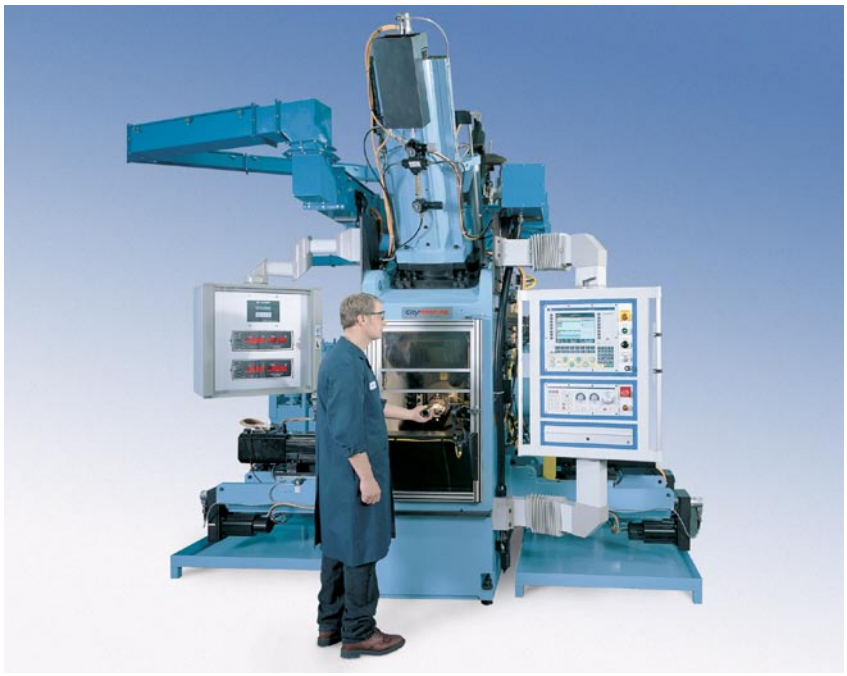
Drive & Control **profile**

Trunnion Machine Helps Automotive Parts Manufacturer Boost Driveshaft Production and Save Space



The Trunnion oversees up to six operations, addressing the issues of single-control programmability and efficient tool changeovers.

There's more than one way to machine a part. Some machine shops find that tried-and-true work cells using the one-operation/one-machine method get the job done. Others are adopting newer technologies such as CNC-based machining centers that fold many operations into one machine with one controller. And still others are keeping their old cell methods while adding some of the new machining center technology to increase production capacity and save valuable plant floor space.

One manufacturer that has successfully complimented its old cell style with new machining methods is Dana Corporation's

Challenge

Machine manufacturer needs CNC drive & control package for Trunnion multi-station indexing machine

Bosch Rexroth Solution

- MTC200 CNC system
- RECO12 I/O rack mount
- BTV06 handheld operator terminal

Benefits

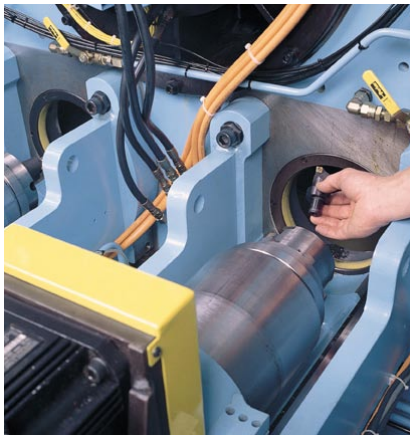
- New CNC machine significantly increases parts production compared to cell machining
- Easy-to-use controls system provides integrated operability
- Simultaneously control up to seven independent CNC processes and all PLC tasks
- Communicate diagnostics and performance data
- Handheld terminal used for machine set up procedures; simplifies operating tasks

For Dana, two new Trunnion machines, each featuring a single Rexroth MTC200 CNC system from Bosch Rexroth's Electric Drives and Controls division, have proven they can significantly increase part production.

Spicer Driveshaft Manufacturing, Inc., Bristol, VA. Part of the Dana Automotive Systems Group, Spicer Driveshaft's Bristol plant has added two new Trunnion Manufacturing Systems designed and built by City Machine Tool & Die Co., Inc., Muncie, IN, to increase production of end yokes and yoke shafts used in the Spicer driveshaft assemblies. In less than a year, the two new Trunnion machines, each featuring a single Rexroth MTC200 CNC system from Bosch Rexroth's Electric Drives and Controls division, have already significantly increased part production when compared to the same parts produced by Spicer's cell machining.

All Under Control

In response to OEMs and automotive giants like Ford, Chrysler, and General Motors, as well as many tier one suppliers, City Machine designs and engineers solutions to some of the industry's greatest machining challenges. One of those challenges was providing manufacturers with a rotary transfer system, or, as it's now known, the CNC Trunnion Manufacturing System. This one-machine-does-it-all solution that oversees up to six operations,



This multi-station indexing machine is similar to a dial indexing machine, except that the Trunnion has a horizontally oriented axis of rotation.

not only addresses the issues of single-control programmability and efficient tool changeovers, but at 150 inches wide, 189 inches long, and 121 inches tall also satisfies a growing need for a smaller machine footprint.

According to Dennis Kelly, City Machine engineering manager, the Trunnion is a multi-station indexing machine that is similar to a dial indexing machine, except that the Trunnion has a horizontally-oriented axis of rotation. (The word "trunnion" comes from the horizontal pin around which old civil war cannon barrels used to rotate.) Every station on the Trunnion performs independent operations, ranging from drilling, tapping, and threading to full CNC turning and boring.

"Apart from the traditional requirements for a CNC drive/motor/control package (i.e. price, delivery, meeting horsepower/torque/speed/space requirements), it is extremely important that our end users can operate this multi-station machine as one fully integrated machining center," explains Kelly. "Our customers do not want to feel that every station is a separate entity with its own screens and programming quirks. They want to be able to control every aspect of the machine by just pushing a few control buttons."

For Kelly, usability was the key to the machine's design and it was the main reason the company selected the MTC200 CNC system for the Trunnion. Able to simultaneously control up to seven independent CNC processes and all PLC tasks while communicating

diagnostics and performance data, a single MTC200 CNC can command multiple machining operations involving various spindles and slide groups while coordinating automated handling and measuring systems. Up to 32 axes can be assigned to seven CNC processes, including main spindle, rotary axis-capable main spindle, linear axes, rotary axes, and combined spindle/turret axis, and it performs all functions required for 3-D, circular, and helical interpolation, polar coordinate transformation, main spindle synchronization, and follower (synchronous) and gantry axes.

In addition, the CNC's C-axis functionality improves machine efficiency by performing complex turning, milling, and drilling operations without the need to re-clamp the workpiece. And additional time and cost savings are realized by simultaneously performing multiple axis functions in one or more CNC processes.

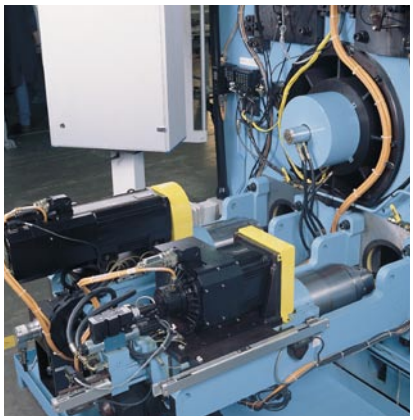
Other Rexroth components complimenting the MTC200 system include Bosch hydraulics, a RECO12 I/O rack mount unit for I/O modules, and a BTV06 handheld operator terminal. The handheld terminal is used for machine set up procedures and simplifies operating tasks by allowing the operator to control the machining axis in jog mode or to fully run the machine from the hand pendant.

Notes Kelly, "So although you're dealing with an inherently complex system with multiple stations performing a variety of tasks, the user interface represents all of these tasks in a clear way

A single MTC200 CNC can command multiple machining operations involving various spindles and slide groups while coordinating automated handling and measuring systems.

to give users the feeling they are operating one machine."

Another important feature, says Kelly, is changeover. If operators want to retool for a different part, they should be able to easily convert programs, offsets, and other part-specific information. That can only be done if many systems are integrated to the point where they behave like one system.



By using the SERCOS interface, the Trunnion's CNC system provides high precision and high-speed cutting as a result of velocity and position loops that are closed in the drives and independent of the network data rate.

"The MTC200 was designed from the ground up with complex multi-station machines in mind," observes Kelly. "By using Rexroth, we have found a solution that makes an inherently complicated control problem relatively simple and straightforward, therefore, system integration is simplified and the developed machine code is easier to maintain. In the end, our customers get a system that is easier to use and debug with part changeover that is generally quick and simple."

Kelly also noted that Bosch Rexroth was involved in many phases of the Trunnion's development, from specification of components to hands-on help with the programming of the controls and PLC.

A Working Relationship

At the Dana Spicer plant, the Trunnions, featuring six workholding stations and 30-second-per-piece or faster production speeds, typically produce tube or ball yokes and yoke shafts from forgings. The forgings are placed in a pallet and then loaded by the Trunnion's robotics into the system's first station for clamping and indexing. Since the Trunnion's MTC200 control supports turning, milling, drilling, and probing, complete machining can be accomplished with a single workpiece clamping operation. From there the forging proceeds through a series of operations, including cross-hole drilling, facing, broaching, and lathe and groover cutting, adhering to very close tolerances.

By using SERCOS digital communications, the Trunnion's

CNC system provides high precision and high speed cutting as a result of velocity and position loops that are closed in the drives and independent of the network data rate. A servo response of 250µ without following error assures high precision at the fastest machining rates and chip to chip times. Likewise, contour accuracy at high path velocities are achieved through fast NC block processing times, dead time-free NC block switching, and look ahead NC block preparation, resulting in excellent surface finish and extended tool life.

When running at maximum efficiency with an average 30-second or less cycle time the Trunnion can produce 1,000 pieces per shift compared to 600 pieces per shift in similar cell production. Because each of the six spindles on the City Machine Trunnion performs the work of a single turning machine or horizontal machining center, the Spicer plant can achieve increased throughput, reduce operation costs, and save floor space by using only one machine.

Kelly says there are many misconceptions about trunnions and finds many manufacturers believe trunnions can only be used to manufacture one dedicated part, but he says that's not the case. "The City Machine Trunnion System with Rexroth controls provides for a hassle-free, operator-friendly experience. To change to a new part, the operator need only change appropriate tooling and the program/offsets. Part changeover has never been easier."

The CNC's C-axis functionality improves machine efficiency by performing complex turning, milling and drilling operations without the need to re-clamp the workpiece.

The CNC system's integrated line editor, ASCII editor, and optional graphical NC editor provide a wide range of programming tools for all levels of expertise. Externally created or post-processed CNC programs can be imported and exported from serial interface ports or local or network disk drives. The system also features turning, milling, drilling, and probing cycles to simplify programming of repetitive machining tasks.

Kelly added that the Trunnion also features durable sliding spindle carriers. By using this unique design, says Kelly, most cutting tools can be conveniently changed outside of the machine and in less than one minute. With the push of a button, the sliding spindle carriers retract from the machine base, allowing the operator easy access to the tooling area, and spindles are furnished with quick change tooling adapters, enabling even faster tool changeovers. With another push of the button, spindle carriers slide back into the base and the machining process continues.

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