Chapter 26
Development of Modified Bageshwari Wool Charkha

R. P. Saini, S. K. Singal, Imtiyaz Ali and Ramesh Chandra Joshi

1 History of Traditional Bageshwari Charkha

The spinning of locally grown wool using drop spindle and foot-operated charkha is a traditional occupation of people of the Himalayas. This helps in utilizing wool for weaving fabric for local use and sale [1]. In 1926, Late Shri Jeet Sing Tangnia developed a concept of wood-based charkha for spinning yarn in Bageshwer region, Uttarakhand. This charkha was developed in small workshop situated in his home, and all settings of the charkha were done with the help of hand tools. A lot of physical work was required to operate this charkha due to which it was incapable to spin a large quantity of wool [2]. In 1929, this charkha was dedicated to Mahatma Gandhi in his Kurmanchal Rally. A charkha was also given to the Vraddha Ashram situated in Mumbai. With the increasing demand of the charkha, a charkha manufacturing workshop was established in 1934. Thus, charkhas were manufactured in this workshop till 1943 with the help of labor. Furthermore, some more advanced machines, i.e., lathe machine, etc., were required for the ease of manufacturing of charkha. A large lathe machine driven by water power was invented in 1944. Furthermore, several machines driven by small hydropower were invented to perform various operations during the manufacturing of this charkha. Therefore, Bageshwari charkha was manufactured with the help of water power machines [1].

R. P. Saini (✉) · S. K. Singal · I. Ali · R. C. Joshi
AHEC, IIT Roorkee, Roorkee, India
e-mail: saini.rajeshwer@gmail.com

S. K. Saha and M. R. Ravi (eds.), *Rural Technology Development and Delivery*,
Design Science and Innovation, https://doi.org/10.1007/978-981-13-6435-8_26

This charkha is formally known as "Uni Charkha" can be classified into two types such as single and double. Both operations, i.e., spinning and twisting are completed on one side in single size, whereas left side and right side are used for spinning and twisting, respectively, in double-size charkha. This charkha can be fabricated by matching the marked number on the various parts of charkha. Mobil oil should be injected in the movable part of the charkha [3]. Oil should be injected two–three times in a day. Bageshwari charkha is used in both Kumaon and Garhwal region of the state. In Kumaon region, it is widely used by the tribal's of Munshyari, Dharachula, and Dharamgarh area and non-tribal area of Bageshwar and Pithoragarh district. In Garhwal region, it is widely used in Mana, Pipalkoti of Joshimath Block of Chamoli District and in Ukhimath Block of Rudraprayag District. It is estimated that more than 60,000 families are involved in hand spinning and weaving in Uttarakhand state.

2 Problems Identified in Traditional Bageshwari Charkha

Bageshwari charkha which is widely used in the hilly region is shown in Fig. 1. Almost 60,000 families are using this charkha to spin yarn from the locally produced Tibati wool. This thread is used for making mats, rugs, clothes, etc. In order to identify the problem faced by spinners, RuTAG IIT Roorkee team visited Berinag on March 25–27, 2011. The team interacted with the spinners living in the adjoining villages with the help of regional coordinator of the Himalaya Trust and a training on

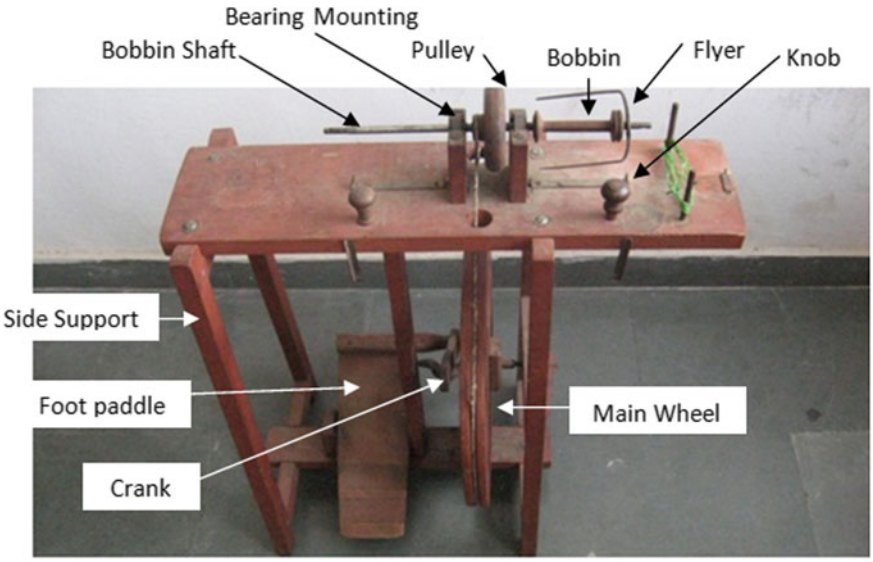

Fig. 1 Traditional Bageshwari charkha

Fig. 2 RuTAG team interacting with people working on the existing Bageshwari charkha

the modified charkha was conducted at AHEC, IIT Roorkee (Fig. 2). The following shortcomings were identified on the basis of feedback given by the operators:

(i) Nonuniform filling of bobbin,
(ii) Nonuniform thickness thread of yarn,
(iii) High labor leads to high cost and low productivity.

In order to eliminate these limitations of traditional charkha, an attempt has been made to modify this charkha and presented in this paper. The experimental investigation has been carried out using Local Tibetan and Tibetan 56 to estimate spinning production at RuTAG, IIT Roorkee. Wool samples spun by traditional and modified charkha have been sent to Wool Research Association (WRA) Lab, Thane, Maharashtra, Government of India for analyzing yarn quality.

3 Modifications Made in Traditional Bageshwari Charkha

In order to eliminate the shortcomings, a traditional Bageshwari charkha was modified in four phases. After each modification, the charkha will be given to spinners for their feedback. Modifications made in each phase are shown in Fig. 3. After the first stage modification as shown in Fig. 4, the users were not found satisfied with the performance of the modified Bageshwari charkha because of low production capacity and low quality of the thread. Therefore, based on feedback given by the

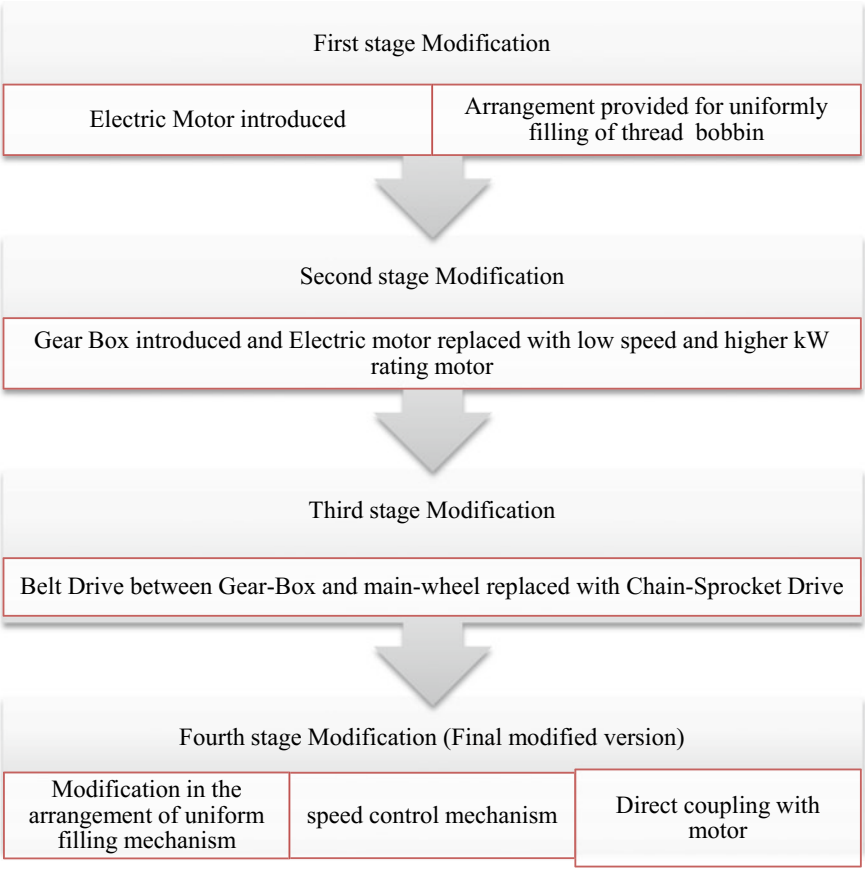

Fig. 3 Different phases of modification for traditional Bageshwari charkha

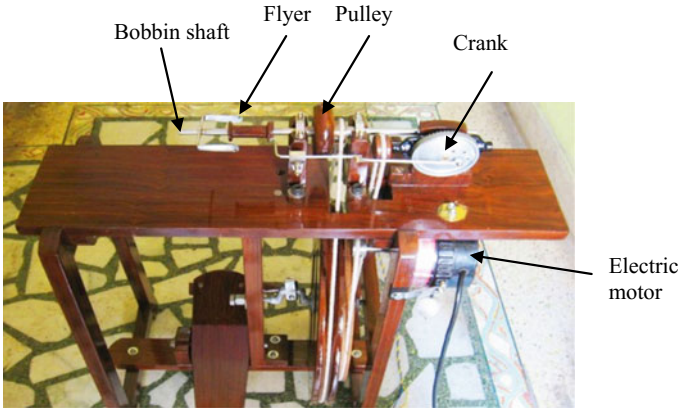

Fig. 4 First-stage modifications

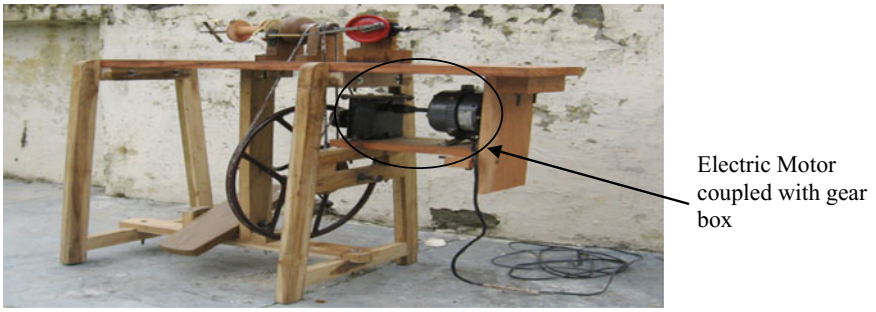

Fig. 5 Second-stage modification (motor and gearbox arrangement)

operators, Bageshwari charkha was further modified by introducing gearbox and replacing electric motor with low speed and higher kW rating motor, as shown in Fig. 5. After the second stage modification, production capacity was found to be increased. However, the quality of thread was not found as per standards. Hence, the chain sprocket arrangement with the gearbox was introduced in the modified Bageshwari charkha as shown in Fig. 6. After this third stage modification, good thread quality has been found. The modified Bageshwari has been further modified in order to provide uniform filling of thread bobbin and speed control mechanism.

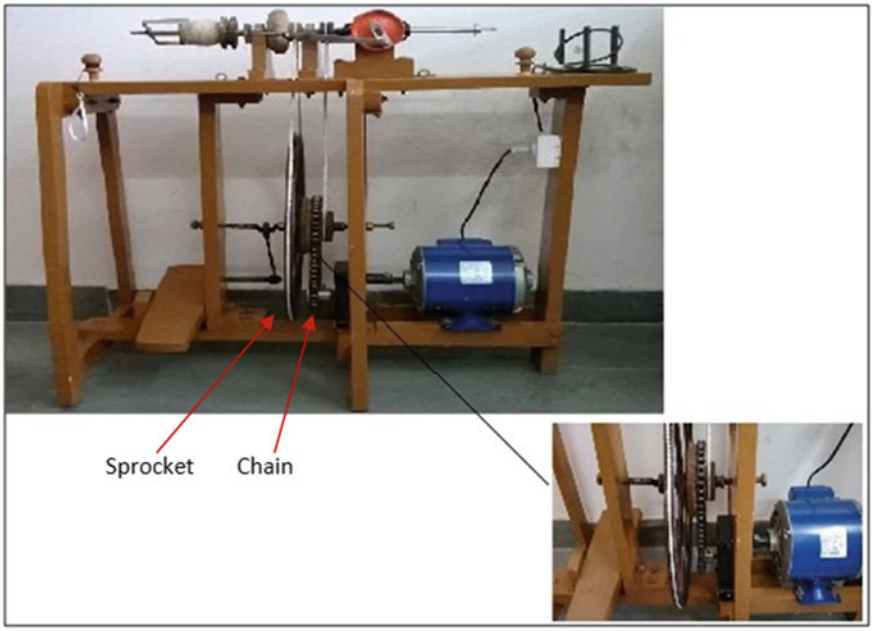

Fig. 6 Third-stage modification (chain sprocket arrangement)

Thus, a traditional Bageshwari charkha was upgraded by introducing foot-operated electrical motor, speed controller, modified flyer, and a crank for lateral motion of bobbin. Moreover, wooden frame has been replaced by lightweight steel pipe which facilitates in easy assembling and disassembling. Figure 7 shows the schematic of the modified Bageshwari wool charkha. A photograph of the modified Bageshwari wool charkha is shown in Fig. 8.

4 Performance Assessment of the Modified Bageshwari Wool Charkha

In order to assess the performance of modified Bageshwari wool charkha, different types of wool, i.e., Local Tibetan and Tibetan 56 were spun by experienced spinners of Uttarakhand. Further, an attempt has been made to compare the spinning production and yarn quality produced by the modified charkha and traditional charkha. Spinning production test has been carried out at RuTAG, Alternate hydro energy center, IIT Roorkee, whereas yarn quality of spun wool is got tested at Wool Research Association (WRA) Lab, Thane, Maharashtra, Government of India.

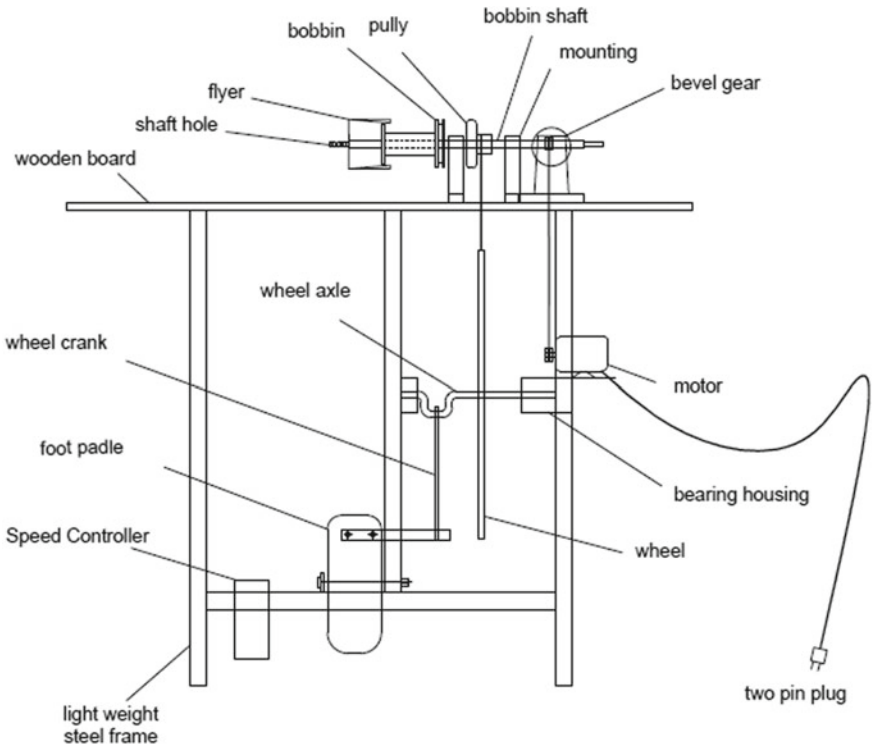

Fig. 7 Schematic of the modified Bageshwari wool charkha

4.1 Spinning Production Test

Spinning production test has been carried out on the basis of various parameters such as weight and length of yarn per hour and speed of spinning wheel. Summary of results for the spinning production is given in Table 1. Figure 9 shows the comparison between the count of Tibetan wool spun by the modified and traditional charkha.

It has been observed that wool spun by the modified Bageshwari charkha has higher production rate and higher count for each sample considered under the present study. Based on the results obtained for Local Tibetan and Tibetan 56, the modified charkha is found to be more efficient than traditional Bageshwari wool charkha. Further, based on the response of the spinners, the modified charkha is easy to operate at higher speed. However, spinners also encountered the two problems during spinning such as heating of motor and loosening of connection of bobbin with crank hook due to vibration. The use of high rating motor to avoid heating and replacement of crank hook mechanism are the measures, which also been taken to mitigate the difficulties faced during spinning.

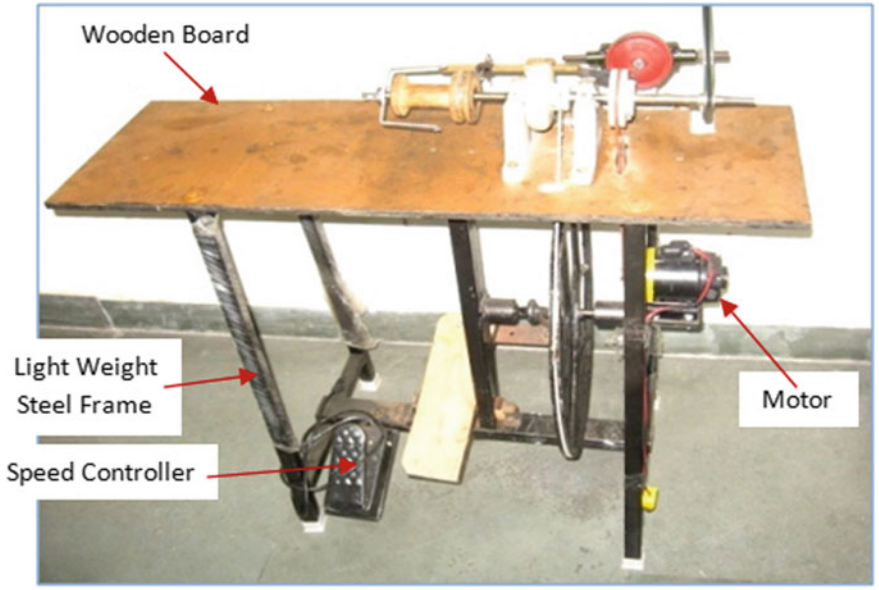

Fig. 8 Photograph of the modified Bageshwari wool charkha

Table 1 Summary of the spinning production test

S. no.	Type of wool	Unit	Modified Bageshwari wool charkha			Traditional Bageshwari wool charkha		
1.	Tibetan wool	Length (m/h)	234	285	234	164	218	225
		Weight (g)	31.75	61.61	70.61	38.95	56.51	72.96
		Count	7.37	4.62	3.31	4.12	3.85	3.08
2.	Tibetan no. 56	Length (m/h)	340	368	375	213	250	196
		Weight (g)	55.85	85.47	105.72	47.00	44.95	53.01
		Count	6.08	4.30	3.54	4.53	5.56	3.69
Maximum speed (RPM) observed			1500–2000			1000–1300		

4.2 Analysis of Yarn Quality

In order to examine the yarn quality, spun wool was also tested at Wool Research Association (WRA) Lab, Thane, Maharashtra, Government of India. The quality of yarn was measured on the basis of different parameters such as linear density of yarn, twist per unit length, single yarn strength, fiber diameter analysis, total fatty matter content (%), and number of fibers in cross section [4]. Fineness of the yarn depends on the count. The strength of yarn generally increased with twist up to a certain limit. Beyond this limit of twist, the strength of yarn was reduced. Higher twist of the yarn helps to resist the abrasion. Twist multiplier (TM) is a function of twist per inch and

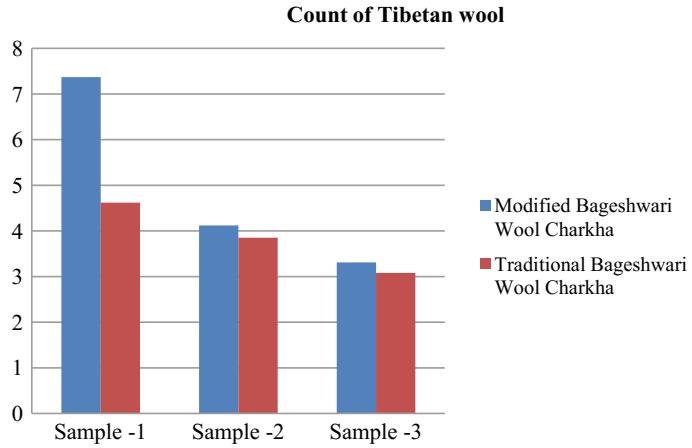

Fig. 9 Comparison between the count of Tibetan wool spun by the modified and traditional charkha

Table 2 Summary of the results provided by WRA lab

S. no.	Test parameters	Local tibetan wool		Tibetan 56 wool	
		Modified charkha	Manual charkha	Modified charkha	Manual charkha
1	Count	7.49	4.35	6.07	4.62
2	Linear density of Yarn	1/7.49	1/4.35	1/6.07	1/4.62
3	Twist per unit length	8.3	7.5	6.2	6.2
4	Twist multiplier	3.04	3.60	2.52	2.89
5	Number of fibers in cross section	136	200	100	131

count. Lower twist multiplier implies that the yarn was bulky, hairy, and soft and production capacity of charkha will be more. On the contrary, higher twist multiplier of the yarn gives lean yarns with low hairiness with improved spinning stability. For better quality of yarn, the number of fibers in cross section should be less for higher value of count. The behavior of charkha does not affect fiber diameter analysis and total fatty matter content of yarn. Table 2 gives the summary of different parameters evaluated at WRA lab. Based on the comparison between yarn quality produced by the modified charkha and manual charkha, the performance of the modified Bageshwari wool charkha is found satisfactory and can be recommended for spinning of wool in Uttarakhand.

Table 3 Comprehensive summary of conclusions

S. no.	Observations	Modified charkha	Traditional charkha
1	Operating	Manually/Electrically	Manually
2	RPM	1500–2000	1300
3	Speed of spindle	Variable	Variable
4	Count	Higher count for local wool	Lower
5	Production rate	High	Low
6	Strength of yarn	Average good (low to moderate twist multiplier)	Good (high twist multiplier)
7	Local wool production	High	Normal
8	Wool to be spun	Local wool	Local, Australian wool
9	Yarn production	Multiple thickness	Constant thickness
10	Operation of spindle	Easy	Moderate
11	Yarn quality	Controllable	Controllable

5 Conclusion

Traditional Bageshwari charkha is quite popular in the Himalayas region for spinning locally grown wool. Under the present study, this charkha was modified in four stages to overcome the shortcomings raised by operators. These modifications will be beneficial for a significant portion of population of the state who are using this charkha for spinning locally grown wool. Thus, a traditional Bageshwari charkha was improved by introducing foot-operated electrical motor, speed controller, modified flyer, and a crank for lateral motion of bobbin and lightweight steel pipe instead of the wooden frame. In order to assess the performance of modified Bageshwari wool charkha, spinning production test was carried out at RuTAG, IIT Roorkee and yarn quality got tested at WRA lab. Table 3 gives a comprehensive summary of conclusions based on spinning production and analysis of yarn quality. Based on the results of the test conducted at RuTAG and WRA lab, it can be concluded that the results of the modified charkha are promising and can be used for spinning of wool. Furthermore, five sets of the modified charkha have been fabricated and distributed to spinners through NGOs for field testing. A training program has also been organized by RuTAG for the local users in association with various NGOs.

Acknowledgements The authors would like to thank the Dr. R. P. Gakkhar, Former Professor, MIED, IIT Roorkee and Mr. Yogeshwar Kumar, Jansamarth NGO, Tehri for their technological support. We are also thankful to office of PSA of Government of India for providing the financial support.

References

1. Mehta GS (1996) Uttarakhand, prospects of development. Indus publishing Company, New Delhi
2. Mudgal R (1996) Economic dimensions of rural development. Sarup & Sons Publication, New Delhi
3. Tangnia DS Uni Charkha Pushtika, Karn Press, Bageshwar (Almora)
4. Indian standard, Method for determination twist in yarn IS-832 (1985)