

Design and fabrication of Commercially Viable Bullock Tractor

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Abstract

The authors developed a versatile bullock tractor, which can perform different farming activities. The activities include cultivating, sowing, weeding, spraying, etc. which require lot of labour and time. The paper reveals design and development of simple mechanisms used in the machine. The mechanisms include basic four bar mechanism, cam follower mechanism, and an intermittent motion mechanism. The bullock tractor has been fabricated and field trials have been carried out in different types of lands in the region. The results are very encouraging and the farmers are satisfied with the performance of the bullock tractor.

Key Words: Bullock Tractor, Seed Drill, Sprayer, Tines, Cultivator, Weed Collector

Introduction:

The agriculture sector in India still remains partially developed as the advances in other sectors such as automobiles, industrial, soar high heights. The farming activities require lot of labour and time and the activities are very tedious. Commercially viable bullock tractor is developed and proposed as farmer friendly equipment as it can perform all the farm activities, such as cultivation, seed sowing, weeds collection and spraying with the minimum labour and time.

The field trials were carried out in the land of Vidarbha, which is Deccan plateau, one of the toughest land in India. Considering this aspect commercial viable bullock tractor can perform all farm activities in any soil in India. The trials were very encouraging and the farmers who operated the system were satisfied. With certain modification the developed bullock tractor will be made commercially available to the farmers.

Design Need:

The development of the new bullock tractor is based on the following needs.

1. To perform different farming operations as and when required.
2. To improve quality of work
3. To improve the productivity of different farming operations.
4. To save valuable time particularly during sowing and weed collection.
5. To save labour (minimum labour requirement)
6. To improve overall productivity (Crop yield)

After detailed analysis of the manual operations the authors have developed different mechanisms to perform different operations to satisfy the above needs.

Design requirements:

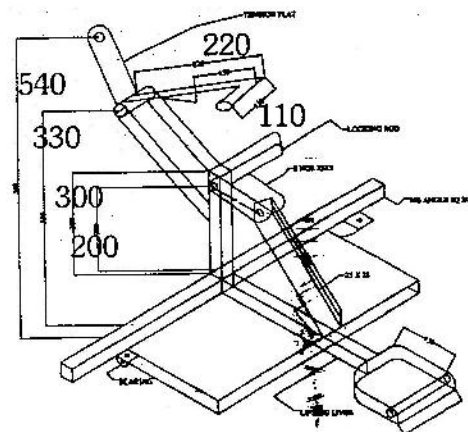
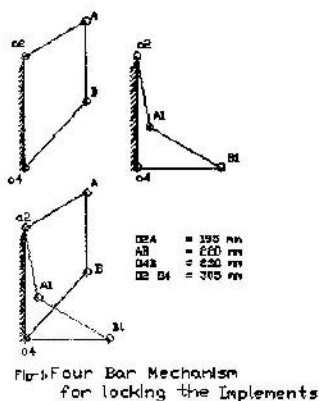
The small farmers in the region generally have a single pair of bullocks and very few implements to perform different farming activities. The following design requirements have been identified to satisfy the needs of the small farmers. The designed tractor should perform most of the activities with the help of one pair of bullock only hence named bullock tractor.

1. Rate of cultivation (4 acre per day)
2. Rate of sowing (4 acre per day)
3. Rate of weed removal (4 acre per day)
4. Rate of spraying (4 acre per day)
5. Depth of seed sowing in the land (@ 50 to 60mm)
6. Seed flow rate (No. of seeds per drop at one place @ 2to3)
7. Distance between two consecutive seeds (Pitch, depends on verity of crop generally 150 to 200mm)
8. Spray pump pressure
9. Piston displacement (50mm)
10. Lift of implements above ground while transportation (250mm)
11. Wheel base (1200mm)
12. Distance between two rows (depends upon verity of crops)
13. Wheel diameter (900mm)
14. The type of land (irrigated and non-irrigated land)

The attachments have been designed as per the above requirements.

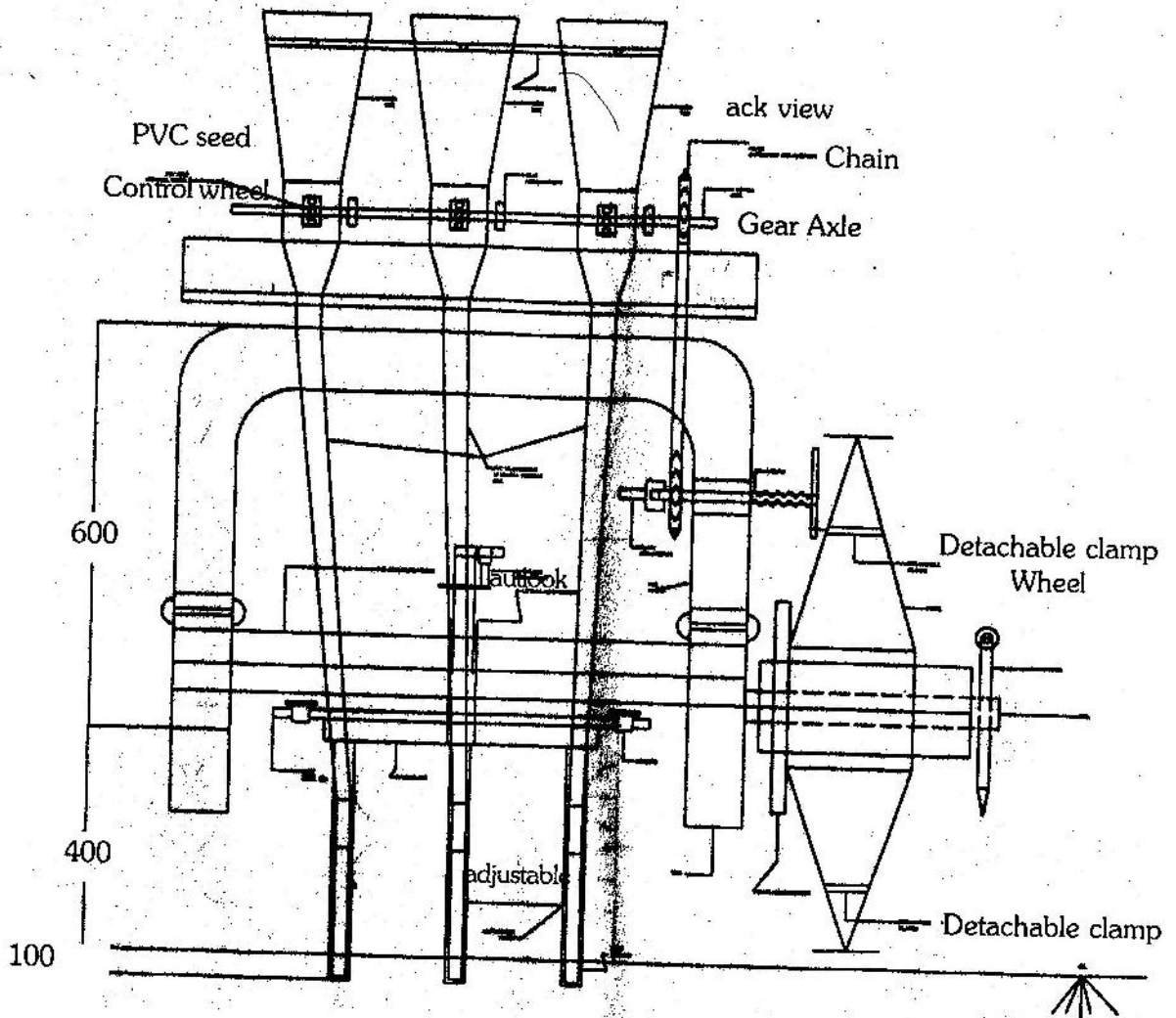
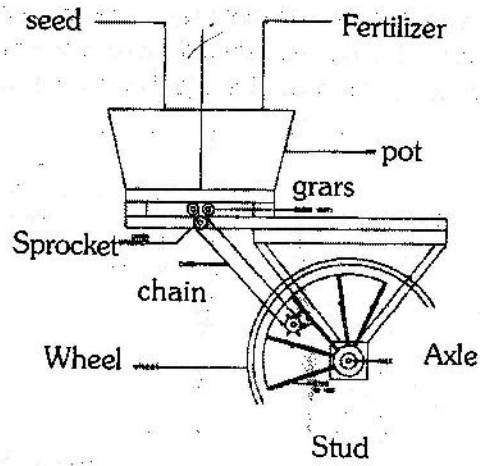
Attachments and Mechanisms:

1. Cultivation: Cultivation is pre-sowing operation. It is generally done after ploughing. The necessary force required for cultivation (@500N) has been applied through the four bar toggle mechanism. The dimensions of mechanism have been finalized. Fig. 1 shows the details of the mechanism. The characteristic of this linkage is that when the implement is attached to it gets inserted in the land it kinematically locked and the required force is applied through the inertia of the system. The mechanism is designed in such a way that it can be used for other attachments such as sowing & weed removal figure 1A shows the application of mechanical.

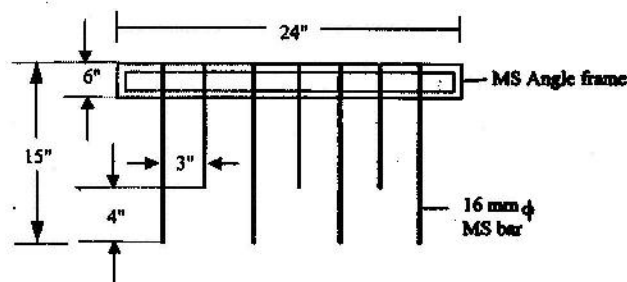


TOGGLE/ LIFTING MECHANISM

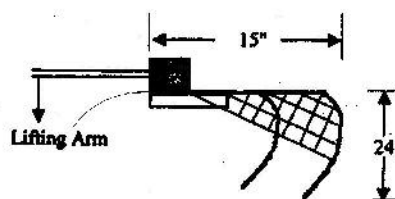
2. Sowing: Sowing is very precise activity and to be completed within very short available span (in the month of June & July). Skilled labour is involved. A special seed sowing system has been developed including seed drill, toggle mechanism, motion transmission mechanism, and the tines. The system is versatile and can be used for most of the crops in the region. Fig. 2A shows the mechanism and fig2B shows the back view.



3. Weed removal: Weed removal is most time consuming and requires more labours. The growth of crops is directly affected by weeds. It must be removed within time otherwise crop yield would be reduced. A specially designed weed collector shown in fig 3 can be attached to the toggle mechanism.



TOP VIEW



SIDE VIEW

Fig. 3. Strips Collection Equipment

4. Spraying: Two separate manual pumps have been attached on the chassis. The required pumping is obtained through specially designed cam follower mechanism driven through the wheel of a tractor. Fig.4A Shows the spraying attachment and fig 4b shows the corresponding mechanism.

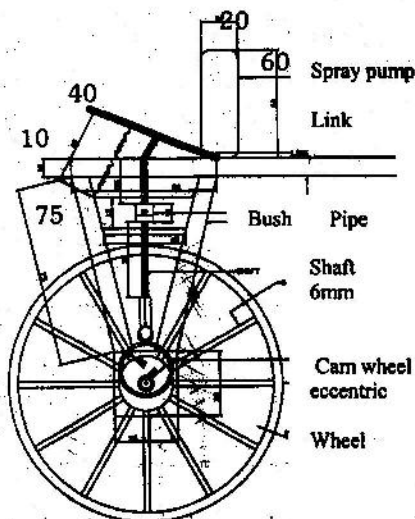
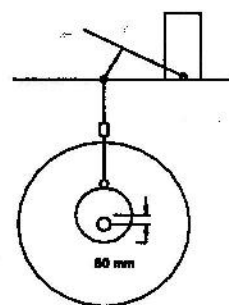


Fig 4 A spraying arrangement



Sprayer Cam and Follower Mechanism

Design of Machine:

The components of the bullock tractors have been designed and details are given in table no.1

Table 1 details of component of model

Sr. No.	Component	Dimension	Quantity
01	Wheels	Dia=900mm, Width=50mm, No. of Arms=12	02
02	Frame	Width=525mm, Length=1175mm, Height =1025mm	-----
03	Axle	Dia=36mm	02
04	Zo bar	Length=3150mm	01

Result and Analysis :**Table no.2 comparison of activities performed by conventional method and by model bullock tractor.**

Activity	Crop	Conventional Method		Bullock Tractor	
		Time required	Field Area	Time Taken by	Field Area
Cultivator	1.Soyabean	One day	2 Acre	One day	3 Acre
	2.Cotton	One day	2 Acre	One day	3 Acre
	3.Pizeon	One day	2 Acre	One day	3 Acre
	4.Wheat	One day	2 Acre	One day	3 Acre
Weed Collection	1.Soyabean	One day	1 Acre	One day	4 Acre
	2.Cotton	One day	1 Acre	One day	4 Acre
	3.Pizeon	One day	1 Acre	One day	4 Acre
	4.Wheat	One day	1 Acre	One day	4 Acre
Seed sowing	1.Soyabean	One day	2 Acre	One day	4 Acre
	2.Cotton	One day	1 Acre	One day	3 Acre
	3.Pizeon	One day	2.5 Acre	One day	4 Acre
	4.Wheat	One day	1 Acre	One day	4 Acre
Spraying	1.Soyabean	One day	2 Acre	One day	4 Acre
	2.Cotton	One day	2 Acre	One day	4 Acre
	3.Pizeon	One day	2 Acre	One day	4 Acre
	4.Wheat	One day	1 Acre	One day	3 Acre

The productivity of various activities have been greatly increase (almost doubled) when it is performed by the develop bullock tractor model that can be seen from the data given in table no.2.

Conclusion:

The developed bullock tractor has been fabricated and extensive field trials have been carried out. The overall productivity of various farm activities has been increased considerably. The labour requirement has been also minimized. The small farmers will be benefited with this tractor. The standardization of the components is essential for commercial manufacturing of the system. The bullock tractor is designed in such a way that even a small fabricator could fabricate the tractor with very less cost.

References:

1. J.E. Shigley, Theory of Machines, Tata McGraw Hill Publication
2. R A Kepner, Principal of Farm Machinery, New Age International Publication
3. B.D.Shivalkar, Design of Machine Element, Central Techno Publications
4. B.D.Shivalkar, Design Data Book, Central Techno Publications
5. P.S.G., Design Data Book, M/s DPV Printer

6. Shridhar B.N, Structural Handbook, University Press
7. Robert N. Norton Design of Machinery Mc graw -Hill
8. Joseph Edward Shingley Charles R. Mischke, Mechanical Engineering Design Mc Graw -Hill International Ed.
9. David H. Myszka, Machine and mechanism applied kinematic analysis, Pearson education Asia
10. Field Survey Conducted at various Fabricator of Bullock Cart

