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Spotlight

Fascinating agri-engineering

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Photo: private

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Many people think of agricultural engineering as old and unmodern – in fact, obsolete. Why, they ask, should innovations be developed for this sector, never mind researched? After all, bread or morning rolls, come from the baker. Milk, jam and meat is available in the supermarket just round the corner. For many, agriculture is more associated with romantic images, dung fork technology and slow thinking farmers.

However, agricultural engineering will still exist a thousand years from now. Why? Animals producing milk, eggs and meat will always need to eat – and we humans too. Farmers supply the ”basic material“ for this: to the grain mills, the bakers, the dairies and slaughterhouses. In theory, people would survive without motorised transport, although life would be difficult. But without food we couldn't continue living. And this is why farming and agricultural engineering are both necessary.

Actually, agricultural engineering is often a pioneer in technology. Let's take transmission design as an example. With tractors, there have been transmissions with as many as 60 forward gears – and dual-clutch automatic transmissions were developed over 50 years ago. In the automobile industry similar automatic “direct shift” transmissions have only been available for around 20 years. Figure 1 shows a good example of a powershift transmission for tractors. Clearly to be seen here is that more than one clutch is necessary for such a transmission. However, a definitive gear changing capability has to be available for all conditions.

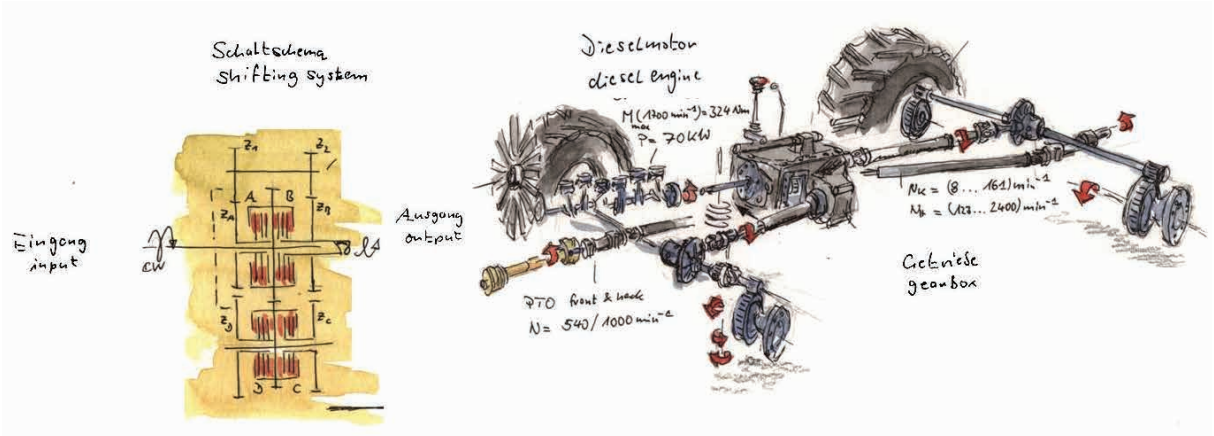

Figure 1: Sketch of a powershift transmission. Study according to Daimler-Benz (Illustration: Andreas Roth)

In order to ensure that two gears are not engaged simultaneously, the clutch action, almost always taking place hydraulically, is especially important. For instance speed of change is dependent on the viscosity, and therefore the temperature, of the oil. An example of gear changing technology is given in Figure 2.

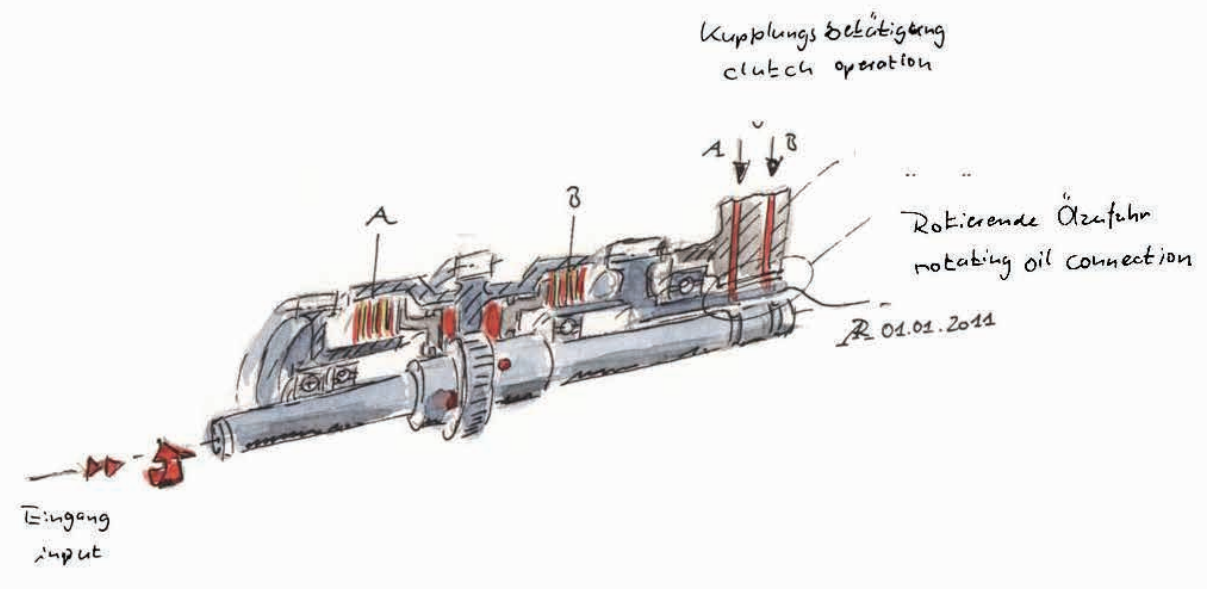

Figure 2: Hydrostatically activated multiple disc clutch, from GKN 2011(Illustration: Andreas Roth)

Naturally, agricultural engineering also profits very significantly from car technology developments. After all, the latter concerns completely different scales of production and therefore an incomparably greater opportunity for development. A modern farm machine is, however, exceedingly intricate and has to simultaneously carry out a variety of tasks. For instance, a combine harvester must cut the crop, transport it to the threshing drum, thresh, clean and separate the grain, convey the grain to an intermediate holding tank and deposit the straw back on the field in swathes, or chop and evenly distribute the chopped straw on the field surface. Thereby, the machine must continue

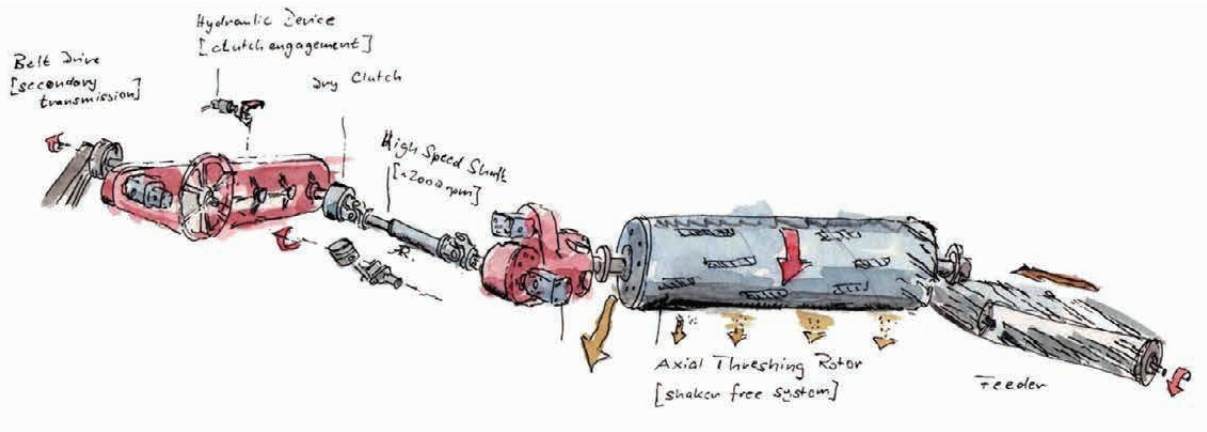

Figure 3: An example of the variety of drives within a combine harvester, reference model of GKN (Illustration: Andreas Roth)

travelling forward at a speed optimal for the harvesting process. Thus, the combine chosen here as an example represents a “factory on wheels”. As a rule, there is just a single engine powering all these tasks. Demonstrated in Figure 3 are examples of the different drives to individual working components. Also visible is the mechanical-hydraulic power split for the threshing drum.

The basic construction of such a power split is shown in Figure 4. One can apply this for travelling power as well as for delivering power to individual working components. This approach allows much greater flexibility and adjustment ability to suit actual working conditions. Hydrostatic units are naturally also powered by the main engine. The more often the hydraulic motor output is adjusted, the more the drive speed is altered. Within the planetary gearing both power forms (hydraulic and mechanical) are brought together again. Thus, changing gear ratio may be unnecessary over wide ranges.

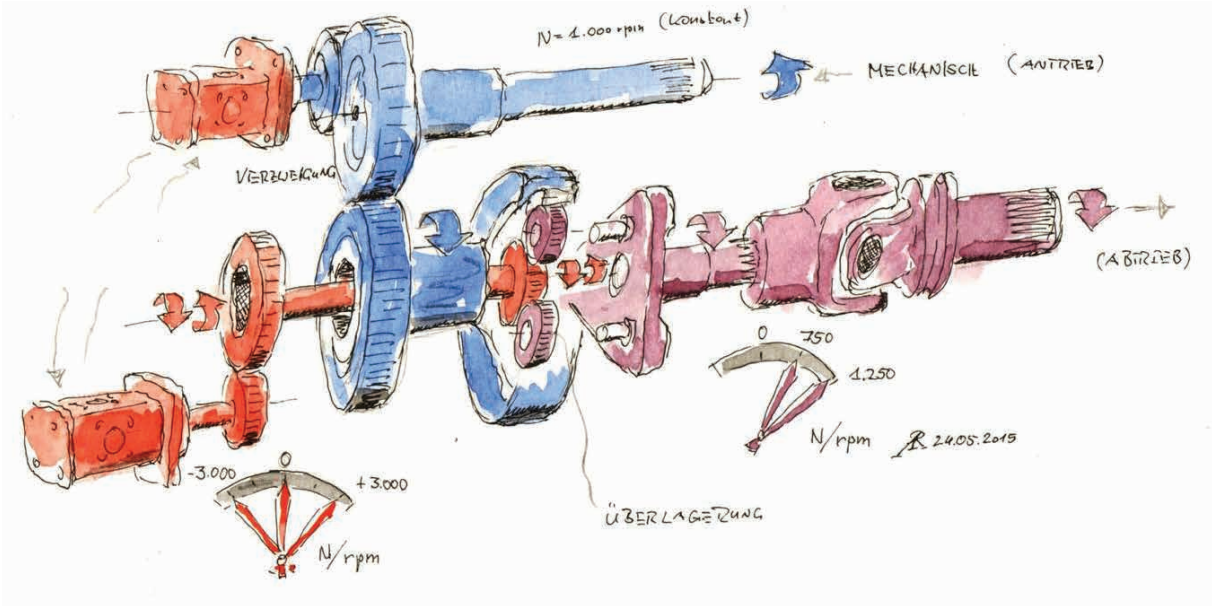

Figure 4: Construction of a hydraulic-mechanical power split (Illustration: Andreas Roth)

This therefore represents significant demands on the power delivering technology. A further example of the different tasks required from a single farm machine can be seen with the self-propelled mower illustrated in Figure 5. Compared with this, a car has only a single task: the transportation of passengers and driver from A to B, naturally as speedily, comfortably and safely as possible. This also applies to trucks, although with reference to the load in this case. Naturally, there are also in such examples considerable demands on the drive technology. However, the power in such cases goes mainly to a single user, the wheels, compared with the vast multiplicity of drive and control demands from an agricultural implement.

Certainly, in automotive engineering very different road conditions have to be considered as well as a range of temperatures and also climate conditions differing from country to country. However, anyone who believes grass in southern Germany is the same as that in the north of the country, or even in Scotland or South Africa, and that the crop can be harvested with the same machinery settings, is completely wrong. The solution for each situation has to be different.

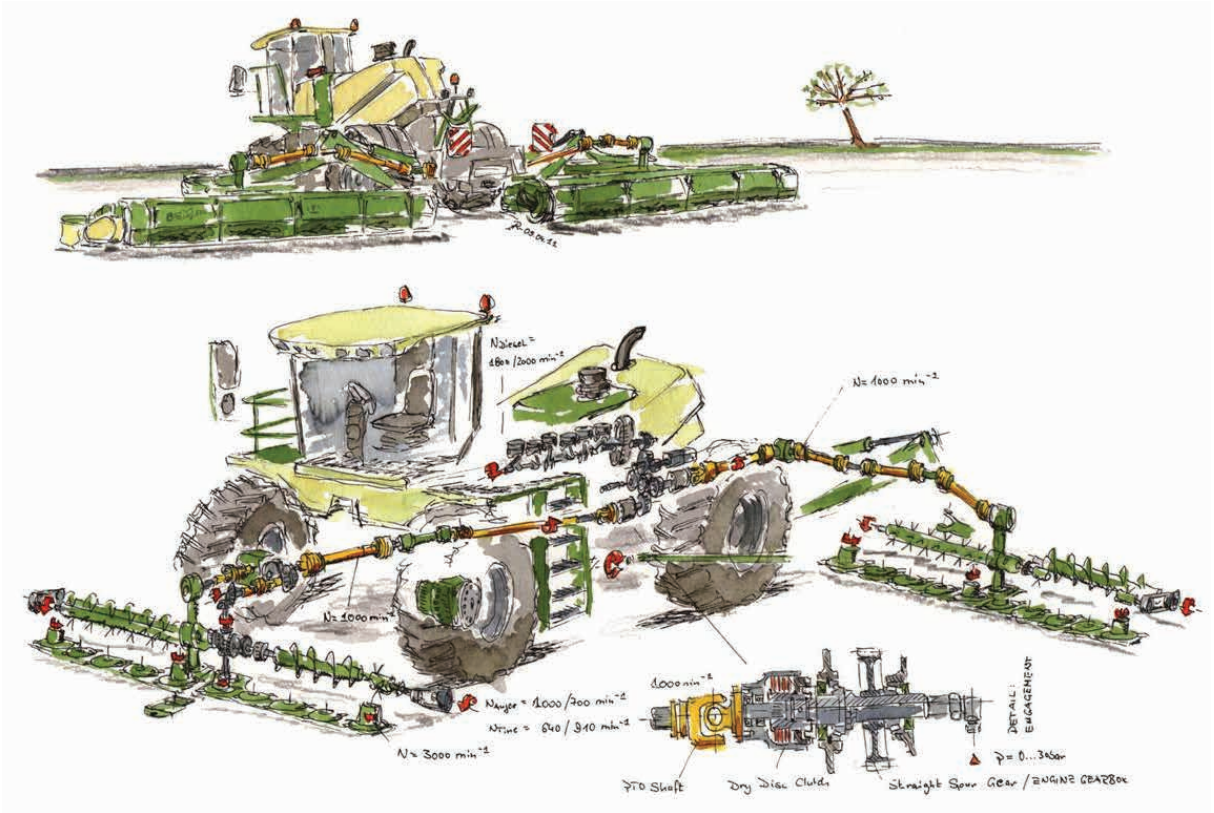

Figure 5: An example of the variety of drives within a self-propelled mower, demonstrated with a Krone model (Illustration: Andreas Roth)

One can appreciate the effect of different locations clearly on the basis of a plough: soils can be very different within a few kilometers, or indeed from field to field. With grain, there is not only the different types of crop for harvesting to be considered: very different conditions can be present within a single field. For instance, a single location can feature “lodged” crop lying on the ground because the straw has been bent over by heavy rainfall or hail showers.

Clearly recognisable through such impressive examples, therefore, is the complexity of construction required in agricultural machinery in order to permit several tasks to be carried out at the same time and under a range of varying conditions. A farm machinery manufacturer producing a product to be marketed internationally has therefore to travel widely during its development to ensure that application of the implement can be successful worldwide.

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