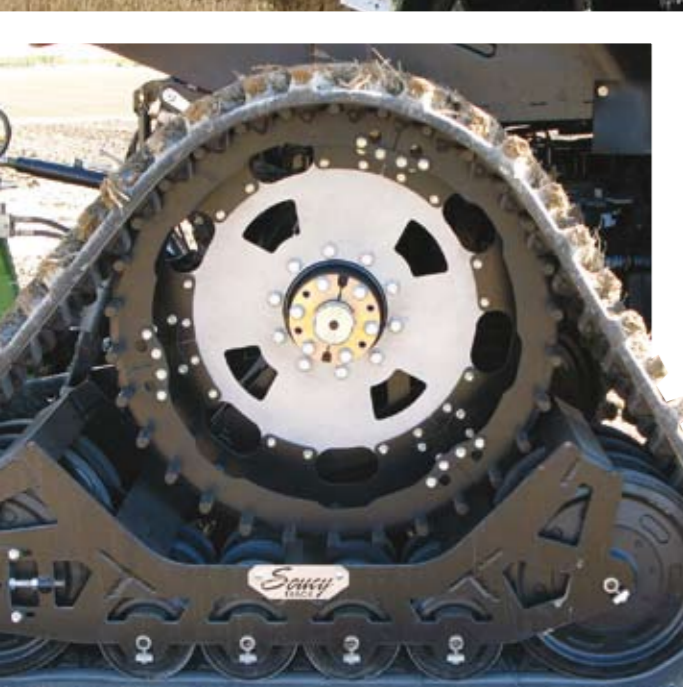


WHEELER DEALERS

THERE'S A GROWING DEMAND FOR SMALLER WHEELED TRACTORS THAT CAN BE QUICKLY RETROFITTED TO RUN ON TRACKS – AND THERE ARE MANY (REPUTABLE) COMPANIES OUT THERE THAT CAN HELP



▶ The popularity of 350-500hp farm tractors that use track running gear rather than wheels and tyres has spawned interest in equipping smaller wheeled machines with tracks. As a concept, this is nothing new: for years wheeled tractors have been fitted out with tracks for specialist work such as harvesting peat and grading snow trails. The difference now is that farmers want to use tracks for heavy draft work as well as delicate top work – yet also retain the versatility of running on tyres for road transport and other operations.

Track systems for modern 4WD tractors must therefore cater for outputs from 50-350hp and provide the expected benefits in terms of reduced ground pressure and improved traction. They must also require minimal alteration of the host vehicle and be easy to install and remove.

“I think there is a vast untapped market for equipment that converts a mid-size wheeled tractor into a tracked tractor,” says UK-based machinery retailer Ray Runciman. “We’ve seen the benefits of running very high horsepower tractors on tracks, but relatively few farms can justify such machines; there are far more 200hp tractors in everyday use.”

Caterpillar established the credentials of modern-day crawler

LEFT AND ABOVE: Modern retrofit track systems allow farmers operating mid-size tractors to get the benefits of reduced ground pressure and high levels of traction without creating a bulkier, less manoeuvrable machine

BOTTOM LEFT: Soucy retrofit track assembly



tractors for farm use with its Challenger series. Using twin rubber traction belts rather than steel tracks gave them more acceptable mobility between field and yard – steel cleats and a concrete surface is not a healthy combination – as well as reduced servicing and maintenance requirements, and lower noise levels.

Having shown what they could do, the Challenger tractors were later joined by similar machines from John Deere – these were also adapted to a permanent twin-track configuration from wheeled-tractor designs. But when Case IH entered the market with its Steiger Quadtrac, it took a different approach, adding four track units to an articulated-chassis wheeled tractor. This configuration may not have the ultimate zero-turn manoeuvrability of a twin-track layout, but it does eliminate the field-end scuffing inherent with the twin-track's skid-turn system and avoids the need for a special-transmission set-up to provide steering.

Case's development programme sparked interest in retrofit kits for 4WD articulated tractors already in use. Their potential for improving field performance was explored by

the Ministry of Agriculture & Rural Development in Alberta, Canada.

Field comparison

Using a 300hp Case IH 9250 4WD articulated tractor equipped with four retrofit Gilbert & Riplo GripTrac track assemblies, each with a 775mm chevron-pattern rubber traction belt, the research team recorded a notable advantage in tractive efficiency. Measured as maximum pull-to-weight ratio, the converted tractor achieved a figure of 0.7, which was higher than a similar wheeled tractor, and did so at lower slip levels. At 5% slip, the tracked tractor pulled almost twice as much as the wheeled version.

In theory then, a farmer could convert his own tractor with retrofit tracks and pull a bigger implement for greater productivity, or keep the same implement and downsize to a smaller tractor with lower costs.

The other attraction is the potential for good reduction in soil

compaction, although as tyre engineers will point out, the issue is not quite as clear-cut as first appears.

In the Alberta trials, the rubber-tracked tractor, weighing in at 16.7 tonnes, had a total footprint of 65,044cm², which calculates to a static ground pressure of 0.28kg/cm² (4.0psi) at the front and 0.23kg/cm² (3.3psi) for the rear axle.

This does not take into account pressure spikes beneath the idlers and rollers, nor the tendency observed in the trial for this particular track design to dig in at the front and lift at the rear under heavy draft load.

Even so, these impressive figures could only be matched by fitting large tyres in either dual or even triple sets, creating an even larger, more unwieldy machine. The only downsides to fitting tracks identified by the Canadian researchers were poorer power delivery efficiency and a harsher ride on firm surfaces. The rolling resistance generated by

MAIN IMAGE: Agritrac design is not currently being produced; farmer-engineer Steve Heard is looking for a new licensee

ABOVE LEFT: In addition to 4x4 trucks, Mattracks specialises in track systems for small tractors up to 100hp

ABOVE: Soucy tracks fitted to a tractor operated by British Antarctic Survey



Amfibios track assembly from Tidue used on a New Holland combine harvester to minimise soil compaction damage (photo: Farmers Guardian)

having to bend a tightly bound traction belt around the drive wheel and idlers is to blame for the inferior power efficiency, which in the Alberta trial was measured at 72% for the tracked tractor versus 76% for a similar unit on tyres.

Retrofit track systems

Manufacturers have addressed this issue in subsequent designs. Other concerns include stability under heavy draft load, the effect of using a relatively small drive sprocket on overall gearing, and ease of fitting



New Holland does not offer tracks as original equipment on its articulated 4WD Series TJ tractors, so the only solution is to fit tracks such as these ATI units



Bruko track units from Greccav on a Challenger TerraGator applications vehicle adapted for earthmoving operations

and removal. "That last point is important for farmers looking to use retrofit track systems on conventional rigid-frame tractors," says Runciman. "With the Soucy track system we're supplying in the UK, a set of four tracks can be replaced by the tractor's original wheels in about six hours – a perfectly acceptable figure for a job that will be done only occasionally, not every other day."

Modifications to the Case IH Puma tractor, on which Runciman demonstrates the tracks, are limited to replacing the nylon front axle kingpin bushes with steel versions to cope with the extra weight. "We've also learned to run the front axle parallel, not with some toe-in as is the case with tyres, to eliminate excessive wear to the traction-belt drive lugs during turns," he adds.

With differently sized drive sprockets on the front and rear units to achieve the correct driveline ratio, Runciman says overall gearing is reduced by between 23-26%, so the tractor will not run as fast. It is the medium-range gears rather than the

On track for comfort with integral suspension



The development of a track system for medium-sized tractors that provided traction and ground-pressure advantages without any drawbacks was the focus of a Silsoe Research Institute project in the UK through the 1980s. The resulting design has still to be matched by modern retrofit track systems, at least in some respects.

"The key objective was to design a track system that imposed no restrictions or limitations on the tractor, which means it also had to provide equivalent ride comfort," says Andy Scarlett, who now runs his own vehicle engineering research consultancy. "Other methods of fitting tracks to wheeled tractors, such as wrapping a belt around the tyre and an idler, had been tried but they all had their problems or limitations."

Incorporating suspension was the main challenge, and rather than installing a track-frame pivot or mounting the whole undercarriage on springs, the Silsoe team decided on a compact integral-suspension design. This allowed the idler roller assembly to move up and down relative to the upper frame and provided a generous 136mm (5in) of travel – a lot more than provided by a tyre – but with similar stiffness to prevent excessive roll.

"One of the difficulties is that the suspension tends to compress as the track tension increases, due to increasing draft load," Scarlett points out. "That was solved by arranging the rear of the two trailing arms that connected the idler roller assembly to the main-track frame in such a way that it bisects the angle of the track either side of the rear-idler wheel."

This crucial piece of geometry cancels the forces created as the track grips and pulls harder, so that the full suspension movement remains available at all times.

Two trailing links, which ensure the track remains parallel to the tractor axle, connect the idler assembly to the main frame. A rubber-airbag suspension unit was then inserted between the upper frame and the first of the two trailing arms to act as a compact but compliant spring. Hydraulic dampers helped to control suspension movement over bumps and dips.

The next problem, for which a patented solution was devised, was to keep the track at the correct tension when suspension movement effectively changed the dimensions of the track assembly. Rather than attaching the front idler rigidly to the track frame, it was mounted on a steel rod that could slide in a phosphor-bronze bush.

"This sliding movement was controlled by a tensioning rod attached to the upper frame, with steel compression springs providing the initial tension," Scarlett explains. "As the idler frame moved up and down, the tension control arm moved the idler wheel backwards and forwards, altering the geometry in proportion to the suspension movement and keeping the track in near-constant tension."



The pneumatic suspension system allows the track roller assembly to move up and down with the front idler moved in and out mechanically to maintain the correct traction belt tension

TRACTION TECHNOLOGY

low ratios that are used for high torque operations.

That is not a concern, according to Runciman, and this view is echoed by John Deere's UK tractor specialist Gordon Day: "There are some concerns, because a wheeled tractor is designed to work typically at 8-12% slip levels and the tyres act as a torque limiter of sorts, whereas tracks run at 0-5% slip and can generate much higher levels of drawbar pull and torque loads."

A mitigating factor, he points out, is that using the higher gears to compensate for the ratio step-down at the track drive means all the transmission components are running faster for the same ground speed. "We're happy to warrant a tractor fitted with after-market tracks, but any failures that are attributable to the tracks being used would be excluded," adds Day.

Licensee wanted

Until recently, Deere's UK division supplied a retrofit track system under licence. The H-Track design –



RIGHT: Dutch firm Westtrack is working with Case IH engineers to explore the potential for fitting machines like this 285hp Magnum with tracks front and rear

BELOW RIGHT: Incorporating tracks as part of the original specification allows manufacturers to make best use of the little space they occupy

BELOW: A set of GripTrac units on a self-propelled crop sprayer



like that of the ATI Track Module System – uses a drive wheel equivalent in size to the tyre it replaces so there is no step-down in overall gearing. Deere did not renew its licence last year, largely because the track assembly is not part of the company's global product portfolio, so its originator, farmer and engineer Steve Heard, is looking for a replacement licensee: "I'm also in the final stages of developing a new but similar design to match the larger tyres that wheeled tractors commonly use these days," he says.

In the Netherlands, Westtrack is one of Europe's most prolific manufacturers of retrofit track systems, largely due to the desire among Dutch farmers for systems that protect the soil. Its modular machine, based around a number of common components, is designed to fit almost any 2WD or 4WD tractor, without affecting the original ratios.

Although Westtrack is working with engineers in Europe and the USA on exploring a wide-belt design for some tractors in the Case IH range, many of its units use slim belts to provide a narrow, elongated contact patch for working in crops where fat tyres are unsuitable.

In the USA, Mattracks caters for horticultural and groundscape enterprises, focusing on retrofit track units for tractors up to 100hp, in addition to 4x4 road vehicles. ATI and Gilbert & Riplo, and Italy's Tidue

tend to focus on heavy-duty systems for harvest machinery, where flotation is the key requirement.

Reducing damage

Claas Industrietechnik has seen growing demand for its TerraTrac system, as combine operators come to realise they can reduce the residual damage to soil caused by harvesting operations. They have also been adopted by sugar beet and potato harvester OEMs, where the tracks' low height and narrow width leaves more space for the harvesting mechanism. Elsewhere in Germany, potato harvester manufacturer Harain Maschinenfabrik produces its own rubber-belt track system for mechanical or hydrostatic drive and incorporating hydropneumatic suspension for the track rollers.

Greav's Bruko track unit, used by Agco's Challenger unit in Europe on TerraGator application vehicles adapted for earthmoving operations, also has an electronically controlled suspension system to help maintain ride comfort on hard surfaces.

So far, though, this is one aspect where the pneumatic tyre still has the edge. The elongated contact patch of a traction belt may provide smoother passage over a rough surface, but the ride quality of rigid-track frames on a hard road surface is no match for the cushioning provided by the deflection of a correctly inflated tyre. **ivT**

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