CHAPTER - V

SUMMARY AND CONCLUSIONS

Draft animal power is not only based on renewable energy sources, but it is also economically and socially appropriate in the community in which they are used. Throughout the developing countries of the world, draught animals are still important part of highly appropriate and effective system of food production and transportation. Draught animals are major source of motive power for majority of farmers in India. Camel is a major draught animal which is widely used for agriculture and transportation purpose in arid and semi-arid region of the India. Still the major part of the animal power is unutilized. To enhance the annual utilization of animal power a rotary power transmission system is suitable method through which numbers of matching gadgets can easily be operated.

According to the local needs four matching gadgets were identified and developed for the rotary transmission system. Electricity generation setup for battery charging, maize sheller dehusker sheller, groundnut decorticator and air compressor were selected and modified for rotary mode transmission system. Different operating parameters were selected for rotary mode by analyzing different performance parameters of the matching gadgets in laboratory simulation experiment.

It was very difficult to select the operating parameters of matching gadgets in the rotary mode. A laboratory simulation setup was developed to select the operating parameters of the matching gadgets in the controlled laboratory condition for actual operation in the rotary transmission system.

A rotary transmission system consisted of a centrally mounted gear unit of crown, pinion and spur gears which was driven by a camel. The total step up in velocity was 147.9. The output was made available outside the circular track through underground shaft. This power can be utilized to run the machines requiring power up to 0.75 kW. The output shaft had a flywheel for uniform supply of power. Ratchet system was also provided to avoid hammering on the legs of camel by the horizontal hitch beam. All selected matching gadgets were tested in the rotary transmission system at different operating parameter, which were selected through laboratory simulation experiment. The performance parameters of the matching gadgets were assessed at in controlled laboratory condition at different operating speed. Laboratory test data were statistically analyzed. Alternator speed of 1250 rpm and 33 Ah battery were selected for electricity generator. Drum speed of 400 and 300 rpm were found suitable for maize dehusker sheller and for groundnut decorticator respectively. As the basis of laboratory simulation experiment crank speed of 300 rpm of air compressor was found to be appropriate for rotary transmission system.

On the basis of laboratory experiments, all four matching gadgets were tested with the camel powered rotary transmission system with suitable operating parameters. Different performance parameters of the gadgets were observed in the rotary mode. Animal physiological and physical parameters for operating each gadgets were also recorded for calculating the fatigue score. For charging the battery in rotary mode a work rest cycle of 15 min(W) – 15 min(R) – 15 min(W) – 30 min(R) – 30 min(W) – 60 min(R) – 30 min(W) – 60 min(R) – 60 min(W) – 60 min(R) – 90 min(W) – 60 min(R) – 90 min(W) was followed for the camel. 6 hours of charging time was needed for charging 33 Ah battery in the rotary mode. Simulating loading experiment with CIAE animal loading car was done to evaluate the animal parameters in continuous operation with the same draught of maize dehusker sheller and groundnut decorticator. From the simulating loading experiments it was found that maize dehusker sheller and groundnut decorticator could be continuously operated for 5 hours with the camel in the rotary mode. In the rotary mode 12 min of operating time was needed to compress the air upto the pressure limit of 8.45 kg/ cm^2.

Comparison of the performance of matching gadgets between laboratory simulation and rotary mode of operation was also done. In the rotary mode of operation the performance of the gadgets was lower than that of laboratory condition as it was very difficult to maintain the same operating speed throughout the operation in rotary mode because of variation of the speed f the animal in different levels of draught and fatigue level.

On the basis of study following conclusions were drawn:

1. Laboratory simulation experiment of the matching gadgets provided the proper technical idea regarding the different performance parameters and draught requirement of the gadgets in the rotary mode of operation.
2. Small battery can be successfully charged through the electricity generator. 33 Ah battery took 5 hours 30 minutes of charging time at the alternator speed of 1250 rpm in the laboratory test condition. Charging voltage and specific gravity of the battery were significantly increased with the charging time. Similarly, power requirement and charging current significantly decreased with the passage of charging time.
3. Laboratory simulating testing of maize dehusker sheller gave the best performance at drum speed of 400 rpm. Power requirement of maize dehusker sheller at 400 rpm of drum speed was 0.4 kW. Dehusking efficiency, shelling efficiency, cleaning efficiency, output and as well as broken grain percentage were significantly increased with the increase in drum speed.

4. Performance of groundnut decorticator was better at the drum speed of 300 rpm. Decortication efficiency, broken grain ratio, output and power requirement were significantly varied with the drum speed. Power requirement was 0.5 kW at drum speed of 300 rpm.

5. Pressure rise of the air compressor was significantly increased with the increase in crank speed and operating time. Power requirement of the air compressor was reached upto 0.9 kW at the last level of compression in laboratory simulation setup.

6. Due to higher draught at initial level of charging a work rest cycle of 15 min(W) – 15 min(R) – 15 min(W) – 30 min(R) – 30 min(W) – 60 min(R) – 30 min(W) – 60 min(R) – 60 min(W) – 60 min(R) – 90 min(W) – 60 min(R) – 90 min(W) was found suitable for battery charging in rotary mode. Charging time of 6 hours was required for charging the battery at 1250 rpm of alternator speed in rotary mode.

7. Dehusking efficiency, shelling efficiency, cleaning efficiency, broken grain percentage and output of 94.7 per cent, 95.5 per cent, 96.1 per cent, 5.12 per cent and 165 kg/h were obtained from maize dehusker sheller in rotary mode experiment at the drum speed of 400 rpm. The draught requirement was in the ranges of 55 kgf to 60 kgf . Experiment with simulating load in rotary mode indicated that maize sheller dehusker can be operated continuously for 5 hours with the camel power in rotary mode.

8. Decortication efficiency, broken grain ratio and output of groundnut decorticator was observed to be 97.72 per cent, 0.038 and 204.73 kg/h respectively in the rotary mode at the drum speed of 300 rpm. 55 kgf of average draught was required to operate the groundnut decorticator in the rotary mode. Groundnut decorticator can be operated continuously for 5 hr with the camel power in rotary mode.

9. Air compression upto the pressure limit of 8.3 kg/cm^2 was attained within 12 minutes of operation of air compressor in the rotary mode at crank speed of 300 rpm. The draught on the camel was increased with the passage of operating time.

10. Due to fluctuation of speed in rotary mode, the performance of the matching gadgets was lower in the rotary mode experiment than that of the in the laboratory simulation setup.

11. All the identified gadgets were found suitable for camel powered rotary transmission system as the fatigue level was within the safer limit.