	10
8	8	5.5	12
9	9	7	16
10	10	15	20
11	11	18	22
12	12	23	26
13	13	25	29
14	14	29	32
15	15	33	37



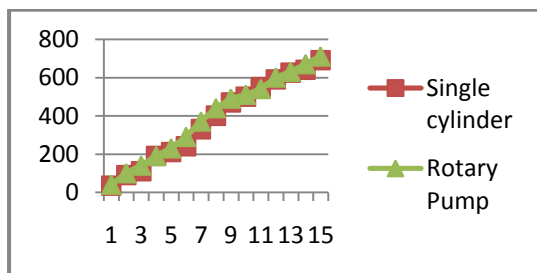
Graph-1: Pressure Vs Number of Stroke
 (Pressure (Psi) on Y-Axis & No Of Stroke On X-Axis)

2. Procedure for discharge vs number of strokes study

Each sprayer was mounted on a test rig and filled with clean water up to its full capacity. A Subject operated the handle lever giving full stroke each time, The discharge for each trial were observed. The same procedure is applied for all three types of sprayer. Twelve replication were taken.

Table-2: Discharge Vs Number of Stroke

Sr. no	no. of Stroke	Discharge (ml)	
		Single cylinder	Rotary Pump
1	1	35	40
2	2	90	100
3	3	110	140
4	4	190	190
5	5	210	230
6	6	240	290
7	7	330	370
8	8	400	440
9	9	470	490
10	10	500	510
11	11	550	540
12	12	590	600
13	13	625	630
14	14	640	670
15	15	690	710



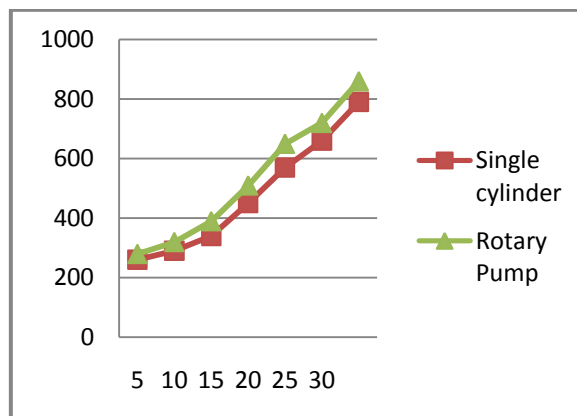
Graph-2: Discharge Vs Number of Stroke
 (Discharge (ml) on Y-Axis & No Of Stroke On X-Axis)

3. Procedure for discharge vs pressure relationship

This test was carried out as per the procedure specified in IS 10134-1982 Indian Standard on methods for manually operated sprayers each sprayer was fitted was a pressure gauge. sprayer mounted on the rig and filled to its full capacity with water. A Subject operated the lever to maintain the desire pressure and discharge was measured.

Table-3: Discharge Vs Pressure

Sr. no	Pressure (psi)	Discharge (ml)	
		Single cylinder	Rotary Pump
1	5	260	280
2	10	290	320
3	15	340	390
4	20	450	510
5	25	570	650
6	30	660	720
7	35	790	860



Graph-3: Pressure (Psi) Vs Discharge (ml)
 (Discharge (ml) on Y-Axis & Pressure (Psi) On X-Axis)

VI. CONCLUSION

In the rotary type LOK sprayers are portable, light in weight, easy to handle and proves to be economical for wide area spraying as well as for spot spraying. The invented rotary type of LOKsprayer shows better result in terms of increasing optimal output, reducing efforts and leads tothe increase inefficiency and performance.Rotary type LOK sprayer delivers liquid with sufficient pressure. This causes liquid to reach to all the foliage and spreads entirely over the sprayed surface.When the lever moves downward, the rotary pump completes its rotation and by means of this complete rotation the suction and compression occurs in rotary pump.

The mechanism of rotary LOK sprayer model is suitable for treating large areas as well as

the small areas such as nurseries, greenhouse & vegetable gardens. From the trial taken on the fabricated model we come to conclusion that spraying can be done efficiently with the help of rotary pump lever operated sprayer with slightly higher input power from the operator. The pump can deliver the liquid at higher pressure than single cylinder alone, so that it reaches all the foliage and spreads entirely over the sprayed surface. It is slightly higher in weight yet sufficiently strong, easily workable and repairable. It is economical therefore affordable for all kind of farmers. It requires comparatively less time for spraying so we can get more fields spraying per day. It is cost effective than the existing spraying pumps available in the market as no operating cost (fuel cost or cost for maintenance of animal) is needed.

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