➤ BY CHARLES RUSSELL

Making Sure Parts STAY PUT

Developments in rare-earth magnetic chucks.

Even though magnetic chucks have been around for years, and are often used for grinding operations, they also find application in milling, drilling and electrical discharge machining.

A rare-earth magnetic chuck allows a user to hold ferrous parts that are difficult or impossible to secure any other way, even with a non-rare-earth magnetic chuck.

WEN Technology

A set of four 20"X32" NG100 magnetic chucks on angle plates for large mold components with a part mounted (left) and without.

'Rare' Developments

Rare-earth magnets consist of materials such as samarium-cobalt and neodymium-iron-boron. In the 1970s, the first magnetic materials to incorporate rare-earths were introduced to the metalworking industry. The main rare-earth raw material in these magnets belongs to the lanthanide series of the periodic table.

Developed in 1966 and refined in 1972, samarium is used to make powerful magnets that can withstand temperatures of up to 250º C. They are made from an alloy of samarium and cobalt.

Neodymium-iron-boron magnets were developed in 1983 and are currently the most powerful family of magnets available. However, NdFeB rare-earth materials are highly susceptible to corrosion, so they are always coated with zinc, nickel or epoxy.

Rare-earth magnets are far more powerful than the alnico and ferrite (ceramic) magnets often found in workholding systems. As a result, they provide far greater gripping force when holding ferrous parts that can't be held by other methods. Also, magnetic chucks are ideal for holding parts that must have five of its sides cut. Vises and other workholders limit the cutting tool's access to a part's surfaces.

Three types of magnetic chucks are available: permanent, electromagnetic and permanent electromagnetic. Permanent magnets switch on and off through their alignment within the chuck to the mild-steel surface on the chuck's top. The alignment is designed so that in the off position, the magnet is hidden from the workpiece and no longer affects it. The clamping force of a permanent-magnetic chuck is restricted, because the machine operator has to overcome the magnetic resistance when turning the chuck on and off.

With an electromagnetic chuck, an electric current runs through a coil wrapped around a soft iron core to create a magnetic field perpendicular to the coil. Because these magnets must always have power to create a magnetic field, if power is lost, so is the clamping force. Therefore, these chucks aren't recommended for machining centers and pallet changers. Also, the electricity that produces the field generates large amounts of heat within the chuck and on its surface.

Permanent-electromagnetic chucks are smaller and more powerful than other types of permanent-magnetic chucks. Along with NdFeB, these chucks incorporate alnico magnets that serve as magnetic switches. Magnets are turned on or off in less than a

second by changing the polarity via an electric-current pulse. Electricity only turns the magnets on or off. It's not required to maintain the magnetic field.

Application-Specific

Manufacturers of magnetic workholders offer products for specific operations. One is milling.

"Rare-earth magnetic chucks offer a lot of flexibility for milling applications, because machine operators don't have to program their spindles to avoid clamps and vises," said Bob Collins, manager of workholding products at Hermann Schmidt Co., South Windsor, Conn. "However, cutting forces must also be taken into consideration when using a magnetic chuck, because side forces, which are the chuck's weakest area, could exceed its holding capabilities. By knowing the size and shape of a workpiece and the speeds and feeds of the machine, calculations can determine if the side force is going to be too great for the application."

Collins said Hermann Schmidt is developing new rare-earth magnetic chucks for high-speed machining applications. He expects to have several prototypes ready for cutting tests this summer.

WEN Technology, Magnetics Div., Raleigh, N.C., has developed a new series of permanent-electromagnetic neodymium chucks designed specifically for milling ferrous parts, said the company's president, John Powell. The chucks can be oriented either vertically or horizontally, and can be used with rotary tables and palletized systems.

Walker Magnetics

Permanent-magnetic chucks provide uniform part-gripping pressure when milling, which reduces machine-induced vibration.

"Designated 'Neo-Linear' for their powerful magnets and simple linear-pole design, these chucks are engineered as complete workholding systems," Powell said. They are available in two versions: The NL50s have 2"-wide poles and are best-suited for larger parts, and the NL25s have 1"-wide poles and are well-suited for smaller, thinner parts.

The linear-pole layout provides flexibility and simplicity, and the chucks' tapped-hole pattern allows the user to attach a full array of optional accessories. A typical setup would be one in which mild-steel risers are used to raise the workpiece, for clearance, when edge milling and through-hole drilling.

Offering up to 11 tons/sq. ft. of pull, the gripping force is consistent over the entire face of the workpiece and helps provide excellent accuracy and finish,

reduced cutting vibration, improved tool life and fast, easy setups.

Powell said WEN Technology's new Neo-Grid chucks are offered in three standard pole sizes and two standard powers. The smaller poles—NG50 features 2" square poles—provide the best solution for small or thin parts. For larger parts, WEN offers the NG75, which incorporates 3" square poles. The NG100, which has 4" square poles, is for large parts.

Walker Magnetics Group/O.S. Walker, Worcester, Mass., recently launched a new style of rare-earth magnetic chucks designed specifically for use with high-speed machining centers. Walker's LP-HSM permanent-magnetic chucks have a unique low-profile design and feature a dual-magnet pack system. Its NdFeB magnets provide nearly twice the holding power of standard-height magnetic chucks.

They are designed for use with or without referencing systems in applications ranging from manually operated to automated robotic systems. Additionally, all LP-HSM chucks have their surfaces ground flat, parallel and square within 0.0002". Size is held within 0.0002" in the Z-dimension. These magnetic chucks are available in two sizes: 6"x12"x1.732" and 12"x12"x1.732".

Walker also has two new styles of NdFeB magnetic chucks designed specifically for sinker and wire EDMs. They are available in sizes from 2"x2" to 12"x12".

Styles include a low-profile, permanent-magnetic chuck that can be mounted directly to the machine table via two counterbored through-holes or toe clamps with a removable handle and end stop, and a standard wire EDM, permanent-magnetic chuck engineered to handle large or tall workpieces. All surfaces on the chucks are ground flat, parallel and square within 0.0001". △

The following companies contributed to this report:

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