

MAGNETEK ENRANGE WIRELESS CONTROL SYSTEMS

Mobile Hydraulic Telescopic and Articulating Cranes



Project — Auto Crane Company's Mobile Hydraulic Cranes

Location — Tulsa, OK

Application — Hydraulic Truck-mounted Telescopic and Articulating Cranes

Products Used —

- Enrange Flex Pro™
- Enrange MHR Radio Controller
- GS North America Hydraulic System

CHALLENGE

- Provide a wireless control system to accommodate numerous mobile hydraulic truck sizes, configurations and applications
- Reduce installation time and cost of a wireless control system to partner with a state-of-the-art hydraulic system
- Increase mobile hydraulic crane efficiency and safety

SOLUTION

- Magnetek improved the performance, productivity and safety of this truck-mounted crane by implementing a wireless control system that is scalable to meet the specific needs of each user
- Innovative receiver solution combines the components of a radio receiver and hydraulic controller into a convenient single unit reducing installation time and overall costs
- Increased mobile hydraulic crane operation efficiency and safety with wireless control of an industry-first crane load management system

Auto Crane Company, a subsidiary of Ramsey Industries located in Tulsa, OK, developed the very first auto crane in 1958 by placing a crane in the trunk of a car. This work-truck industry pioneer has since produced some of the most reliable cranes and crane-service bodies on the market. Continually striving to provide new and innovative products, Auto Crane has introduced a number of new cranes over the years. Providing both electric and hydraulic cranes, Auto Crane now offers models with the capability of lifting up to 14,000 pounds. The company's products are known for their innovation and versatility, allowing Auto Crane to maintain its number-one position in the industry today.

Auto Crane, in partnership with Magnetek, Inc. and GS North America LLC, introduced its newest innovation to the market: a totally proportional crane control system. GSNA is a premier provider of electro-hydraulic and electronic control solutions to original equipment manufacturers in North and South America. Magnetek is North America's largest supplier of digital drive systems for industrial cranes, hoists and monorails and provides Energy Engineered® wireless controls to North America's foremost overhead material handling and mobile hydraulic customers.

The challenge for Magnetek and GSNA was to replace Auto Crane's existing pistol-grip wireless hydraulic control and outdated hydraulic system. The old control system required an operator to use two hands to depress a proportional trigger and an on/off thumb trigger control that offered primarily single function control. The truck-mounted cranes handle a variety of lifting requirements for service technicians and this configuration was cumbersome and inefficient. In its original configuration, the trucks utilized basic hydraulic controls with limited proportional functions, which caused undue boom stress loads and the inability to perform multiple proportional functions at the same time. The radio remote control did not provide any crane status information, and was not scalable to meet unique user demands.



THE OLD SYSTEM

The old mobile hydraulic control system employed on the crane trucks was similar to that in use by the majority of the industry, and includes a pistol grip transmitter, series hydraulic system, single pressure switch and series circuits.

The system utilized a pistol grip transmitter with thumb actuated toggle switches that activated only when the proportional trigger was pressed. In the event that the toggle was accidentally released, the hydraulic system could slam shut without ramping down resulting in an instant stop on the crane and load. The severe shock to the boom and truck often damaged the boom.

The old hydraulic system was in series causing flow degradation when two or more functions were engaged at the same time. The system's poor metering of the hydraulic oil caused the flow rate to drop in half to the original function when an additional function was put into operation. Series configuration is considered an outdated technique for hydraulic control and is a common problem with many of the systems currently in the field.

All of these issues were rectified by the new system designed and manufactured by GSNA and Magnetek for Auto Crane's numerous mobile hydraulic truck sizes, configurations and applications.

THE NEW SYSTEM

GSNA, in partnership with Magnetek, provided the state-of-the-art crane control and operating systems that offer fully proportional hydraulic valve control, with multiple speed scaling and the ability to operate multiple functions of the

crane at one time. The team moved technologies once only found in expensive high-end trucks to economical mid- to lower-end models. The new system is comprised of three major components: the hydraulic system, the hand-held transmitter, and the receiver. The three major components work together to produce a crane load management system that is extremely user friendly to the operator and provides for the efficient and safe operation of the crane.

GSNA provided the custom hydraulics that included the industry-first J1939 Boom Angle Sensor with truck frame level monitoring. The unique hydraulic system valve bank from GSNA is designed so that individual crane functions operate in parallel, giving each function the ability to operate independently and without flow degradation found in series systems. This means that the operator has the ability to boom out or rotate the boom and make a lift at the same time. The valve bank works in conjunction with the other components to support the 100-percent proportional control and individual crane functions eliminating uncontrolled swings and boom jerk. The multi-speed control scheme is an industry first and allows for multi-function creep control on the transmitter and speed scaling functionality on the control.

The new hydraulic system is scalable from 5,000 pound cranes to 14,000 pound cranes. The new design allows for a change in speed and performance parameters through the entire load range. One valve bank is used through Auto Crane's entire product range with the only change being the electric current parameters set through the control. A crane's profile is pre-loaded into the controller and every crane has its own profile. So, the controller reads and matches the correct control profile for each crane – this is where the marriage of the hydraulics and electronics really excels.

The system significantly improves the truck's stability and safety by implementing a total machine control system that monitors and coordinates all machine movements. Level, pressure and proximity sensors measure positions, determine loading and monitor speeds of critical machine functions. I/O modules provide electro-hydraulic proportional control of the crane functions. Wireless technology is a proven solution for flexible remote machine control. Integrating the wireless controller with the CAN network, including operator control, provides a cost effective, efficient and safe control network for a machine operator.



CONTROL SYSTEM INNOVATIONS

The wireless transmitter chosen for the system was Magnetek's Enrange Flex Pro™ fully proportional hand-held transmitter that allows for multiple-speed operation on every crane function independently. It means that for the first time, an operator can control the crane functions simultaneously and proportionally fully independent of each other and is no longer limited to performing just one function at a time. This enhances load movement, placement and safety. An operator can ramp up or ramp down while lifting the load or rotating the boom. Each button is fully proportional and programmable – an industry first for the truck-crane market.

The control provides the operator with the ability to proportionally operate the crane with 100 percent power at four different speed scaling levels: 100 percent, 75 percent, 50 percent, and 25 percent for fine control. The settings can be changed on the fly with a simple adjustment on the face of the transmitter allowing all buttons to be operated in the full range of the selected speed setting. It gives the operator unmatched control to precisely and effortlessly place even the toughest load. An on-board emergency SIL 3 stop button is included as a safety interface. The Flex Pro operates at a world-wide accepted 433 megahertz frequency and is CE certified.

The rugged Flex Pro is specifically designed for the mobile industry and replaces the bulky trigger-toggle switch operation of the old system. In addition, it is 70 percent lighter than the old transmitters. This allows for belt clip mounting and one-hand operation for improved working capability and increased safety; the belt clip also helps prevent accidental loss or damage at the work site.

Magnetek also provided the receiver, its revolutionary Enrange MHR wireless controller. This industry first product combines the components of a radio receiver and hydraulic controller into a convenient single unit that significantly reduces costs and frees up valuable space on the trucks. It manages the output to the hydraulic valve bank as the transmitter is actuated. This ensures repeatable and constant performance at all temperatures and loads. The result is smooth ramp up and ramp down of each crane function independent of any other functions.

The MHR has an LCD graphic display that allows for viewing of system settings and a series of readouts that monitor the overall operation of the system. This is another industry first in the truck crane market. There were initial concerns that the screen would not withstand the harsh, outdoor environments of the field, but repeated shock impact testing proved the LCD's durability. The screen is a valuable piece of the system in that it provides an easily read status of the crane at all times.



The LCD allows the operator to diagnose problems accurately and quickly for optimal uptime of the crane. These are not just alpha-numeric status codes, but the actual description is clearly spelled out for ease of troubleshooting. The display shows the status of the crane in general and in the event of a malfunction, error messages are displayed, pinpointing the issue.

The screen allows for true diagnostics of any crane issue. One of the primary communications provided by the compact LCD is the status of the transmitter. A quick check on the screen allows the operator to know without question if the transmitter is functioning properly. Graphic displays include the transmitter signal strength similar to a cell phone bar graph and a transmitter battery life display with a low battery warning.

ADVANTAGES OF USING MAGNETEK'S RADIO REMOTE CONTROLS

- Innovative, cost-effective, custom-engineered wireless communication products
- Meet application specifications to reduce internal engineering and costs, improve time to market and enhance performance
- Manufactured and tested in our U.S. facility
- Customized application software designed at our Canonsburg, PA, facility
- Aftermarket service available in our Ontario, Canada, facility as well as our U.S. facilities



The diagnostic system allows for monitoring all aspects of the machine functions, including boom angle relative to ground position, hydraulic pressure, winch status, and proportional outputs status. It is a closed-loop monitoring system that also monitors one of the most common failures in an electrical system: cable failure. By monitoring the status of the cable and the coil on the hydraulic solenoid, the operator can diagnose the source of a crane malfunction in less than five seconds. This is extremely important for the mobile hydraulic market. The diagnostic system also provides preventive maintenance indication, error event logging and messaging. An innovative last wrap indicator is optional on the winch and provides an added measure of safety and performance enhancement not previously utilized on the trucks.

CRANE LOAD MANAGEMENT

Additionally, a crane load management (CLM) system is included that incorporates boom-pressure transducers, and dual-axis sensors provide feedback on machine and boom angle status for the ultimate in safe crane operation.

If the crane is not level, the boom-mounted LED status light provides a warning, and the vehicle will not function unless the unsafe condition is corrected. When the crane is operating at zero to 90 percent of rated capacity, the light will remain green. At 90 percent of rated capacity, the light will turn yellow and the speed will be reduced to 50 percent. At 100 percent of rated capacity and above, the light will turn red and a stop function is initiated. For added safety, the new system allows for manual override, which was difficult with the old system.

With the new system, alarms can be programmed for the crane to notify the operator of numerous situations including out of level, anti-two block (A2B), or rotational limit switches. A small, but practical innovation is the E-stop alarm. Often an operator is unaware that the transmitter's stop button has been deployed, and this alarm rectifies this simple, yet time consuming situation increasing the uptime of the unit. Alarm status is unlimited specific to the machine. This is the only system in the industry that provides this level of diagnostics.

The hydraulic system was developed as the result of the extensive engineering and research and development efforts of Auto Crane, GSNA and Magnetek Enrange. The system design underwent an extensive field testing program including thermal cycle testing.

Utilizing the latest in CAN technology, the total machine control solution provides improved safety and increased productivity resulting in a mobile hydraulic crane design with numerous industry-first innovations that met the customer's expectations. The Auto Crane unit was first demonstrated at the ICUEE Trade Show in 2009, and again at the 2010 NTEA Work Truck Trade show.