JOHN DEERE ACCUDEPTH™ CONTROL SYSTEM PROVIDES DEPTH CONTROL ACCURACY TO 2/10 INCH ON IMPLEMENTS

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Abstract

The AccuDepth control system is designed to meet customers' needs for precise and accurate tillage. (See Figure 1.) Accurate depth control provides improvements in the utilization of tractor horsepower and fuel costs. Precise depth control is important for moisture conservation, fertilizer placement, and soil management. The patented AccuDepth control system handles adjustments on the move, increases productivity, and makes work easier for customers. The floating hitch, frame strength of the patented tube through tube design, and wheel package placement allow the implements, such as the 2400 chisel plow, to offer unmatched consistency of tillage depth from front-to-back and side-to-side. (See Figure 2.) AccuDepth control utilizes individual wheel sensors and electronic circuitry to level the frame and to maintain depth measurements unparalleled in the farm equipment industry. The AccuDepth control system on the 2400 chisel plow saves fuel, shatters compacted soil layers, mixes soil, and maintains accurate depth control to 2/10-inch accuracy. This represents unprecedented soil management for producers.

Introduction

The 2400 Chisel Plow is a machine with a new, innovative, patented depth control system called AccuDepth. AccuDepth technology allows for precise depth control of individual frame sections on the go from the tractor cab. AccuDepth controls the primary and intermediate depths and side-to-side leveling from the operator's seat. (See Figure 3.) Additionally, the 2400 Chisel Plow is a primary tillage tool for shattering and mixing soil to a depth of 12 inches for production of agricultural crops. The 2400 Chisel Plow also has combinations of new technologies with innovative applications of existing technologies. Design of the patented tube through tube frames utilizes new manufacturing technology.

Wheel rockshafts define wheel placement on machines and most times compromise shank patterns. The elimination of the rockshaft on the 2400 allows the depth control wheels to be located around ideal shank spacing for improved soil and residue handling. Ideal shank and wheel placement has allowed for a 4 bar frame. The combination of the four bar frame, floating hitch, front wheel placement (ahead of front rank), enables the 2400 to have unprecedented ground following capability.

Discussion

Markets

Farmers can be more productive by increasing their time operating in the field with less time spent adjusting for varying conditions. Precise and consistent depth control will result in lower fuel requirements, moisture conservation, better fertilizer placement, and improved overall soil management. Productivity increases and improved soil management will lower input costs and increase yields. These improvements will lower food and commodity' (products made from these agricultural crops) costs for consumers. The total current chisel plow market is approximately a 1500 unit market.

Retail (List) Price

The price is size dependent; however, they range in price from approximately $7500 to $50,000. The 2400 chisel plow with the AccuDepth control system has just been released to the public for purchase on December 15, 2000. Shipments will not occur until August 15, 2001.

Functional Areas

This new tillage machine enables precise placement of seeds and incorporation of chemicals. Accurate chemical incorporation reduces amounts of chemicals used, lowering costs to producers and risks to the environment. AccuDepth replaces a rephasing series cylinder system for more accuracy and consistency in tillage depth affecting seed placement or chemical incorporation. This electronic hydraulic depth control system enables easier and quicker depth control modifications within a field, or between fields. Productivity is improved by maximizing operating time. The electronic depth control is programmed to retract inner and outer wing wheel modules during the transport folding cycle.

On the 2400 chisel plow, a five section 55 1/2' working width folds into a 16 1/2' transport width. The result is a tighter folded width for transport providing a safer transport, for the operator, and for passengers of vehicles passing the 2400 Chisel Plow on the road.

Operation

Sensors at the wheels work with a controller and cab-mounted console. As the operator makes adjustments, cylinders at each wheel have a proportional valve and potentiometer that react, raising and lowering each section separately. (See Figure 4.) The controller stores set points, sends signals to the proportional valve, receives height sensor signal, and communicates the position to the display. (See Figure 5.) The console displays the frame's movement, showing each section's position relative to the rest of the frame. The operator stays in the cab to make adjustments and work more acres per day.

Tractor Compatibility

The AccuDepth control system will work on John Deere's 2400 chisel plow and other new products to be announced later this year. The AccuDepth control system will not retrofit on competitive model chisel plows. The AccuDepth control system can be utilized with pressure compensating or closed center hydraulic system tractors with the GreenStar™-Ready wiring harness and the implement connectors. (See Figure 6.) For John Deere, these tractors are the 7010, 8010, and 9000 series tractors. The AccuDepth control system cannot be utilized on true, typically older, open center hydraulic system tractors. All tractors require the GreenStar™ wiring harness, which can be factory installed on 8010 and 9000 series tractors. For the 7010 series tractors, all other John Deere tractors, and all other competitive models, an additional field installed kit must be ordered which includes the display, GreenStar™ wiring harness, implement connectors, and an add-on hydraulic valve.

The 2400 chisel plow is a complete primary tillage tool designed to be pulled behind 150 to 425+ horsepower tractors, or John Deere 7010, 8010 and 9000 series tractors. Please see a local John Deere dealer for specific tractor compatibility. Horsepower varies dramatically dependent upon width, depth wheel options, and ground engaging chisels.

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Design Engineering

A formal technology delivery process (TDP) was used to brainstorm and to mock up concepts without the burdens of up front financial and manufacturing issues associated with product developments scheduled close to production dates. The resulting concepts provided both financial and manufacturing advantages. Similar sessions were held with hydraulic, electronic, casting, and machining suppliers to gain similar advantages from the potential suppliers. The emerging concepts were reviewed with four customer requirements groups to verify future customer needs and incorporated into the new designs.

After TDP, the development team utilized a product delivery process (PDP) to design, develop, and deliver the new product through six formal phases. Engineering problem-solving tools and techniques used during the program development phases included conventional field load and deflection measurements, stress coat and strain gauge analysis, finite element analysis (FEA), and accelerated design verification (ADV).

Patents have been issued on the following designs: electrohydraulic depth controls (Number 5,957,218) issued on September 28, 1999 and tube through tube frame (Number 6,016,877) issued on January 25, 2000. Additionally, patents have been submitted for the following designs: flat fold mechanism (applied for), wheel module overall design (applied for), curved lower wheel link (applied for), castor arm design (applied for), and the cast hitch link (applied for). Patents have also been filed for the depth control linkage (applied for), the wheel retraction sequencing for narrow fold (applied for), and mechanical override of cylinder valve (applied for).

Summary

AccuDepth provides depth control accuracy to 2/10-inch across the entire width of the implement. This level of accuracy conserves soil moisture and saves fuel by preventing the implement from operating too deeply. It allows the operator to raise, lower, set depth, and level the frame right from the tractor cab. The AccuDepth control display gives you operating depth and frame levelness with one glance at the monitor.

Figure 1. The AccuDepth control system is designed to meet customers' needs for precise and accurate tillage. Illustrated in this picture are the two displays for the AccuDepth control system—the AccuDepth display on the left and the GreenStar™ display on the right.

Figure 2. The floating hitch on the 2400 chisel plow offers uniform consistency of tillage depth from front-to-back and side-to-side.

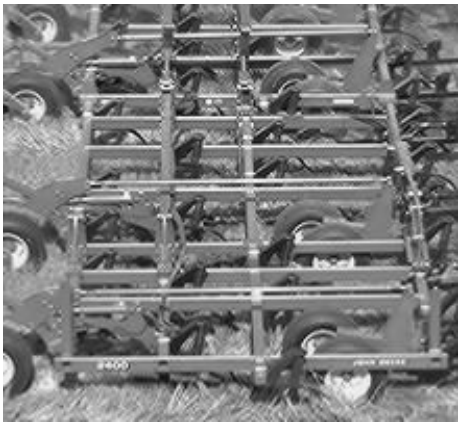

Figure 3. AccuDepth controls the primary and intermediate depths and side-to-side leveling from the operator's seat.

Figure 4. Sensors at the wheels work with a controller and cab-mounted console. As the operator makes adjustments, cylinders at each wheel have a proportional valve and potentiometer that react, raising and lowering each section separately.

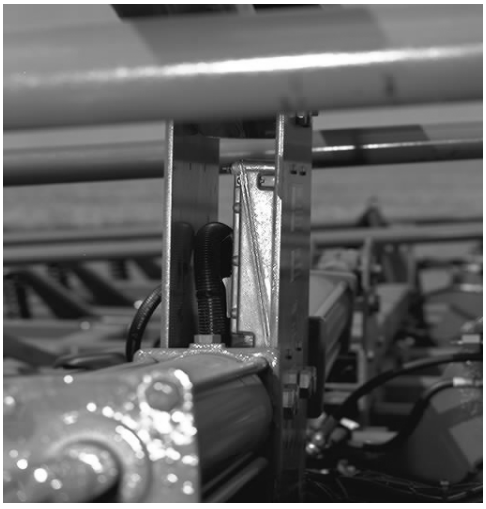

Figure 5. The controller stores set points, sends signals to the proportional valve, receives height sensor signal, and communicates the position to the display. It is located between the wing towers on the center frame of the implement.

Figure 6. The AccuDepth control system can be utilized with pressure compensating or closed center hydraulic system tractors with the GreenStar™-Ready wiring harness and the implement connectors.