Thomas Herlitzius and Lutz Bischoff, Dellfeld

Intensive grain separation on the walkers with help of a separator drum

The most important performance limiter in combines with tangential threshing system and subsequent Horden straw walkers is the grain separation on the straw walkers. To improve walker separation, its action was supplemented by the development of a separation drum (Power Separator). The underthrow conveying action drum with eccentric-action fingers located in the rear third of the walkers gave highly consistent optimum results. Through active tearing apart of the straw mattress the Power Separator improved separation without too much mechanical damage being done to the straw.

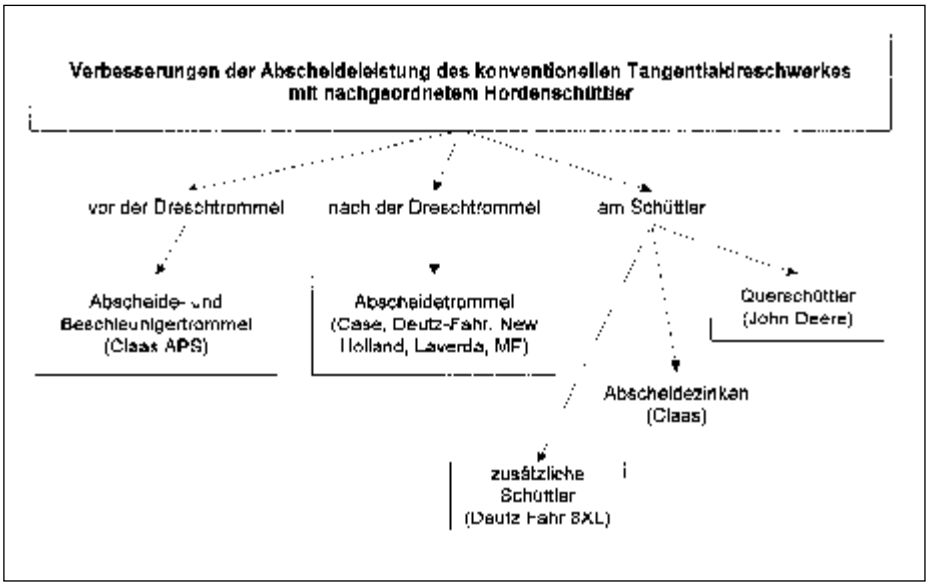

Fig. 1: Functional components for improved grain separation

The continually dominating tangential threshing separation principle with subsequent Horden straw walkers in combine harvesters has undergone many improvements in the last 30 years. The most important performance-limiting parameter of such machines remains the grain separation on the straw walkers. Seeking methods of improving the walker separation whilst retaining the advantageous ground principles of

- Limited power requirement
- Simple construction
- Universal application

a wide range of function components have been developed which support the gravity-induced migration of grain through the harvested material mattress (*fig. 1*).

Greater material throughput through higher machinery performance in association with increasing moisture content in the non-grain components (NGC) presents new efficacy and reliability problems for conventional walker aids. For this reason the development of improved walker aids has been given precedent with John Deere since 1995.

Selection of a function principle

The aim of every walker aid is the expediting and increasing of gravity-aided grain migration through the straw mattress. In this context the following widely differing variants for helping to intensify separation are available.

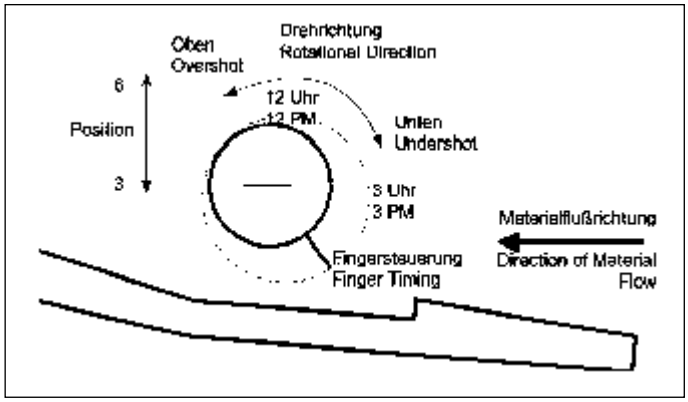

Fig. 2: Developed Parameters

Dr.-Ing. Thomas Herlitzius works at the John Deere Werke Zweibrücken, Homburger Straße 117 – 125, 66482 Zweibrücken and from 1988 to 1992 was a member of the scientific staff at the Chair of Agricultural Machinery, TU Dresden; e-mail: *HerlitziusThomas@JohnDeere.com*
Dipl.-Ing. Lutz Bischoff works at the John Deere Werke at Zweibrücken and from 1986 to 1995 was a member of the scientific staff at the Chair of Agricultural Machinery, TU Dresden; e-mail: *BischoffLutz@JohnDeere.com*

Keywords

Grain harvesting, walker separation, separator drum

Literature

[1] EP 0933017: Rotationsförderer mit einem Rotationskörper und wenigstens einem Mitnehmer und Erntemaschine mit einem solchen Rotationsförderer

- Active walker steps
- Pick-up action drum
- Airflow through the walkers
- Rotating tines on walker level

After the development potential of a drum with controlled-action fingers was first indicated in test stands and field trials, further attention was given to this working principle.

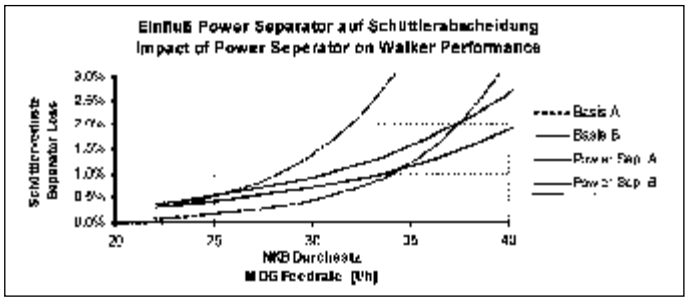

Fig. 6: Performance increase due to the Power Separator

Development steps

Alongside the main target of active separation support, the following criteria had to be met by a functional component situated after the threshing system:

- Reliable material flow (no wrapping or blocking)
- Universal availability and functional reliability in all conditions
- Limited power and space requirements
- Construction suitable for efficient assembly and completion

The large number of variables and working parameters were first of all reduced to a certain number on test stand trials and optimised as far as possible. Singled out for special mention here are (*fig. 2*):

- Transport direction of the material (over or under the drum)
- Fingers: form, configuration and number
- Drum rpm
- Form of walkers under the drum
- Drum diameter and distance to the walker surface

The test stand results with the greatest potential were verified in subsequent field trials and additional information was gathered on:

- Functional reliability in all crop types worldwide
- Component dependability and length of working life
- Effective influence of separation performance results

Results

After several development phases it was shown that an underthrow conveying drum with eccentric-action tines (Power Separator) position in the rear third of the shuttlers led to highly-consistent optimum results (*fig. 3*).

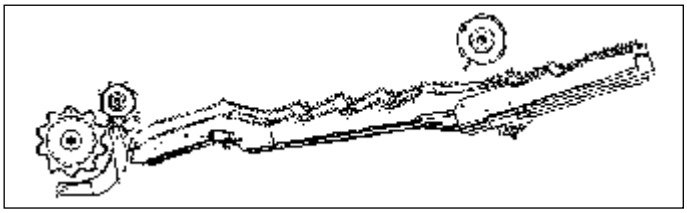

Fig. 3: Optimised position of the Power Separator in a combine

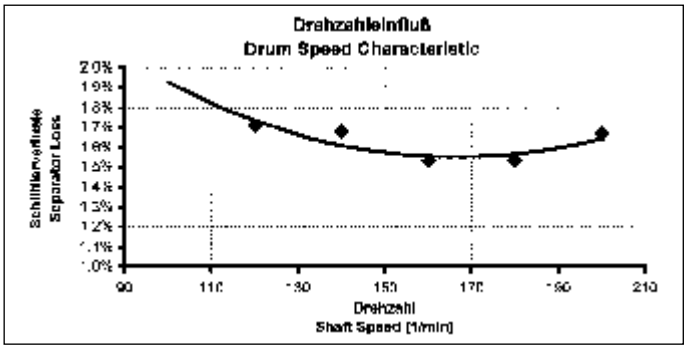

Fig. 4: Drum r.p.m. characteristic

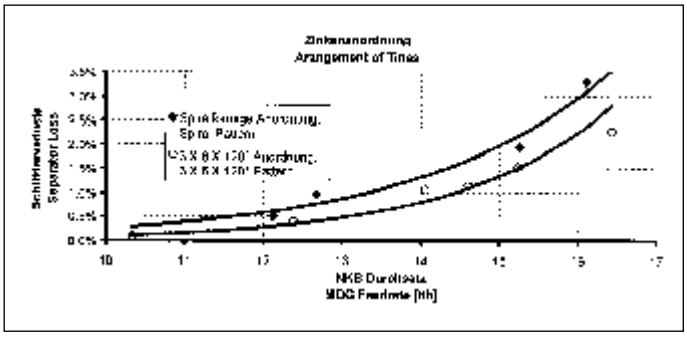

Fig. 5: Comparison of different tine arrangements

The speed of the Power Separator featured a circumferential velocity greater than the conveyance speed of the harvested material mattress on the shuttlers. *Figure 4* shows recordings from one of the measurement series for rpm optimisation.

Over several trial years and conditions, an rpm of 150 min^{-1} crystallised out as optimum. The relative drive energy for this can be taken from the schuttler crankshaft.

Finger configuration was also determined after several years of development. The radial positions were optimised to give three tines per walker spaced over 120° of drum circumference. *Figure 5* shows the differing performance results of spiral placement of fingers compared with the above-mentioned configuration.

This action smoothed out the material flow and resulted in a rearrangement and alteration of the individual components of the harvested mass whereby the still unseparated grain was given the possibility through the newly created free space of falling through the mattress in the direction of the walker surface. The walker surface remained unaltered in the area of the separation drum. The walker form (step formation, pitch) is adjusted to suit the drum so that drum action is supported by the efficacy of the conveyance and separation effects. *Figure 6* shows comparisons of two different recordings of walker losses in each case with and without fitted Power Separator.

Summary

The Power Separator is the realisation of a basic idea for improving grain separation through active tearing apart of the straw mattress on the walkers without excessive mechanical damage of the straw (retaining straw quality). Comparable solutions to this feature cross-walkers and gathering tines. The development aim of an increase in separation performance with absolute functional reliability was achieved through optimising the function parameters.