Suitability of cycloidal cam in shedding mechanism

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A suitable cycloidal cam has been designed and compared with the simple harmonic cam to study the behaviour of warp yarn tension and warp breakage rate. Electronic tensiometer was used to measure the tension of the warp yarn during weaving with and without shuttle for both types of cam to understand the effect of shuttle propulsion on warp yarn tension. It is observed that the warp breakage rate is comparatively less in case of cycloidal cam. The tension behaviour is also found to be smoother in case of cycloidal cam.

Keywords: Cam follower, Cycloidal cam, Simple harmonic cam, Shedding cam, Weaving

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Shedding motion is one of the basic motions in weaving machine. Due to rotation of cam in shedding motion of the loom, harnesses are moved up and down to form shed for weft insertion. The displacement-time relationship of the follower governs the shape of the cam. Several attempts have been made to modify cam profile. Gu attempted to minimise the lateral force to the bowl for which it causes the side thrust and ware of the mechanism. He also showed that lateral force on the bowl for cycloidal cam is initially less than that for simple harmonic cam over the change periods. Hinkle described that the dynamic force exerted by a cycloidal cam to the follower follows purely sinusoidal curve. Grossberg showed the movement of the follower for both types of cam through one unit of distance in one radian of cam rotation from which it can be concluded that the initial displacement is slower in cycloidal cam as compared to that in simple harmonic cam, resulting in low initial heald velocity for cycloidal cams. The gradual displacement becomes higher by gaining higher velocity but finally the follower again reaches the end point slowly in case of cycloidal cam. This heald movement behaviour has an obvious effect on warp yarn tension variation and abrasion of warp with picking elements.

In the present work, keeping all other cam parameters unaltered as compared to existing simple harmonic set of cams for a particular loom, a set of cycloidal cams has been designed from the profile which is drawn with the help of computer program written in c-programming language with graphics interface. After manufacturing the cam, the comparative displacement of cam followers was studied along with the warp breakage rate, and basic tension and its variations in a standard mill loom-shed.

From the computer programming and graphics, the actual profiles of the cycloidal cams were drawn and accordingly the casting of cams was made. These were then machined and case hardened.

Actual displacement of the cam follower for both the sets of cam was measured to get the actual heald displacement behaviour for simple harmonic and cycloidal cams.

A powerloom with negative tappet attachment was chosen with warp(48 ends/inch) and weft(42 picks/inch) counts of 24 Ne. Number of warps in the beam was 2500 and the loom speed was 165 rpm for the plain woven cotton fabric. The width of the loom was 120cm with negative let off attachment. Heald level was kept at 290° as the warp yarns were comparatively weaker.

Variation in warp tension for both sets of cam was measured by Rothschil Tensiometer with measuring head of 0-100 cN in the position between back rest and lease rods. To eliminate hindrance from shuttle during actual weaving process on line, the tension of warp was measured for both the sets of cam, firstly without using shuttle and then by inserting shuttle to get the actual cam behaviour.

Warp breakage rate was studied for both types of cam sets on the basis of breaks per 1000 warps per 10000 picks (Table 1).

Figure 1 shows the displacement behaviour of two types of cam. It can be seen that cam follower of cycloidal cam starts in a slower and smoother fashion as compared to simple harmonic cam follower and then it moves faster compared to simple harmonic
Table 1—Comparative study of breakage rate

<table>
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<th>Type of cam</th>
<th>No. of observations</th>
<th>No. of breaks</th>
<th>Time of study min</th>
<th>No. of picks inserted</th>
<th>Breakage rate/ 10,000 picks</th>
<th>Average breakage rate</th>
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<td>7300</td>
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</table>

Fig. 1—Displacement of cam followers

motion cam follower and at the last part of the displacement, the cycloidal cam follower stops comparatively more gradually.

Figure 2 shows the dynamic tension on the warp yarn by keeping the loom running without inserting the shuttle, which shows during the change period of healds that the change in tension on the warp is smoother at the beginning and end part of the change period. The same behaviour is also reflected in Fig. 3 when tension is measured dynamically during normal loom running. Highest tension values at beat-up zone and higher tension level at the bottom position of heald as compared to that at top position is in accordance with the findings of Talukder.

When comparative breakage rate with both types of cam is studied (Table 1), it is observed that the breakage rate is comparatively lower by more than 8% in case of cycloidal cam. This is because of the fact that the smoother cam follower movement at the starting and finishing zones enables better stress distribution of the warp yarn.

It is concluded that the tension on the warp yarn is marginally smoother in case of cycloidal cam as compared to that in case of simple harmonic cam. Breakage rate of warp yarn is found to be comparatively lower in case of cycloidal cam as compared to that in case of simple harmonic cam, but the large scale trial is required to substantiate the fact.

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References