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Comparison of Heald Frame Motion Generated by Rotary Dobby and Crank & Cam Shedding Motions

Abstract
Mechanism models are introduced for rotary dobby, crank & cam shedding motions. Equations governing heald frame motion are derived. Heald frame motion curves are obtained and compared with each other. It is shown that higher heald frame maximum velocity & maximum acceleration, as well as a longer approximate heald frame dwell, are generated by the rotary dobby rather than the crank or cam shedding motions, due to the intermittent nature of the rotary dobby shaft's motion.

Key words: *rotary dobby, cam shedding motion, crank shedding motion, weaving, weaving machine.*

Introduction

Shedding is one of the principal operations in the weaving process, which separates warp yarns into two layers to form an opening for weft insertion called a shed. Crank, cam and dobby are shedding motions which use a heald frame system for lifting warp yarns up or down to form a shed. Crank and cam shedding motions are mainly used on high-speed air-jet and water-jet weaving machines for weaving fabrics with plain and basic weaves. Despite the widespread use of negative dobby on air-jet and water-jet looms in industry, the use of rotary dobby (i.e., positive dobby) with air-jet looms has been widened in recent years, due to the increase in rotary dobby running speeds. An increase in loom speeds imposes higher demands on heald frame design, due to the increase in inertial forces. New heald frame designs which can resist higher mechanical stresses have been developed and demonstrated in the exhibitions, and used especially on high-speed air jet weaving machines.

Heald frame motion characteristics, and therefore the inertial forces affecting heald frames, differ depending on the type of shedding motion. This is of importance in designing the heald frames to be used with different type of shedding motions. No publication was found in the literature of a comparative study of heald frame motion characteristics of different type of shedding motions. This paper deals with heald frame motion characteristics generated by crank, cam and rotary dobby shedding motions. Mathematical equations are derived, and the heald frame's displacement, velocity and acceleration are calculated and compared with each other according to the heald frame dwell period, the maximum heald frame speed and the maximum heald frame acceleration.

Working principle of crank, cam and rotary dobby shedding motions

Figure 1 shows a schematic view of the crank shedding motion. It consists of a crank rocker mechanism (A_0ABB_0) and a slider crank mechanism (B_0CD). The crank (link 2) rotates at half of the loom's speed. The crank's continuous rotation is transmitted to link 4 by link 3. During one revolution of the crank, link 4 swings between its foremost and rearmost positions. The slider crank mechanism converts the angular displacement of link 4 to the linear displacement of the heald frame. The foremost position of link 4 corresponds to the bottom position, and the rearmost position of link 4 corresponds to the upper position of the heald frame. Heald frames change position in each loom revolution, and therefore the crank's shedding motion generates a heald frame motion only for plain weave.

Figure 2 shows a cam shedding motion, which consists of a double shedding cam (2 and 2'), an oscillating follower (link 4)

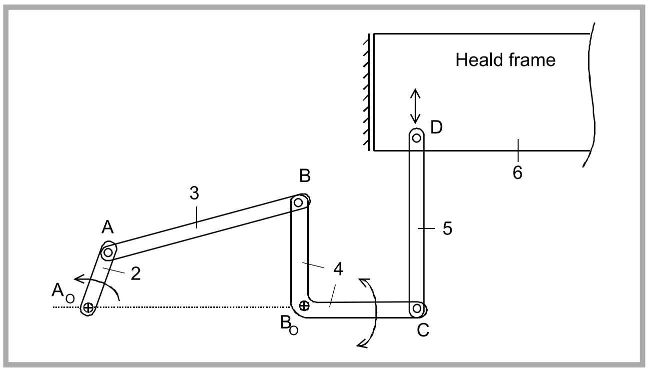

Figure 1. Crank type of shedding motion; A_0ABB_0 - crank rocker mechanism, B_0CD - slider crank mechanism, 2 - crank, 3, 4, 5 - links, 6 - heald frame.

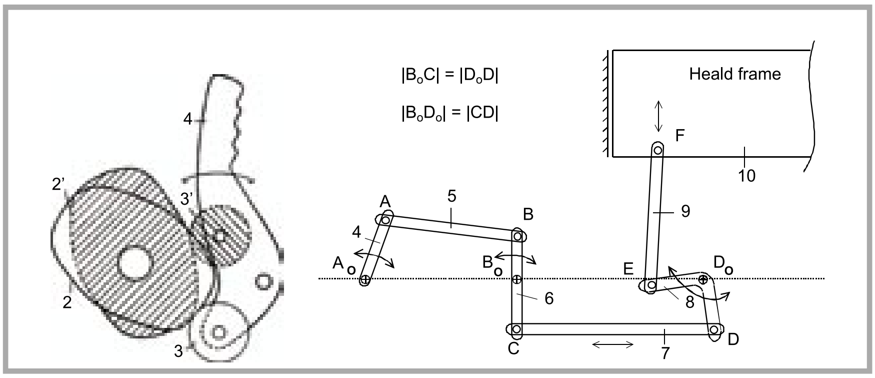

Figure 2. Positive cam shedding motion; the first drawing was taken from ref. [1]; A_0ABB_0, B_0CDD_0 - four bar mechanisms; D_0EF - slider crank mechanism, 2, 2' - double shedding cam; 3, 3' - rollers; 4 - oscilating follower; 5, 6, 7, 8, 9 - links; 10 - heald frame.

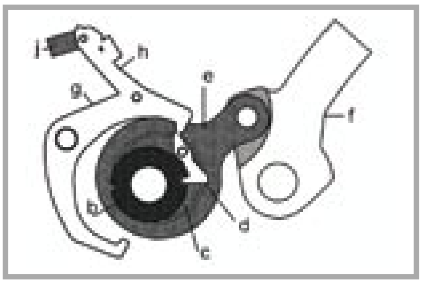

Figure 3. Fimtextile Type RD 3000 rotary dobby cross-section [2]; b - link fixed to dobby shaft; c - eccentric link; d - metal piece; e, f, g, h - links; j - electromagnet.

with two rollers (3 and 3') and a motion transmission mechanism to the heald frame. This type of cam shedding motion is called a positive cam shedding motion, in which both the upward and downward movement of heald frames are carried out by cams. There are as many double shedding cams and motion transmission mechanisms as there are heald frames. Each double cam has its own rollers, which are mounted on a common follower with a certain angle. When a cam continuously rotates in a clockwise direction, a follower swings in clockwise and counter-clockwise directions, and dwells at the end positions when necessary (depending on the weave). The clockwise rotation of the follower (link 4) causes link 6 to rotate in a clockwise direction also, and likewise the anticlockwise rotation of the follower (link 4) rotates link 6 in an anti-clockwise direction. The motion of link 6 is transmitted to link 8 by link 7. As $|B_0C|=|D_0D|$ and $|B_0D_0|=|CD|$, the motion of link 8 is the same as that of link 6. Finally, the motion of link 8 is transmitted to the heald frame (link 10) by link 9. Heald frames move upwards when the followers rotate clockwise and they are lifted down with the anticlockwise rotation of the followers. The followers' dwell at the end positions corresponds to the dwell of the heald frames at the upper and lower shed positions.

Figure 3 shows a rotary dobby cross section. Link b is fixed to the dobby shaft. A metal piece (d) is pivoted on the eccentric (link c) and can rotate around its pivot axis. A spring (not shown in the figure) forces the metal piece to rotate in the clockwise direction, and hence the metal piece presses on link b. There is a ball bearing between links b and c (not seen in the figure). There is also a ball bearing between link c and link e. Links g and h, the electromagnet (j) and the metal piece (d) constitute the pattern selection mechanism. Link g can rotate around its pivot by the action of the electromagnet (j) via link h. If link g is rotated in an anticlockwise direction, then the metal piece rotates in the clockwise direction, and its bottom tip becomes engaged in the groove on link b. If link g is rotated in a clockwise direction, it presses the upper tip of the metal piece and disengages it from link b by rotating the metal piece (d) in an anticlockwise direction. When the engagement happens, link f rotates in an anticlockwise direction during the 180° rotation of the dobby shaft (i.e., link 1). Link f dwells at its foremost position during the 180° rotation of the dobby shaft, if the engagement does not occur. The dobby shaft stops after every 180° degree rotation, and the pattern selection mechanism engages or disengages the metal piece with link b. If the engagement happens, then link f moves to the other position. Otherwise, it remains in the same position. The motion transmission mechanism of the cam shedding mechanism can also be used as a motion transmission mechanism for a rotary dobby. In this case, link f of the rotary dobby corresponds to link 4 of the motion transmission mechanism. The foremost position of link f of the rotary dobby corresponds to the higher position of a heald frame, and the rearmost position of link f corresponds to the lower position. As a result, the counterclockwise rotation of link g of the pattern selection mechanism corresponds to the higher position of the heald frames, and the clockwise rotation to the lower position.

In contrast to the continuous rotation at a constant speed of the drive shaft of the crank- and cam-shedding motions, the rotary dobby shaft has to rotate intermittently with 180° increments to allow the engagement or disengagement of the metal piece with link b. A mechanism called the 'modulator' is used to convert the continuous rotation of a loom main shaft to the intermittent movement of the rotary dobby shaft.

Derivation of equations for heald frame motion

The motion equation of a heald frame will be derived with respect to the loom's main shaft angle for each shedding motion as follows.

Crank shedding motion

The crank type of shedding motion consists of a crank rocker mechanism (A_0ABB_0) and a slider crank mechanism (B_0CD). Figure 4 shows parameters representing angular and linear positions of the links of crank rocker and slider crank mechanisms. The angular position of the link 4 (φ_4) is obtained with respect to angular position of the link 2 (φ_2) as follows [3].

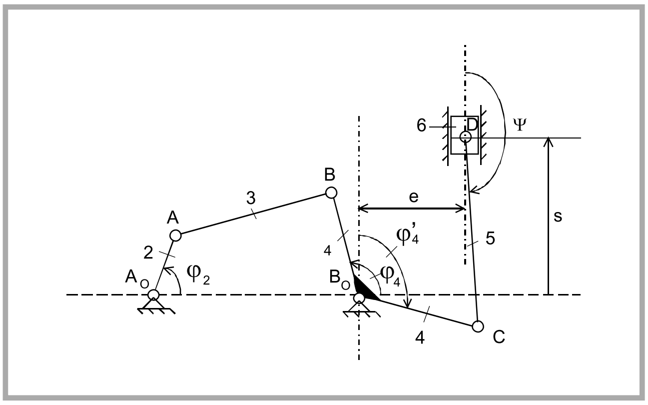

Figure 4. Parametric representation of crank shedding motion; A_0ABB_0 - crank rocker me-chanism, B_0CD - slider crank mechanism, 2 - crank, 3, 4, 5 - links, 6 - link representing heald frame; s - hold frame displacement.

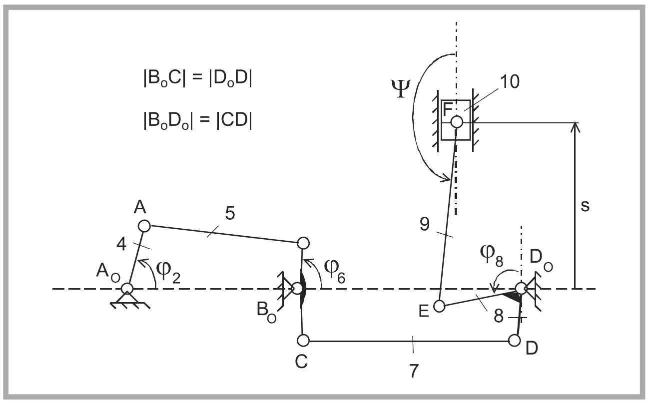

Figure 5. Parametric representation of motion transmission mechanism; A_0ABB_0, B_0CDD_0 - four bar mechanisms; D_0EF - slider crank mechanism; 7, 8, 9 - links; 10 - link representing heald frame; s - hold frame displacement.

$$\varphi_4 = 2\arctan\left(\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}\right) \quad (1)$$

where:

$a = (1-k_2)\cos\varphi_2 - (k_1 - k_3)$,

$b = -2\sin\varphi_2$,

$c = (k_1 + k_3) - (1 - k_2)\cos\varphi_2$

and

$k_1 = r_1/r_2$, $k_2 = r_1/r_4$ and

$k_3 = (r_2^2 - r_3^2 + r_1^2 + r_4^2)/(2r_2r_4)$

r_1, r_2, r_3 and r_4 are the link lengths of the crank rocker mechanism defined as follows:

$r_1 = |A_0A|$, $r_2 = |AB|$, $r_3 = |B_0B|$, and $r_4 = |A_0B_0|$.

Equations 2 and 3 are kinematic analysis equations of the slider crank mechanism which relate the heald frame displacement (s) the to angular position of link 4 (φ'_4) [3].

$$\Psi' = \sin^{-1}\left(\frac{r'_4 \sin\varphi'_4 - e}{r_5}\right) \quad (2)$$

$$s = r'_4 \cos\varphi'_4 + r_5 \cos\Psi' \quad (3)$$

where r_4' and r_5 are link lengths of the slider crank mechanism defined as follows.

$r_4 = |D_0E|$ and $r_5 = |EF|$, φ_4', Ψ, s, are e are other parameters of the slider crank mechanism shown in Figure 4. Considering that the crank (i.e., link 2) rotates at half of the loom speed, the heald frame displacement can be calculated with respect to the loom's main shaft angle using equations 1, 2 and 3.

Cam shedding motion

In cam shedding motions, shedding cams convert the continuous rotation of the cam shaft to the swinging motion of the followers. This swinging motion is then transmitted to the heald frames by the motion transmission mechanism shown in Figure 5, which consists of two four-bar mechanisms (A_0ABB_0 and B_0CDD_0) and a slider crank mechanism (D_0EF). The followers 'motion depends on the weave. An analysis of heald frame motion will be carried out for plain weave in this work. The motion equation of a follower can be written as follows, for plain weave over two loom revolutions.

$\varphi_4 = f_{(\theta)}$ for $0 \leq \theta \leq \beta$ (4)

$\varphi_4 = \varphi_{40}$ for $\beta < \theta < 2\pi$ (5)

$\varphi_4 = \varphi_{40} - f_{(\theta - 2\pi)}$ for $2\pi \leq \theta \leq 2\pi+\beta$ (6)

$\varphi_4 = 0$ for $2\pi+\beta < \theta < 4\pi$ (7)

$$f_{(\theta)} = \frac{\varphi_{40}}{2}\left(1 - \cos\left(\frac{\pi\theta}{\beta}\right)\right) \quad (8)$$

(Simple harmonic motion curve)

$$f_{(\theta)} = \varphi_{40}\left(\frac{\theta}{\beta} - \frac{1}{2\pi}\sin\left(\frac{2\pi\theta}{\beta}\right)\right) \quad (9)$$

(Cycloidal motion curve)

where

θ : the loom's main shaft angle,

φ_4 : the angular displacement of a follower's arm from its rearmost position.

φ_{40}: the angular swing of a follower's arm between its rearmost and foremost positions.

β : the rotation angle of the loom's main shaft through which the follower's arm swings in a clockwise or anticlockwise direction. This also corresponds to the movement period of the heald frames.

Four-bar mechanisms of motion transmission system

The first four-bar mechanism (A_0ABB_0) of the motion transmission system is shown in Figure 5. The angular position of link 6 (φ_6) is obtained as follows, with respect to the angular position of link 4 (φ_4') [3].

$$\varphi_6 = 2\arctan\left(\frac{-B \pm \sqrt{B^2 - 4AC}}{2A}\right) \quad (10)$$

where:

$A = (1-K_2)\cos\varphi_4 - (K_1 - K_3)$,

$B = -2\sin\varphi_4$,

$C = (K_1 + K_3) - (1 + K_2)\cos\varphi_4$

and

$K_1 = r_7/r_4'$, $K_2 = r_7/r_6$ and

$K_3 = (r_4'^2 - r_5^2 + r_7^2 + r_6^2)/(2r_4r_6)$

r_4', r_5, r_6 and r_7 are the link lengths of the four-bar mechanism of the motion transmission system, defined as follows.

$r_4' = |A_0A|$, $r_5 = |AB|$,
$r_6 = |B_0B|$, and $r_7 = |A_0B_0|$.

B_0CDD_0 is the second four-bar mechanism which transmits motion from link 6 to link 8. This is a special type of four-bar mechanism in which the lengths of opposite links are equal to each other, i.e. $|B_0C| = |D_0D|$ and $|B_0D_0| = |CD|$. For this reason, the angular displacement, angular velocity and angular acceleration are the same for links 6 and 8.

Slider crank mechanism of motion transmission system

The slider crank mechanism (D_0EF) shown in Figure 5 converts the angular movement of link 8 to the linear displacement of link 10 which represents a heald frame. Equations 12 and 13 are kinematic analysis equations which relate heald frame displacement (s) to the angular position of link 8 (φ_6') [3].

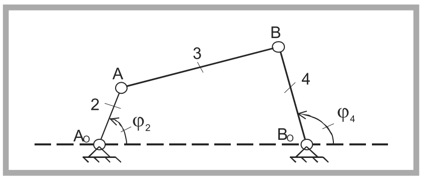

Figure 6. *Crank rocker mechanism; designations as in Figure 4.*

$$\Psi' = \sin^{-1}\left(\frac{r_8 \sin\varphi_8 - e}{r_9}\right) \quad (11)$$

$$s = r_8 \cos\varphi_8 + r_9 \cos\Psi \quad (12)$$

where r_8 and r_9 are link lengths of the slider crank mechanism defined as follows.

$r_8 = |D_0E|$ and $r_9 = |EF|$, φ_8, Ψ, s and e are other parameters of the slider crank mechanism defined in Figure 5.

Heald frame displacement is obtained with respect to the loom's main shaft angle, using equations 4 to 12 to obtain the positive cam shedding motion.

Rotary dobby

The rotary dobby shaft's displacement diagram can be expressed mathematically over two loom revolutions as follows.

$\varphi_2 = f_{(\theta)}$ for $0 \leq \theta \leq \beta$ (13)

$\varphi_2 = \pi$ for $\beta < \theta < 2\pi$ (14)

$\varphi_2 = \pi - f_{(\theta - 2\pi)}$ for $2\pi \leq \theta \leq 2\pi+\beta$ (15)

$\varphi_2 = 2\pi$ for $2\pi+\beta < \theta < 4\pi$ (16)

$$f_{(\theta)} = \frac{\pi}{2}\left(1 - \cos\left(\frac{\pi\theta}{\beta}\right)\right) \quad (17)$$

(Simple harmonic motion curve)

$$f_{(\theta)} = \pi\left(\frac{\theta}{\beta} - \frac{1}{2\pi}\sin\left(\frac{2\pi\theta}{\beta}\right)\right) \quad (18)$$

(Cycloidal motion curve)

In these equations;

θ : the angle of rotation of the loom's main shaft.

φ_2 : the angle of rotation of the modulator output shaft or the rotary dobby shaft.

β : the angle of rotation of the loom's main shaft, within which the modulator output shaft or dobby shaft completes the 180° rotation.

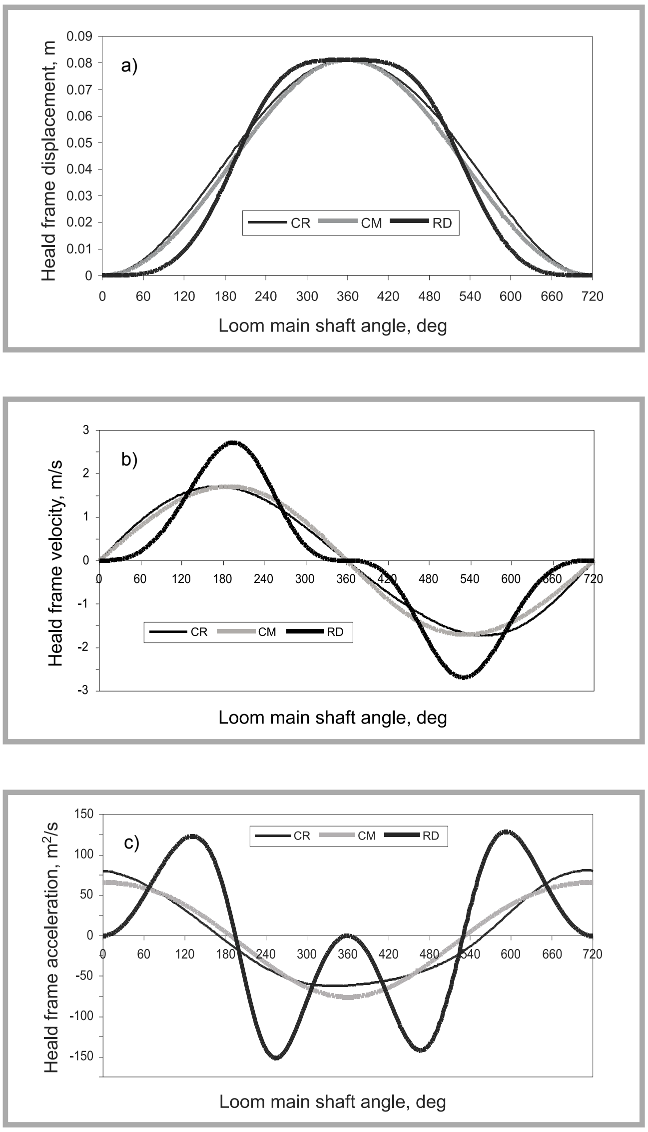

Figure 7. *Heald frame displacement (a), velocity (b) and acceleration (c) diagrams without absolute dwell; CR: crank shedding motion, CM: cam shedding motion, RD: rotary dobby.*

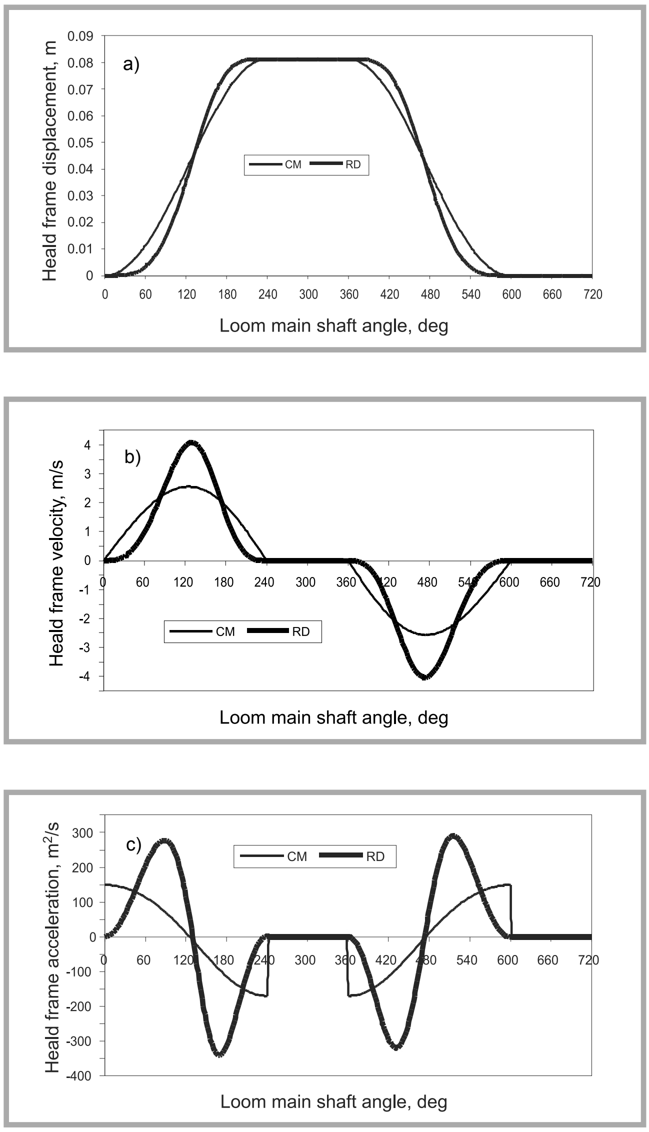

Figure 8. *Heald frame displacement (a), velocity (b) and acceleration (c) diagrams with 120^0 absolute dwell; CM: cam shedding motion, RD: rotary dobby.*

$f_{(\varphi)}$: the motion curve for modulator output shaft (or rotary dobby shaft). Two known motion curves, namely of simple harmonic motion and cycloidal motion, are used in this work to analyse the heald frame's motion characteristics.

Eccentric mechanism of rotary dobby

The crank rocker mechanism shown in Figure 6 is the kinematic equivalent of the eccentric mechanism of a rotary dobby. The angular position of link 4 (φ_4) is obtained with respect to the angular position of link 2 or the dobby shaft (φ_2), as in the crank rocker mechanism of crank type of shedding motion using equation 1.

As the motion transmission mechanism of the rotary dobby is the same as that of the cam shedding motion, equations 10 to 12 are also used for the motion transmission mechanism of rotary dobby. Hence, a heald frame displacement can be calculated with respect to the loom's main shaft angle for a rotary dobby using equations 13 to 18, equation 1 and equations 10 to 12.

The velocity and acceleration equations of a heald frame can be derived by taking the first and second derivative of heald frame motion equations for each shedding motion. They are not given here, but the velocity and acceleration curves of a heald frame are presented in graphic form and the approximate heald frame dwell period, the maximum heald frame speed and the maximum heald frame acceleration are given in Table II.

Results and discussion

The heald-frame motion characteristics generated by a rotary dobby are analysed by using three different dobby shaft motion displacement diagrams, in which te rotary dobby shaft completes its 180° rotation over 360°, 300° and 240° of a loom revolution. Similarly, the heald frame motion characteristics produced by a cam shedding motion are analysed for three different follower displacement diagrams, in which the followers change position over 360°, 300° and 240° of a loom revolution. Heald frames are given 60° and 120° absolute dwell in the case of 300° and 240° motion periods, whereas no absolute heald frame dwell is obtained with the 360° motion period when plain weave is used. As the heald frame motion periods are same for all weaves, the heald frame motion characteristics presented in this part apply to all weaves.

The link lengths of three shedding mechanisms are given in Table 1. The loom speed was taken as 800 rev/min. When link 4 of crank shedding mechanism is at its foremost position, φ_6' was taken as 115°. When the heald frame is at the lower shed position φ_8 and φ_4' were taken as 115° and 80° respectively in the motion transmission mechanism for cam and rotary dobby shedding mechanisms.

Figure 7a shows the heald frame displacement diagrams of three different shedding motions for plain weave over two loom revolutions without any dwell within one loom revolution. Both the follower motion in the cam shedding motion and the rotary dobby shaft motion in the rotary dobby have been chosen as simple harmonic motion. As is clearly seen from the curves, the heald frame motion of the rotary dobby differs significantly from those of the crank and cam shedding motions, whereas the crank and cam shedding motions generate heald frame motions very similar to each other. The heald frame motion of the rotary dobby has a longer approximate dwell at the bottom and upper shed positions. This is shown more clearly with the heald frame speed and acceleration curves in Figure 7b and Figure 7c. Both the maximum heald frame speed and maximum heald frame acceleration are much higher with the rotary dobby than the crank and cam shedding motions.

Similar heald frame motion characteristics are observed in Figure 8a, Figure 8b and Figure 8c in which 240° of a loom revolution is used for the heald frame motion and 120° for the heald frame dwell. As a part of the loom revolution is reserved for the heald frame dwell, the maximum heald frame speed and maximum heald frame acceleration increase significantly. In this case, too, the rotary dobby generates a much higher heald frame maximum speed and maximum acceleration, compared to the cam shedding motion.

Table 2 shows the approximate heald frame dwell period (5% dwell period), the maximum heald frame velocity and the maximum heald frame acceleration in more detail for crank, cam and rotary dobby shedding motions with three different heald frame motion-dwell periods. The terms 'simple harmonic (SHM)' and 'cycloidal (CYCL)' in the tables refer to the follower and rotary dobby shaft motion curves for the cam and rotary dobby shedding motions.

With a 360°motion period, the crank and cam shedding motions generate maximum heald frame speed and acceleration which are very close to each other, but much lower than the rotary dobby in the case of the simple harmonic follower and rotary dobby shaft motion curve. When the cycloidal motion curve is used as a follower motion of the cam shedding motion and rotary dobby shaft motion, the cam shedding motion produces a higher maximum heald frame speed and maximum heald frame acceleration compared with the crank shedding motion. In this casealso, the maximum heald frame speed and acceleration with the rotary dobby are much higher than the cam shedding motion.

In the case of 60° and 120° heald frame dwell periods, the data for crank shedding motion is not included in the table, as it is not possible to obtain a heald frame dwell with it. An analysis of the maximum heald frame speed and heald frame acceleration reveal that the maximum heald frame speed increases in proportion to (360/motion period), and the maximum heald frame acceleration increases in proportion to $(360/\text{motion period})^2$. The rotary dobby generates a higher maximum heald frame speed and maximum heald frame acceleration, compared with the cam shedding motion with both dwell periods for both the simple harmonic and cycloidal motion curves. A comparison of the maximum heald frame speed and maximum heald frame data in the table shows that the maximum heald frame speed is about 60% higher and maximum heald frame acceleration is about 100% higher with the rotary dobby than the cam or crank shedding motions with both motion curves for the same heald frame motion or dwell periods. Although some deviations can occur from these values, depending on the design of the linkages in the mechanisms and the motion curves chosen for the follower motion in the cam shedding mechanism and rotary dobby shaft, the data in the table reflects the general level of the maximum heald frame speed and the maximum heald frame acceleration.

The 5% dwell period of a heald frame is also shown in the table for three shedding motions. The 5% dwell period of a heald frame is defined as the degree of rotation of the loom's main shaft, during which a heald frame moves 5% of its total displacement before and after its bottom and top positions. This is an approximate heald frame dwell period during which the shed is largely open. As seen in Table 2, the rotary dobby produces a much longer 5% dwell periods than do the cam and crank shedding motions. Also, a longer 5% dwell period is obtained

Table 1. *The link lengths in three shedding mechanisms.*

Crank shedding mechanism link lengths, in mm										
r_1	r_2	r_3	r_4	r_4'	r_5	e	-	-	-	-
300	39,3	221,7	205,9	220.0	400.0	200.0	-	-	-	-
Rotary dobby eccentric mechanism link lengths, in mm										
r_1	r_2	r_3	r_4	-	-	-	-	-	-	-
300	39,3	221,7	205,9	-	-	-	-	-	-	-
Motion transmission mechanism link lengths, in mm										
r_1	r_2	r_3	r_4	r_4'	r_5	r_6	r_7	r_8	r_9	e
300	39,3	221,7	205,9	192.0	420.0	200.0	400.0	220.0	400.0	200

Table 2. *Heald frame motion characteristics.*

Heald frame motion	Parameter	No dwell		60⁰ dwell		120⁰ dwell	
		SHM	CYCL.	SHM	CYCL.	SHM	CYCL.
Crank shedding motion	5% dwell, deg.	106	-	-	-	-	-
	V_{max}, mm/s	172.4	-	-	-	-	-
	a_{max}, mm/s^2	8052	-	-	-	-	-
Cam shedding motion	5% dwell, deg.	104	145	146	182	190	218
	V_{max}, mm/s	170.7	217.2	204.9	260.6	256.0	325.8
	a_{max}, mm/s^2	7572	9400	10 904	13 537	17 036	21 153
Rotary dobby	5% dwell, deg.	180	215	210	239	240	262
	V_{max}, mm/s	271.5	344.9	325.9	413.9	407.4	517.3
	a_{max}, mm/s^2	15 116	23 887	21 766	34 401	34 001	53 690

SHM: Simple harmonic motion curve, CYCL.: Cycloidal motion curve, V_{max}: Maximum heald frame speed, a_{max}: Maximum heald frame acceleration.

with a cycloidal motion curve than with a simple harmonic motion curve. Even if there is no dwell in the rotary dobby shaft motion, a sufficient amount of 5% heald frame dwell (which is suitable for many type of looms) is obtained with the rotary dobby. This is especially important for high speed air-jet and water-jet looms to reduce heald frame acceleration, and therefore the inertial forces, while leaving a sufficient amount of shed openness for weft insertion.

The results presented in this part show that there is a distinctive difference in heald frame motion generated by a rotary dobby and the crank & cam shedding motions. This is due to the intermittent movement of the rotary dobby shaft, in contrast to constant speed and continuous shaft motion of the crank and & cam shedding mechanisms. In fact, the negative dobby, the Hattersley dobby and jacquard shedding motions also have a constant drive shaft speed, and they therefore generate heald frame or heald motion similar to crank & cam shedding motions. As a result, it can be concluded that the rotary dobby generates a heald frame motion with a longer approximate dwell period, a higher maximum speed and a higher maximum acceleration than other type of shedding motions, even without any dwell in the rotary dobby shaft's movement.

Conclusion

The rotary dobby differs from other type of shedding motions in that its shaft moves intermittently in 180° increments. This causes the rotary dobby to generate a much higher maximum heald frame speed and maximum heald frame acceleration compared with other type of shedding motions. Because of this, higher mechanical stresses affect heald frames, especially when a rotary dobby is used on high-speed air-jet or water-jet looms. This should be taken into account in designing heald frames to be used with different type of shedding motions and weaving machines.

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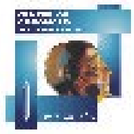

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- prof. Lucjan Pawlicki, Ph.D., D.Sc., Med., Research Hospital of the Medical University of Łódź;
- prof. Janusz Rosiak, Ph.D., D.Sc., (TU-Łódź);
- prof. Janusz Szosland, Ph.D., D.Sc., (TU-Łódź);
- Józef Tazbir D.Sc. Med., "M. Kopernik" Specialist Hospital, Łódź;
- Jan Wojtysiak, Ph.D., D.Sc., Eng., Institute of Teratechnology, Łódź

Organising Committee:
Chairman: Bogdan Ignasiak, Ph.D.
Secretary: Sławomir Sztajnowski M.Sc.

Conference topics

- Textiles in medicine and therapeutics
- Biomaterials: structures and application
- Bioactive and biodegradable fibres

Conference language: English

An exhibition will be organised together with the Conference. Medical and rehabilitation apparatuses and equipment, as well as medical products will be presented.

For more information please contact:

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