Improved Transmission System for Cycle Rickshaws

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Abstract :

The existing cycle rickshaws have only one transmission ratio of 1:2.2 ; which cannot provide the higher torque necessary during certain periods of driving. In this paper the design of a transmission system for the existing cycle rickshaws having two transmission ratios, through which higher torque can be obtained whenever necessary, is presented.

Introduction :

Manually driven cycle rickshaw is an important means of transport in Bangladesh. The design of the body, chasis, suspension system, transmission system etc. of cycle rickshaws is mainly based on tradition and no significant attempt has been made for their development. The existing design of the cycle rickshaws can be improved to have better control, more stability, more passenger comfort and easier driving. Since the rickshaw is manually driven it would be of utmost benefit for the rickshaw drivers if an improved transmission system can be designed so that driving becomes easier.

There are systems for having two or three step transmission viz ; the hub gear or derailleuer system used in bicycles which can be adapted to the cycle rickshaws. But these are designed for light loads and will not be suitable for heavy load and rough driving encountered by the cycle rickshaws in Bangladesh. However, if requested the manufacturer may properly design and produce them for heavy loading condition but anyway these are to be imported which involves hard earned foreign currency. Also the repair and maintenance of these requires much skill which the ordinary rickshaw mechanics may not be able to contribute. Therefore a new and simple transmission system for easy driving of the cycle rickshaws suitable for the conditions of Bangladesh is proposed.

Existing transmission system :

In the existing rickshaws the pedal axle is keyed to the chain wheel sprocket which has got 48 teeth. As the pedalling is done, this chain wheel sprocket rotates and the power is transmitted through a chain to the rear sprocket which is keyed to the rear axle

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and is provided with free wheeling system. This rear free wheel sprocket has got 22 teeth. The speed transmission ratio i. e. the ratio of speed of the chain wheel sprocket to the speed of the rear free wheel sprocket is approximately given by 22/48 i. e. 1:2.2 which means that the rear axle will rotate through 2.2 revolution for 1 revolution of the pedal axle. The corresponding torque ratio is therefore 2.2:1 which means that in order to get 1 unit of torque at the rear free wheel sprocket, 2.2 unit of torque is to be applied at the chain wheel sprocket.

Scope for development :

In the existing system only one transmission ratio or torque ratio can be obtained which makes it very difficult to drive the rickshaw during initial starting, with heavy load, on an steep upgrade, against strong wind and on rough and uneven roads or under combination of these since higher torque is necessary under these conditions which means higher effort must be applied by the rickshaw drivers. If a mechanism like the gear box in automobiles can be incorporated such that, under the above mentioned conditions, the transmission can be engaged to obtain a lower torque ratio, i. e. a lesser torque is to be applied at the chain wheel to get 1 unit of torque at the rear axle with a corresponding decrease in speed, then driving under these conditions will be easier. Under smooth and normal operating conditions, the transmission can be switched to the existing one.

Description and layout of the improved system :

The schematic diagram of the proposed transmission system is shown in Fig. 1. It has two driving chain wheel sprockets P and Q fixed on left and right side of the pedal axle, looking from behind, respectively. The wheel P which has 48 teeth and the wheel Q which has 28 teeth are linked through two chains K and G with the two rear free wheeling sprockets B and H, both having 22 teeth, respectively.

The first set of chain drive connecting the 28 teeth driving sprocket Q to the 22 teeth rear free wheel sprocket H which is fixed with the rear axle, remains in continuous operation. The second set of chain drive consists of the 48 teeth driving sprocket P linked to the other 22 teeth rear sprocket B which is fixed at one end of a hollow splined shaft L. The splined shaft L in turn can rotate freely on the rear axle N. There is an internally splined coller A having a ring type stopper at right end. The collar A can slide longitudinally while rotating with the splined shaft L. The sliding motion of the collar A can be imparted by the shifter M which consists of a suitably hinged fork. The fork actuates a disc collar U which rides loosely on the splined collar A. The collar U when actuated by the fork pushes the collar A against the stopper and the collar A slides along the shaft L and at same time rotates with it. But since the collar U rides loosely on A it does not rotate with the latter. The collar A has got two small pins E fitted perpendicular to the rear axle, on the periphery on a diametral axis. There is another 22 teeth free wheel sprocket C fixed with the rear axle. To this sprocket another collar D is fixed which has got two other small pins F fitted 180° apart near the periphery parallel to the rear axle. There is also a spring S placed between the splined collar A and the sprocket B.

During normal operation the spring S because of its initial compression pushes the collar A such that the pins E are clutched with the pins F. Power from the pedal wheel comes through both the chains G and K to the sprockets H and B respectively. From the sprocket B power goes to the rear axle through the splined shaft L, splined collar A, pins E, pins F, collar D and sprocket C. For 1 revolution of the pedal axle the sprocket H will have 28/22 i. e. 1.2 revolutions and the sprocket B along with the splined shaft and sprocket C will have 48/22 i. e. 2.2. revolutions. Since the sprockets B and C moves faster than the sprocket H, the sprocket H acts as dummy and power actually flows to the rear axle through the sprockets B and C although power comes to both the sprockets H and B. Because of the free wheeling action the sprocket H rotates in the reverse direction relative to the sprockets B and C. Thus the

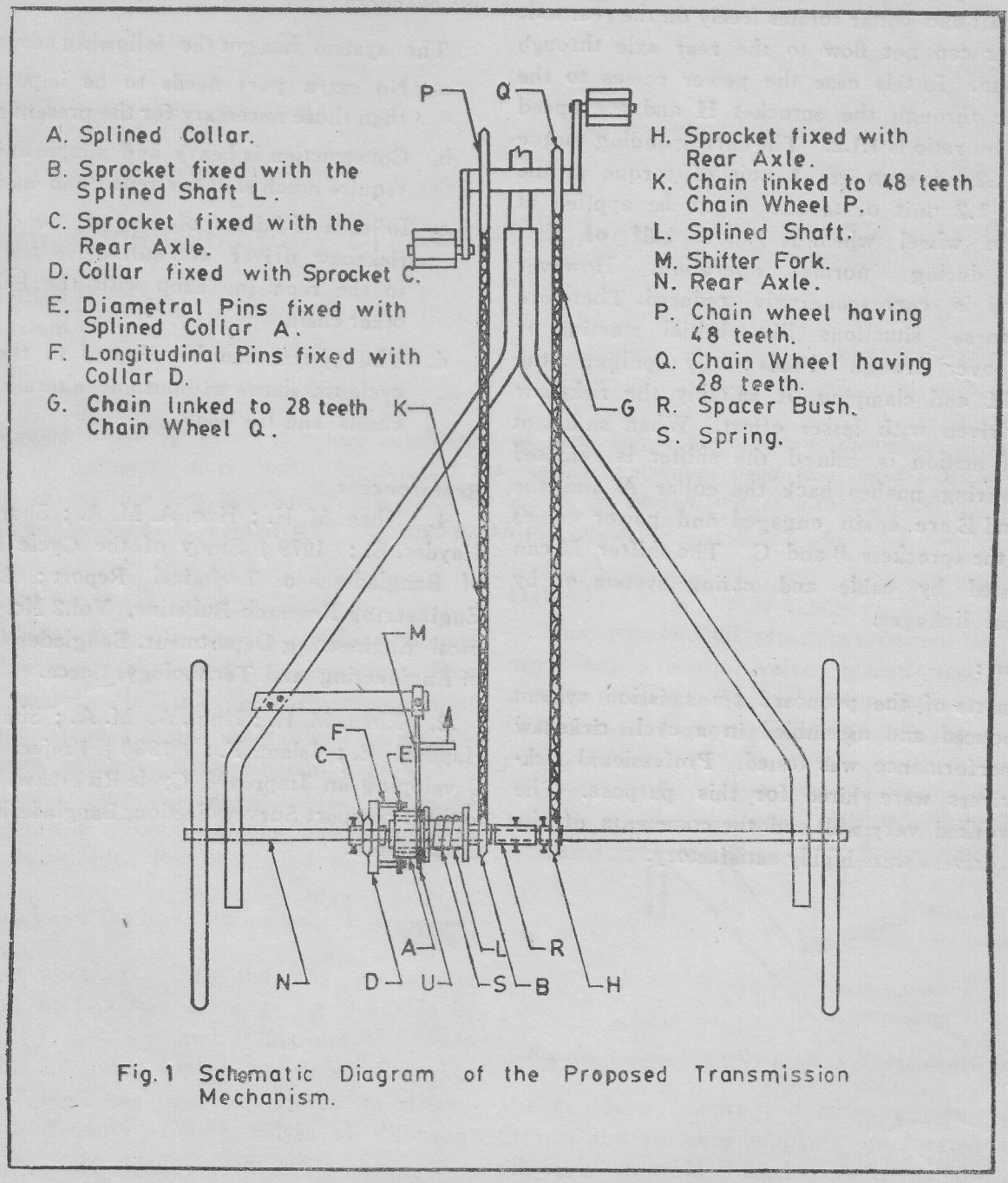

Fig. 1 Schematic Diagram of the Proposed Transmission Mechanism.

speed transmission ratio during normal operation is 1:2.2.

When the shifter M is pulled so that the pins E and F disengages, the sprocket B along with the splined shaft and collar rotates freely on the rear axle and power can not flow to the rear axle through this system. In this case the power comes to the rear axle through the sprocket H and the speed transmission ratio is 1:1.2. The corresponding torque ratio is 1.2:1 i. e. to get 1 unit of torque at the rear axle, 1.2 unit of torque is to be applied at the chain wheel which is about half of that required during normal operation. However the speed is correspondingly reduced. Therefore during worse situations like initial starting or driving over rough roads; by pulling the shifter M and clamping it suitably the rickshaw can be driven with lesser effort. When sufficient inertia of motion is gained the shifter is released and the spring pushes back the collar A and the pins F and E are again engaged and power comes through the sprockets B and C. The shifter M can be operated by cable and casing system or by mechanical linkages.

Discussion :

The parts of the proposed transmission system were produced and assembled in a cycle rickshaw and the performance was tested. Professional rickshaw drivers were hired for this purpose. The system worked very well and the comments of the rickshaw drivers were highly satisfactory.

The increase in cost of production of a cycle rickshaw for incorporating this system will be about Tk. 300.00 but this will be compensated by the gain in social benefit since the rickshaw drivers will have less exertion.

The system has got the following advantages.

a. No extra part needs to be imported other than those necessary for the present rickshaw.

b. Construction is heavy and simple and does not require much skill for repair and maintenance.

c. In case of failure of one of the chains, the rickshaw driver can still drive the rickshaw to the repairing shop with the help of the other chain.

d. The system can be adapted to the existing cycle rickshaws without any alteration of the chasis and the body.

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