

Janus™ MK 2 – Engineering aspects of a modern online calender

Compared with conventional multi-roll calenders, the Janus™ MK 2 with its 45° inclined layout offers significant advantages for roll changing, accessibility, runnability, etc. Apart from these benefits, a good many details, decisively affecting reliability and efficiency, are not so obvious at first sight.



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The NipProtect™ system

To start with, nip security has been greatly improved with the NipProtect™ system, which includes a number of cylinders centrally integrated in the levers of the intermediate rolls (**Fig. 1**).

The purpose of these cylinders is twofold. During operation they balance out the overhung masses and to some extent the mass of the intermediate roll. This results in higher line loads in the upper nips, thus increasing the calendaring capacity for a given line load in the bottom nip. The degree of compensation depends on technological requirements, but is typically 85%.

Another patented function of these cylinders is fast roll nip-opening. When the bottom roll is lowered, all the intermediate rolls are lowered on the oil cushion of the compensation cylinders.

Each cylinder incorporates a throttle piston with a row of oil drain holes, so that the oil drainage cross-section is automatically adjusted according to cylinder stroke.

During opening, when the lowest intermediate roll has to move the greatest distance, the compensation cylinder is almost fully extended and nearly all the oil drainage holes are open.

The cylinder stroke reduces from bottom to top intermediate roll, and the number of open drain holes is less accordingly. During fast opening, the top intermediate roll therefore lowers more slowly than the one below, etc. Due to the different lowering speeds of the intermediate rolls, all nips open simultaneously in less than 0.5 seconds (**Fig. 2**). The further the rolls lower, the more oil drainage holes

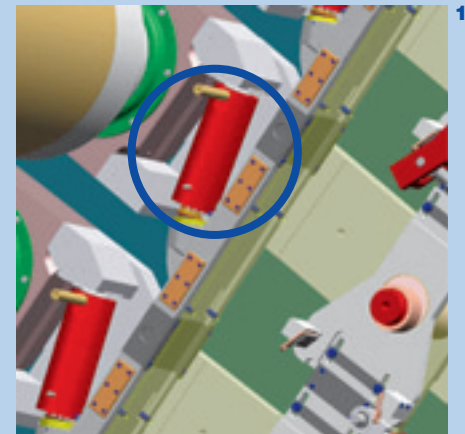


Fig. 1: Compensation cylinder.

Fig. 2: Compensation cylinder arrangement/function principle NipProtect™ system.

Fig. 3: Fast opening – new system (NipProtect).

Fig. 4: Fast opening – old system.

- Roll 2
- Roll 4
- Roll 7
- Roll 11

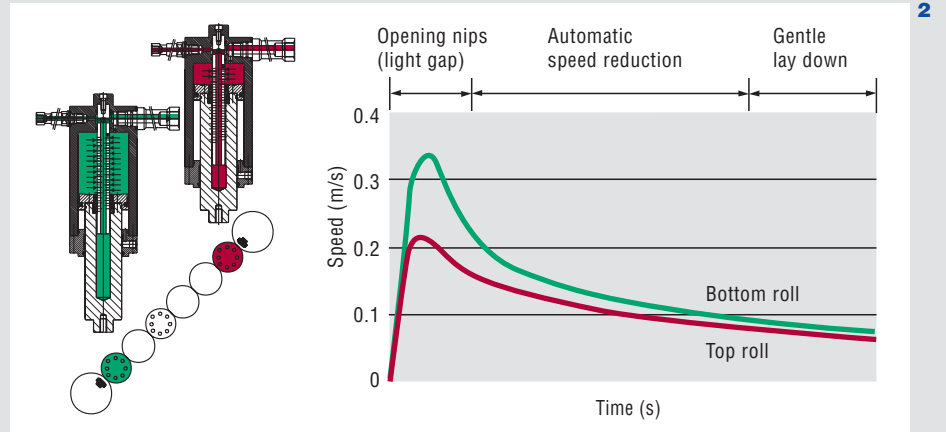
are closed, so that the lowering speed reduces accordingly. Finally, all the rolls are gently laid down on a mechanical stop (Fig. 2 and 3).

Fig. 4 shows conventional calender opening by comparison. During rapid opening, the intermediate rolls are laid down on mechanical stops one after the other from top to bottom. The bottom calender nip is the last one to open, thus leading to high structural loading.

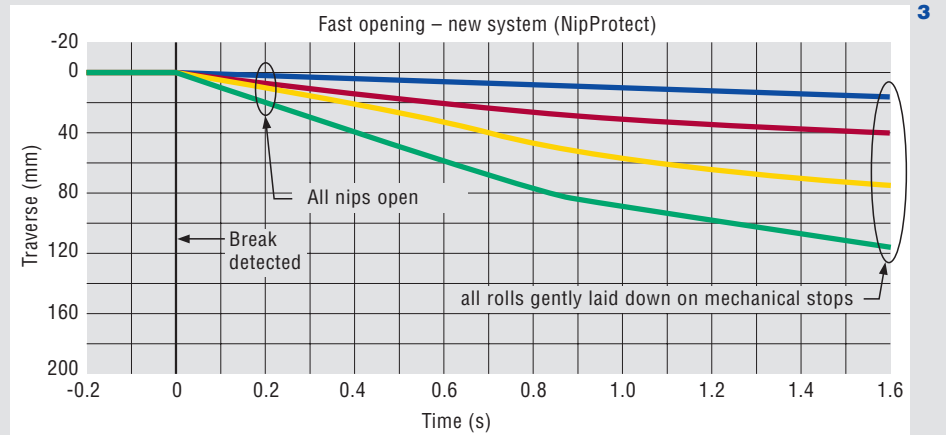
Since June 2000 the first NipProtect™ system has been operating very successfully in a 9-m Janus™ calender. Meanwhile ten calenders have been equipped with NipProtect™, thus demonstrating the confidence of our customers in this system.

Further advantages

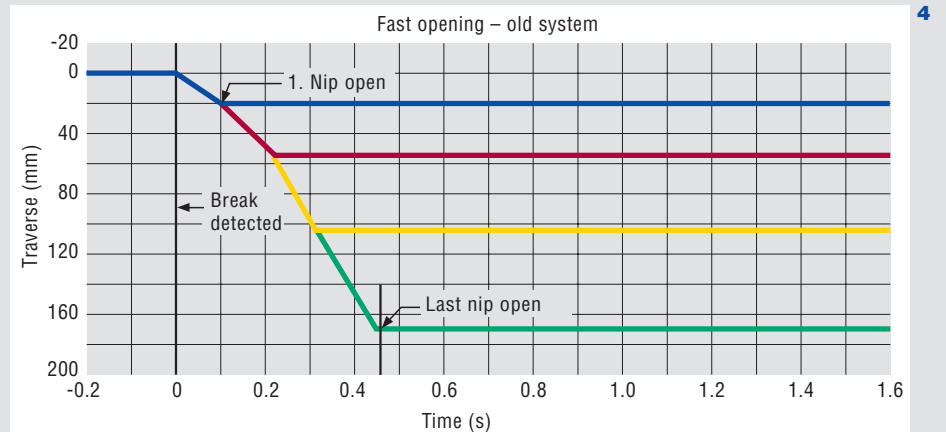
- Thanks to mechanical control of the oil drainage cross-section, the NipProtect™ system is extremely safe and reliable. Even in the event of control element failure, damping remains unaffected.
- At the end of the opening procedure, all rolls are supported on mechanical stops. This ensures complete safety for the operating and maintenance personnel.
- All pressures are controlled with mechanical valves. There are no proportional valves or electronic components.



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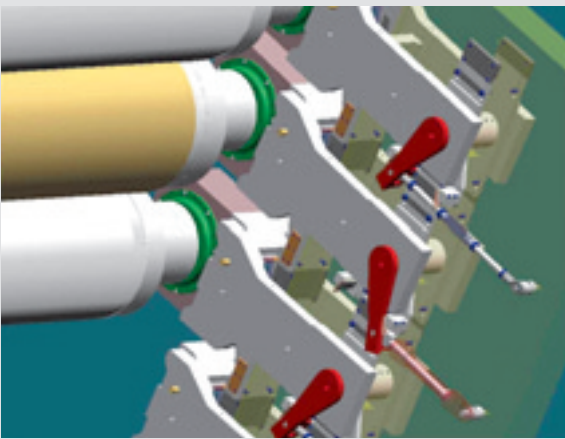
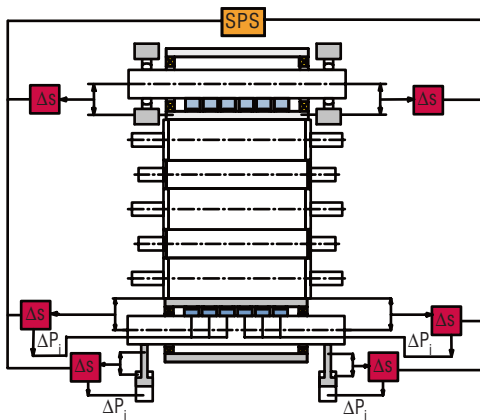


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Fig. 5: Roll stack.

Fig. 6: Eccentric offset adjustment.

Fig. 7: Roll offset arrangement.



5 Floating Stack

The Floating Stack system has thoroughly optimized nip loading.

All the intermediate roll bearings are mounted in levers. The top and bottom rolls are self-loading Nipco™ rolls, each with a shell stroke of 30 mm. As a result, there is no fixed stop in the stack or for the top roll.

The roll stack positioning is monitored by sensors on the Nipco™ rolls. During operation both the Nipco™ roll shells are in the central position (**Fig. 5**).

During fast opening, pressure reduction in the top and bottom rolls has to be equivalent to pressure reduction in the bottom cylinders. If this is not precisely synchronized, conventional systems immediately react with excessive forces on the mechanical stops, possibly causing damage. The Floating Stack eliminates this problem, because any difference in pressure reduction merely displaces the stack positioning slightly, without any negative effects.

Other advantages of the Floating Stack system

- The Floating Stack system is now well proven in about 100 online and offline installations, and is already operating successfully in three modern Janus™ calenders.

- The Floating Stack system prevents mechanical damage, because there are no fixed stops.
- All stack forces are automatically balanced.
- The system incorporates high overall damping and outstanding dynamic behaviour, because it is suspended between two oil-cushioned Nipco™ rolls.

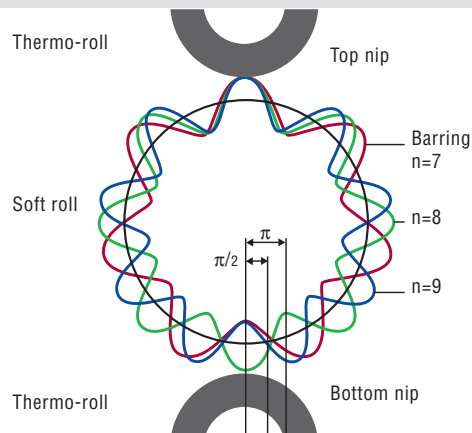
Intermediate roll lever pivot offset – an effective measure against barring?

One of the most controversial aspects of multi-roll calenders is roll cover life, particularly in connection with roll barring.

Barring is a surface wear problem affecting both soft and hard rolls, caused by natural or externally excited vibrations of the roll stack. Since every calender roll stack has its own natural frequencies, barring is bound to occur sooner or later.

Barring can be prevented or delayed by offsetting some of the intermediate rolls perpendicular to the nip axis. This is done by mounting the intermediate roll lever pivot bolts eccentrically, thus enabling the pivot and roll position to be adjusted by up to 20 mm (**Fig. 6**).

Barring frequencies can be detected by installing a monitoring system. In practice, barring patterns exhibit integer mul-



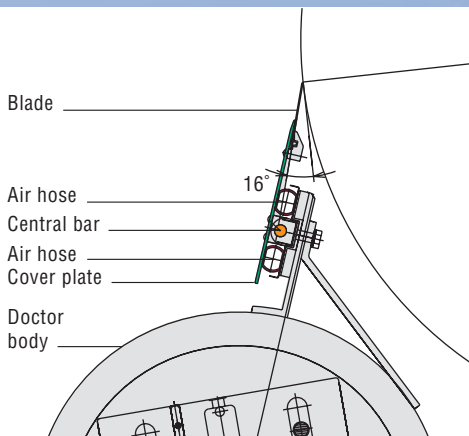


Fig. 8: Doctor blade arrangement.

8 New doctor blade system – for optimal finish with the highest quality roll surfaces

Since paper surface quality reflects roll surface finish, we developed for the Janus™ MK 2 a doctor blade system doing full justice to the highest demands (Fig. 8).

The doctor blades have to keep the roll surfaces clean and prevent wrapping without causing any surface damage. The efficiency with which they do this directly affects paper surface quality.

Uniform doctor blade loading at the low level of 30-50 N/m is important for gentle but effective roll scraping. Materials and design were selected to avoid any thermal deformation due to roll surface temperatures, which can be very high. Only the continuous central bar is made of steel, all other components over the entire blade holder and doctor body width are made of carbon fibre laminate.

Due to the low specific heat capacity and low thermal conductivity of this material, the component surfaces get hot already during the warm-up phase, thus preventing condensation and drop formation during production.

The extremely good strength to weight ratio of this material enables a strong and rigid design with compact dimensions.

This is a big advantage above all with respect to the blade holder cover plate and the doctor body.

The cross-machine stiffness of the cover plate has been reduced so that the blade can follow the roll surface perfectly. In web run direction, the cover plate is rigid enough to prevent even widely fluctuating loading forces from affecting the blade angle to any extent.

Thanks to this compact design, 75 mm wide blades can be used even for the largest roll diameters and at an angle of 16°, recommended for soft covers. Since they are much stiffer than 100 mm wide blades, the blade angle varies less, and the natural frequency of blade vibration is almost twice as high.

Prospects

Apart from these detailed examples of our further development work on Janus™ MK 2 technology, we are of course working on numerous other improvements. These are mainly concerned with the roll changing and drive systems.

In parallel, the principles of Janus™ MK 2 technology have naturally been applied to other calendering sectors as well – see our “Ecosoft™ calender” article in this issue.

tiples of $n = 25-60$ wave peaks and valleys. Fig. 7 shows for example a barring pattern with $n = 8$ wave peaks and valleys. Displacing the roll by e.g. $\pi/2$ changes the peripheral distance from nip to nip, thus interfering with the vibrational feedback mechanism. The roll is decoupled from the barring frequency, which helps to curtail barring from the outset.

State of technology

- Test measurements with a monitoring system have already confirmed longer service life due to roll offset.
- Longer-term trials will show how roll offset can be optimally applied in order to delay or prevent barring.