WOOD HARVESTING
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DEVELOPMENT OF FERIC'S SELF-RELEASING CHOKER HOOK

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Abstract

An effective self-releasing choker hook should improve productivity and safety by reducing both the time to unhook in the landing and the chaser's exposure to hazard. FERIC has developed a modification to the conventional hook configuration and patented a simple, mechanical, self-releasing choker hook for cable yarding. Choker release is activated by the changing direction of pull that occurs when the operator lands the turn and begins to send the rigging back into the cutblock. Field evaluations on cable yarding operations in British Columbia, Washington State and Norway have demonstrated productivity increases exceeding 10%.

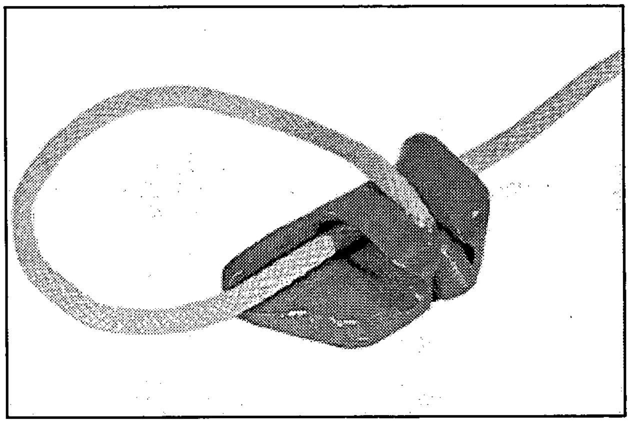

Figure 1. The Eastern Division's first model of a self-releasing choker.

Introduction

In cable yarding operations, the manual release of conventional chokers can be time consuming and hazardous when landing logs on high or unstable log decks. The close coordination required between the chaser and yarder operator during choker release compounds the hazard. The safety and operational benefits of a self-releasing choker hook are clear, and have been the subject of continued interest in the forest industry.

One innovative approach was the 1986 introduction of Johnson Industries Ltd.'s radio-controlled choker hook (Peterson 1987), which enabled machine operators to remotely release a landed log. Although this reduced the exposure of the chaser to hazard, the hardware was expensive and the initial reliability was limited.

In 1993, FERIC's Eastern Division experimented with the concept of releasing the hook by reversing the pull on the choker cable. A patent was applied for and several models (Figure 1) were evaluated with limited success on ground-based skidders.

FERIC's Western Division recognized the potential for high-lead cable systems and initiated a project to address this application. The objectives were to build and test a number of prototypes leading to a simple design; produce them in sufficient quantities for an extensive field evaluation; and quantify operational advantages, limitations and reliability through field testing.

Methodology

In order to develop the concept for cable yarding applications, the researchers experimented with some

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alternative configurations, and initially tried to retain the one-piece simplicity of the original concept. The addition of a simple detent mechanism produced some encouraging results. However, operational inconsistency prevailed, and a more precise latching mechanism was required to control and define the point of release.

A series of prototypes was fabricated, and eventually a reliable, efficient and simple design evolved. One important feature was the close resemblances to the conventional choker hook in form and function.

Castings were produced, and 100 hooks were assembled in the size range that could utilize 10- to 16-mm-diameter wire ropes. These chokers were evaluated on yarding and thinning operations throughout British Columbia and Washington State, and on one operation in Norway. Some ground-based applications were also tried in B.C. and Quebec.

Five larger hooks, for 19- to 25-mm-diameter cables, were also fabricated with the same proportions as the smaller hooks. These large hooks were evaluated on three different high-lead operations in coastal B.C.

The technology was displayed at a number of forestry trade shows. Since it is FERIC's intention to engage the participation of manufacturers in future production, patent applications covering all aspects of the technology were filed in Canada and the United States, and a preliminary market evaluation was made.

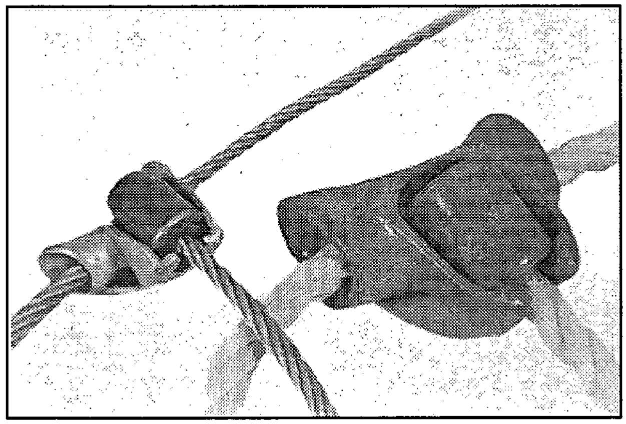


Figure 2. The Western Division's first models of a self-releasing choker.

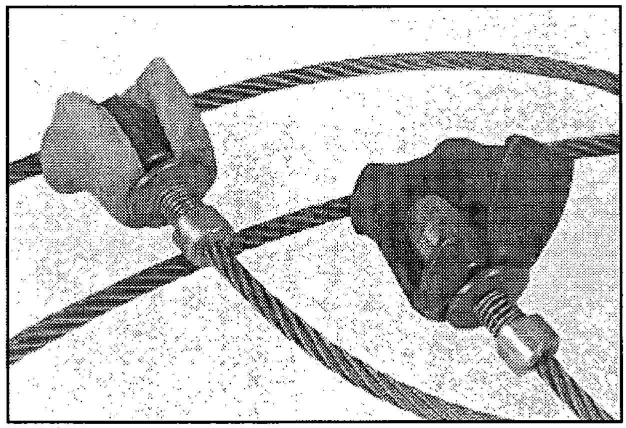


Figure 3. Addition of a coil spring.

Prototype Development

Basic Hypothesis

The initial hypothesis for FERIC's self-releasing choker hook was that the knob would drop out of a suitably shaped pocket as the direction of rigging pull was reversed and the hook was inverted. This hypothesis was successfully tried using a mock-up of a hook and a vinyl rope (Figure 2). However, when steel cable was used, its greater stiffness and elasticity caused the knob to prematurely slide out of the pocket. A coil spring, placed behind the knob (Figure 3), generated enough friction to prevent this and the problem was solved.

Initial Field Tests

Late in 1994, a number of chokers, with 10- to 16-mm-diameter cables, were assembled and tested on a commercial thinning application in the Greater Vancouver Regional District's Seymour Watershed operation. The results were encouraging. After a short adjustment period, the crew was receptive to the new hooks and the operator soon became proficient at making them release in the landing. However, small or limby pieces sometimes required manual release.

Unlike the conventional hook, the new hook was not symmetrical. It was supplied in either a left or right handed configuration to accommodate the technique of rolling a log in either direction to by-pass obstacles (i.e., fight hang-ups). This required some adjustment on the part of the chokersetters.

The new hooks were then tried on larger wood, ranging up to 50 cm in diameter, near Sechelt, B.C. The larger log diameter altered the direction of cable tension on the knob, causing the knob to ride out of the hook pocket and disengage prematurely. Also, the hook was not strong enough for the heavier wood. Modifying the hook produced marginal improvement, but decreased the ability to effectively disengage smaller pieces. In short, the design was incapable of consistent performance over a wide range of log diameters.

The point of hook disengagement was subject to too many variables and the release function required a more consistent and defined initiator. These factors suggested the need for a latching mechanism with specific proportions to define the point of release, regardless of the log's weight or diameter.

Latch Concept

Rudimentary to the latching concept were two elements: the latch and the hook body. The relative movement of these two elements would alternately capture and release a standard choker knob. The latch would be spring-biased in the closed, or knob-retention, position. Also, the choker would be set without opening the latch. An appendage on the latch would bear down on the log's surface during hook roll-over, triggering the latch release.

These were the design objectives that initiated the next stage of development. Several designs were fabricated and field tested (Figure 4).

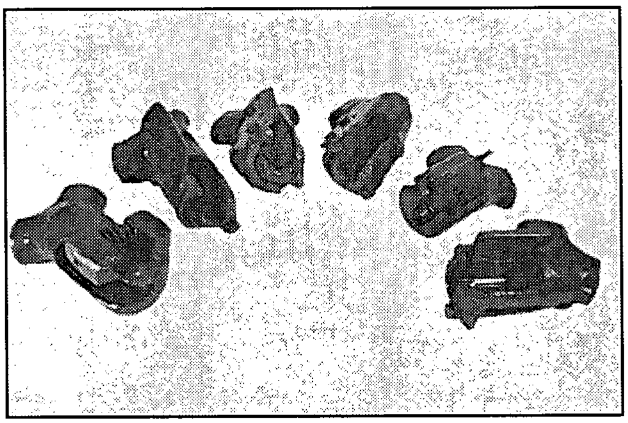


Figure 4. Early prototypes of the latched configuration.

Final Evolution

Initially, compression coil springs were preferred for latch biasing because of their low cost and high availability. Several prototype configurations were fabricated, field tested and subsequently rejected due to shortcomings in durability, serviceability, ease of production and size.

One of the latter configurations (Figure 5) featured a coil spring in torsion about the latch pivot pin. This design required that the knob and cable be backed into the hook pocket, a departure from the usual practice of inserting the knob nose-first. Although initially thought to be of minor importance, this feature proved to be a significant impediment to setting the choker. After use, kinks developed at the end of the cable, which could make backward insertion arduous.

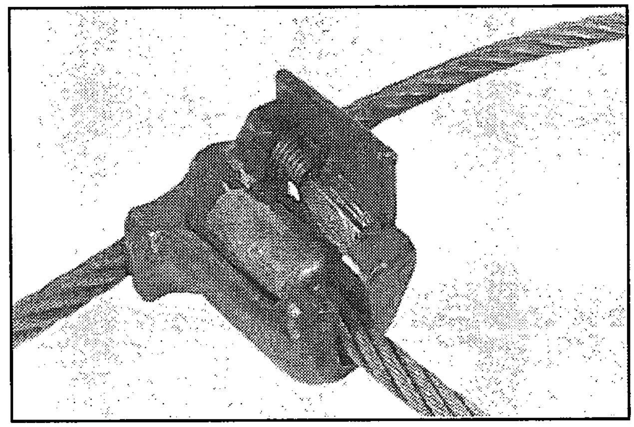


Figure 5. The forerunner to the final design.

The final design (Figure 6) was initially fabricated from a conventional hook. By this time, the resemblances in form and function to the conventional hook were considered essential to acceptance of the new device.

As in the previous design, the size of the latch was minimized. Also, this was the first time that a torsion spring, coaxial with the pivot pin, was used as a latch bias (Figure 7). As this spring was totally enclosed, it

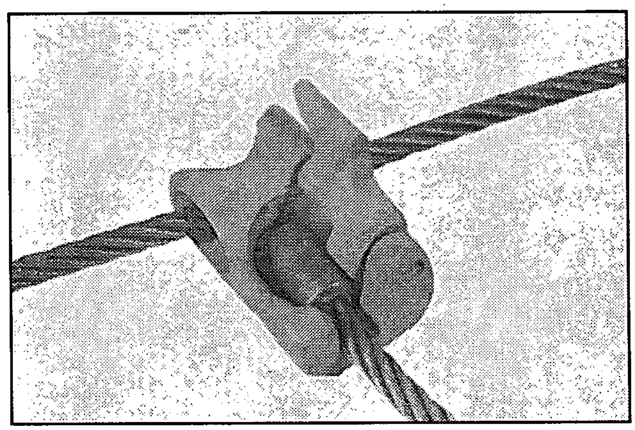


Figure 6. The final design.

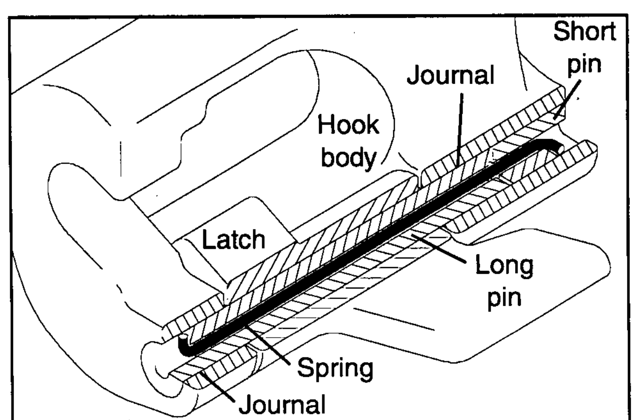


Figure 7. The spring and pivot pin assembly.

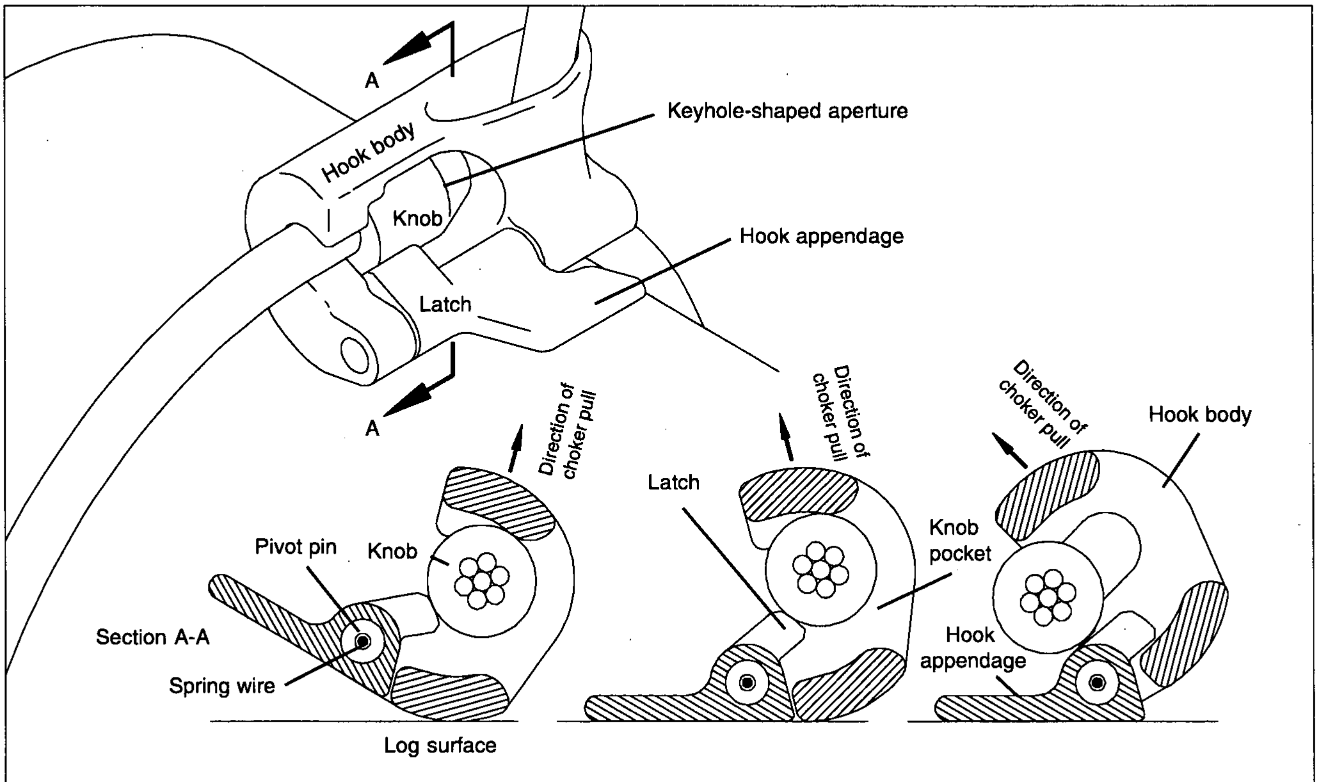
was impervious to external damage. Also, its cost was negligible since it was cut to length from spring wire. Installation required no special tooling, and it was easily serviced. An important requirement was that the spring wire be long enough and of the proper diameter, for sufficient biasing and movement in the latch. This was the main determinant of the length and bulk of the pivot-pin assembly.

The geometry of the knob pocket and the latch (Figure 8) was the key to setting the choker, and its release. In the closed position, the latch and hook body formed a keyhole-shaped aperture through which the knob was inserted in the traditional manner. As the choker tension was applied, the knob was secured between the hook body and a projection of the latch. The hook appendage was also part of the latch. Choker release occurred when the appendage, bearing down on the log surface, would cause the latch to rotate against its spring bias. This rotation also displaced the latch projection from its securing position against the knob, allowing the knob to slide free of the hook pocket. The choker release was coincidental with a 30° to 45° angle between the choker cable and the log.

Casting Procurement, Machining and Assembly

After field evaluating six fabricated prototypes, castings were procured for 100 hooks, for 10- to 16-mm-diameter cables. FERIC machined and assembled the cast prototypes in-house to determine baseline unit costing. Machining, final assembly and painting took slightly more than an hour per unit. Five hooks, for 19- to 25-mm-diameter cables, were also fabricated.

With permanent moulds, casting costs should be similar to those for the conventional hook. However, the self-releasing choker hook requires additional machining and assembly.



The Closed Position
During the inhaul phase, the spring-loaded latch prevents the knob from slipping out of the knob pocket.

Hook Appendage Contacts Log
Once the log has been landed and the yarder operator begins to send the rigging back, the changing direction of pull will rotate the hook and the hook appendage will make contact with the top of the log.

Knob Release
Further rotation of the hook causes the latch to pivot against the spring and allows the knob to slide out of the pocket. The choker is released from the log.

Figure 8. The knob-pocket geometry.

Serviceability

Unlike the conventional choker hook, the new design has moving parts which will require servicing. Occasional oiling of the pin assembly through the spring hole should minimize the accumulation of rust and other contaminants. The pins are heat treated for maximum strength. Nevertheless, an excessive load may bend the pin, or the spring may fail. In this event, only five minutes are required to replace the pin assembly. FERIC has designed an illustrated pin-replacement kit for this purpose.

Field Evaluations

Most of the 100 cast hooks were tested in B.C. Six were sent to FERIC's Eastern Division and four were sent to Norway, while eight were tested by logging contractors in Washington State. The five larger fabricated hooks were tested at high-lead operations in B.C. near Squamish and Port McNeill.

The intent of FERIC's field evaluations was to determine if the hooks provided the user with any benefits over the conventional hooks, and what operating factors made the hooks most effective, marginally effective and inappropriate. For this study, effectiveness is defined as consistent self-release with a minimum number of premature releases.

During the field evaluations, researchers collected subjective feedback from the crews that used the self-releasing choker hooks, as well as detailed-timing data on the cycle elements of both conventional and self-releasing choker hooks. When the prototype chokers were distributed for field evaluation, FERIC researchers worked with the yarding crews to demonstrate the operation of the chokers and to inform the crews of safety issues regarding choker use. The researchers would usually spend the day observing how the crew adapted to the new hooks, and how other factors affected choker performance, such as terrain conditions, rigging configurations, landing size and slope, falling direction, and log size. Any detailed-timing surveys were conducted after the crews had adapted to the operational differences of the self-releasing choker hooks.

Detailed-timing evaluations occurred at four of the test sites. At two of these locations, cycle element times were monitored for the self-releasing choker hooks only. At the other two sites, one using small hooks and one using large hooks, comparative cycle times for both conventional and self-releasing choker hooks were recorded. At seven other test locations, researchers observed the operational characteristics of the choker hooks and noted any pertinent comments offered by the crews.

Detailed-Timing Studies

Boston Bar

At Boston Bar, B.C., the self-releasing choker hooks achieved a 9% cycle-time improvement over the conventional hooks, largely due to the shorter unhooking time (Table 1). Harvesting was a winter operation, using a Madill 009 yarder, in a steep, high-elevation, spruce–balsam stand with very small landings. The average tree size was 0.6 m^3. The small landings required a front-end loader to grasp the logs as they landed. Traditionally, this procedure exposes the chaser to hazard when the chaser unhooks the log. However, the self-releasing choker hook eliminated the need for the chaser's involvement, thus removing this hazard.

Boston Bar and Morton

Documentation of two similar operations, at Boston Bar and Morton, Washington, demonstrated an advantage to yarding tree length (Table 2). Both operations used Madill yarders, and the average tree size was 0.6 m^3. However, the Morton operation yarded tree-length stems

Table 1. Comparison of the Small Conventional and Self-Releasing Chokers at Boston Bar

Description	Conventional			Self-Releasing		
	Average time		Logs	Average time		Logs
	(min)	(%)	(no.)	(min)	(%)	(no.)
Cycle element						
Outhaul	0.35	8	--	0.50	13	--
Hook	1.95	47	--	1.79	47	--
Inhaul	0.63	15	--	0.75	20	--
Unhook	1.23	30	--	0.75	20	--
Total	4.16	100	--	3.79	100	--
Average logs per turn	--	--	5	--	--	5
Premature releases (no. of turns)	--	--	2(13)	--	--	3(29)

Table 2. Comparison of the Boston Bar and Morton Operations

Description	Boston Bar Average time (min)	Boston Bar Average time (%)	Boston Bar Logs (no.)	Morton Average time (min)	Morton Average time (%)	Morton Stems (no.)
Cycle element						
Outhaul	0.46	11	--	0.44	11	--
Hook	2.13	49	--	2.42	59	--
Inhaul	0.91	21	--	0.72	18	--
Unhook	0.83	19	--	0.48	12	--
Total	4.33	100	--	4.06	100	--
Average logs/stems per turn	--	--	2.5	--	--	3.1

Table 3. Comparison of the Large Conventional and Self-Releasing Chokers at Port McNeill

Description	Conventional Average time (min)	Conventional Average time (%)	Conventional Logs (no.)	Self-Releasing Average time (min)	Self-Releasing Average time (%)	Self-Releasing Logs (no.)
Cycle element						
Outhaul	0.78	16	--	0.71	15	--
Hook	2.25	44	--	2.47	53	--
Inhaul	0.63	13	--	0.86	18	--
Unhook	1.33	27	--	0.67	14	--
Total	4.99	100	--	4.71	100	--
Average logs per turn	--	--	5.25	--	--	2.70
Premature releases (no. of turns)	--	--	9(89)	--	--	22(62)

while the Boston Bar operation yarded logs. The unhooking time for the Morton operation was about half that for Boston Bar, due to the greater mass and stability provided by the tree-length pieces. Even with the tops forward, the stems did not backslide and did not upend, as they might have with smaller pieces. In other operations, backsliding and upending were also a problem when landings sloped steeply away from the yarder.

Port McNeill

The Port McNeill operation was the only test of the large hooks with detailed-timing data collected (Table 3). Using chokers with 22-mm-diameter cables, this operation demonstrated how the problem of premature release can negate any advantage of a shorter unhooking time and can force the crew to take greater care and more time to set the chokers. Multiple-log settings required extra care in all of the operations to ensure that the initial rigging pull did not adversely affect one or more chokers, causing them to release prematurely. At Port McNeill, this challenge was increased as the logs were poorly aligned to the inhaul direction, and most had to be gut choked (i.e., choker attached at or near the centre of the log) and swung on breakout. This situation also caused a high frequency of log breakage with both types of choker hooks.

The differences in outhaul and inhaul times between the conventional and self-releasing choker hooks were also due to different yarding distances.

Observations

The following operations were monitored without detailed timing in order to identify the conditions most conducive to efficient performance.

Boston Bar

At Boston Bar, the contractor harvested an area using the self-releasing choker hooks on the first pass, with second-pass cleanup using conventional choker hooks. In the first pass, the majority of the yarded pieces were sawlogs. The cleanup brought in mostly pulpwood and thus facilitated partial sorting. Relieved from the unhooking process, the chaser could concentrate more on bucking and delimbing. The self-releasing choker hooks failed to disengage on a few occasions. This was corrected by kicking the latch; even this was simpler and faster than the conventional unhooking process. The result was a better-organized operation, reduced breakage and improved productivity.

Princeton

An RMS Ecologger and a Christy carriage were used in a lodgepole pine salvage permit operation in Princeton, B.C. This operation demonstrated the benefits of the self-releasing choker hooks in uphill yarding with large landings. Gravity return of the carriage triggered the release. Despite a high number of premature releases, productivity improved due to an increase in the number of turns during the shift.

Prince George

East of Prince George, B.C., on a subalpine fir–spruce site, the self-releasing choker hooks were used to bunch wood at the back end of a Madill 122 swing-yarder operation prior to grapple yarding to roadside. On the same machine in another setting, the self-releasing choker hooks were used exclusively and the chokersetters commented on the greater effort required to keep up with the higher productivity. This was a frequently repeated observation in other operations.

McBride, Merritt, Nakusp and Centralia

In operations using the Maki carriage, at McBride, Merritt and Nakusp, B.C., the effectiveness of the self-releasing choker hooks was hindered. Both cable clamps could not be simultaneously released to slack the dropline and return the carriage during the landing sequence. Consequently, the self-releasing choker hook could not be rolled sufficiently to initiate a release. Nevertheless, correcting this by kicking the latch open was still faster than the conventional method of choker release. In a later test, near Centralia, Washington, the Maki carriage was modified to cause a delay in the skyline clamp application. This allowed the carriage to run back while the turn was landed; self-release was then possible.

Longview

Use of the self-releasing choker hooks increased productivity in a thinning operation near Longview, Washington. This operation used a Koller 301 carriage. An adjustment, similar to that required with the Maki carriage, was made to allow a 4-m reverse of the carriage before application of the skyline clamp.

Kelsey Bay

It was originally thought that a large deflection in a cable yarding operation would require a long return of the carriage to initiate a release. This concern dissipated when testing on MacMillan Bloedel Limited's longline operation at Kelsey Bay, B.C. A short return of the carriage swung the long dropline with sufficient momentum to snap the choker free. The large deflection also required that the chaser be positioned well out of the way. The landing sequence typically required over two minutes, but was shortened to 30 seconds with the self-releasing choker hooks.

An obvious limitation of the self-releasing choker hook was steep downhill yarding, where a log, overrunning the choker, could provoke a premature release with the subsequent danger of a runaway log. The Kelsey Bay test demonstrated how a fully suspended turn eliminated this danger.

Norway

The Norwegian operation demonstrated how the precise control of a hydrostatically driven winch could assist the choker release, by maintaining tension on the choker while landing the log. This was in marked contrast to the usual practice of bouncing the log to shake the conventional choker loose. With the self-releasing choker hooks, bouncing is counterproductive to positioning the latching mechanism against the log to initiate the release.

Ground-Based Skidding

The results of limited testing with rubber-tired and tracked skidders in the Kootenays region of B.C. were disappointing. Bouncing the turn over rough skid trails induced choker entanglement and many premature releases. Also, the skidder operator's methods of reversing the pull direction, by either backing up or making a U-turn, were not very effective. Many turns required manual disengagement. While backing up, the skidder often over-ran and damaged the choker hooks. More extensive ground-based application testing by FERIC's Eastern Division produced better results as the operators' perseverance gave them a better understanding of the device and its characteristics.

Promotion and Technology Transfer

In the interest of technology transfer, FERIC has promoted the new hook at recent conventions and trade shows. Since the project's inception, member companies have also received periodic updates.

Involvement of manufacturers and the safeguard of their investment in product development is an important consideration. FERIC has sought comprehensive patent coverage in Canada and the United States. Manufacturers will also be assisted by market information that FERIC has accumulated during the course of this project.

Conclusions

FERIC has achieved its project objective of developing and testing a simple self-releasing choker hook. The resulting modification of the conventional choker hook is relatively modest when compared to the safety and potential productivity improvements.

Improved safety results from minimizing the chaser's involvement in the unhooking process. The application of the self-releasing choker hooks and the extent of improved productivity will be site-specific. Steep downhill yarding may pose the danger of runaway logs, and should be avoided unless the turn can be fully suspended.

Site and stand characteristics, as well as rigging and carriage operation, affect the success of the self-releasing choker hooks. Heavier pieces and large, flat landings were both conducive to an efficient release. By contrast, steep landings that slope away from the yarder could cause backsliding, particularly with light or limby stems, and prevent a quick release. The yarder operator must modify the landing technique to maintain choker tension around the log to ensure an effective release. With a skyline, the carriage must run back while slackening the dropline to trigger the release. This may require some control adjustment, as was the case with the Maki and Koller carriages.

Premature release was the greatest source of crew frustration and could easily negate any time saved in the landing. Extra care during hookup, particularly with multiple-log turns, is necessary to avoid a reverse pull on the chokers. Premature release was a more common experience with the larger hooks. Until this problem is corrected through engineering modifications, the usefulness of the large hooks will be questionable.

The moving parts of the new design will require maintenance. Rust and dirt contamination did not cause difficulty, and occasional oiling of the pin assembly through the spring hole should control any problems related to this contamination. Pin damage may be further reduced by better heat treatment during production, resulting in harder pins. FERIC has also prepared a pin replacement kit.

Limited ground-based testing by FERIC's Western Division has not produced rewarding results. However, FERIC's Eastern Division has had better results and shown that the development of the operator's skill is a major factor for success.

Final cost prognostication is highly speculative. With permanent moulds, casting costs should be similar to those for the conventional choker hook. However, the self-releasing choker hook requires additional machining and assembly, which may result in a final production cost that is roughly five to six times that of the conventional hook. This cost is offset by improved safety and the potential for increased productivity.

Recommendations

- FERIC should identify manufacturers capable of producing and marketing the new technology, and license the new technology to them. Initial production should focus on the smaller hooks.
- The present hook configuration should not be applied to ground-based skidding operations. However, FERIC should continue its efforts to adapt the technology to this application.
- The successful licensee should continue modifying and testing the larger hooks in an effort to improve their performance.

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