Eccentric action **punches, cuts off** heavy strip

BY J. NEILAND PENNINGTON

Compact, high-speed units consume a steady diet of 10-gauge steel.

Photographs courtesy of The Bradbury Group.

The close-coupled tandem placement of the Viper pre-punch and pre-shear units reduces roll forming line length. The view is toward the line infeed, with the shear in the foreground.

In the roll forming industry, the standard technology for punching and cutting off heavy-gauge sections has for years been linear flying-die or feed-to-stop presses. Rotary punch and cutoff equipment, with its faster cycling, lower cost and smaller space requirement, was usually limited to thinner materials, typically less than 14 gauge.

A fourth technology has emerged in the last year and a half that offers an alternative to flying-die or feed-to-stop systems. A patent is pending on equipment that The Bradbury Co., Inc., markets as having the speed and space advantages of rotary punches with the higher thickness capacity of linear-motion tooling.

The Moundridge, Kan., firm has trade-named the system the Viper, which it designed for steel from 20 gauge to 10 gauge. The Viper units nominally resemble rotary equipment in their relatively small dimensions, and they contain rotating components. But there the similarities end. The Viper replaces rotary drums containing fixed punches and dies with eccentric heads whose crankshaft action

produces the perpendicular tooling motion of conventional flying-die or feed-to-stop presses.

Rotary tooling is fixed on drum carriers and cannot extend and retract. This can lead to punch clearance problems with heavier-gauge metal, said Greg Smith, engineering manager at Bradbury. "It is very difficult to get the clearance correct between the punch and the die because the tooling enters and exits the strip obliquely. The tooling must be ground on a radius to accommodate the entry and exit angles."

The radius requirements make rotary tooling costly to purchase and maintain, added Phil Bradbury, a consultant to the company's parent Bradbury Group and a former senior manager of R&D and marketing. "The radius on rotary tooling requires a compound, multi-axis grinder," he said. "The Viper punch approaches the strip at a 90-degree angle, so it uses lower-cost flat-ground tooling that is easier to sharpen."

Horizontal and vertical motion

Greg Smith's formal description of the Viper technology is "an arrangement of eccentric hubs, driven by timed pinion gears, to obtain reciprocating horizontal and vertical motion of the punch and die from a closed-loop, high-capacity drive." An AC servomotor powers the pinion drive through an antibacklash gearbox. The pinion gear engages low-backlash gears that drive the upper and lower eccentric heads, which act like a pair of press rams.

The punch and die are contained in the two eccentric heads. The punch strokes down; the die strokes up.

The reciprocating motion provides both vertical and horizontal action for the punch and die. "The punch and die move in a plane perpendicular to the strip, but they also move horizontally with the strip," Smith explained. "The two tools begin to engage the strip before the eccentrics reach bottom dead center and withdraw as the eccentrics move past bottom dead center. This movement provides a substantial horizontal stroke length to track the movement of the strip."

Servomotor power

An AC servomotor synchronizes the punch and die with the strip. The proprietary dual closed-loop controller (built by Bradbury affiliate Beck Automation of St. Louis, Mo., under the Sierra trade name) integrates the signal from an encoder on the servomotor with an encoder on the strip. Punching and cutoff accuracy is within 1/16 inch at 300 feet per minute.

The eccentric action approaches the speed of rotary tooling. Bradbury's engineers specify the Viper's strip velocity as 240 feet per minute for 10-gauge steel when punching on 24-inch centers. For 14-gauge steel, the linear speed increases to 300 feet per minute, again punching on 24-inch centers. This nearly doubles the capability of Bradbury's flying die sets working 14-gauge material on 24-inch centers. Its nominal limits for flying dies are 160 feet per minute punching on 24-inch centers and 240 feet per minute on 48-inch centers.

The speed advantage is the result of eliminating two-direction linear

A REPORT FROM THE FIELD

The steel framing industry knows how to keep its secrets. Although there are at least four Viper-equipped roll forming lines in operation, only one of the users would share any performance information, and the company requested anonymity.

We talked to the director of manufacturing for the Viper's beta test site and the executive who made the purchase decision. He was impressed by the equipment's compact dimensions.

"The size of the Viper compared to a flying die allows more production machinery in a given space," he said. "It also permits a smaller plant without sacrificing capacity."

The line speed, he declared, is exceptional. "The Viper runs like nothing I've ever seen. In my early days in the industry, we used four-post pneumatic presses. On structurals, we rarely ran in excess of 150 feet per minute. When we converted to higher-speed hydraulic presses, we ran at up to 200 feet per minute for heavier gauges. The Viper raises that to 300 feet per minute."

Raw speed is a somewhat overrated specification, he suggested. "The problem is removing heavy-gauge parts from the outfeed and handling them fast enough to keep pace with the line. But if you can change your part numbers efficiently and have the means to handle the material, you may have to run only one shift per day instead of two.

"We generally don't get large piece-count orders in the steel framing industry," he continued. "Items are custom-produced and are usually small orders. We can't set up a line and run for two days. In fact, we may change a line six to eight times per shift."

The Viper adapts rapidly; spacing changes are made through the controller. The only mechanical intervention is installing a new die set.

Has the Viper taken a bite out of flying dies' market share? Not if high volume isn't needed, the spokesman said. "If I'm producing for limited distribution, not supplying other plants or have lead times that aren't critical, and if my market research indicates the demand will stay relatively small for some time to come, conventional technology may be applicable."

His company was in the opposite situation. "We were producing at a very rapid clip, and I couldn't afford a long startup time with new technology," he said. "Bradbury had a hydraulic flying die backup system available if there were problems with the Viper." The safety net went unused.

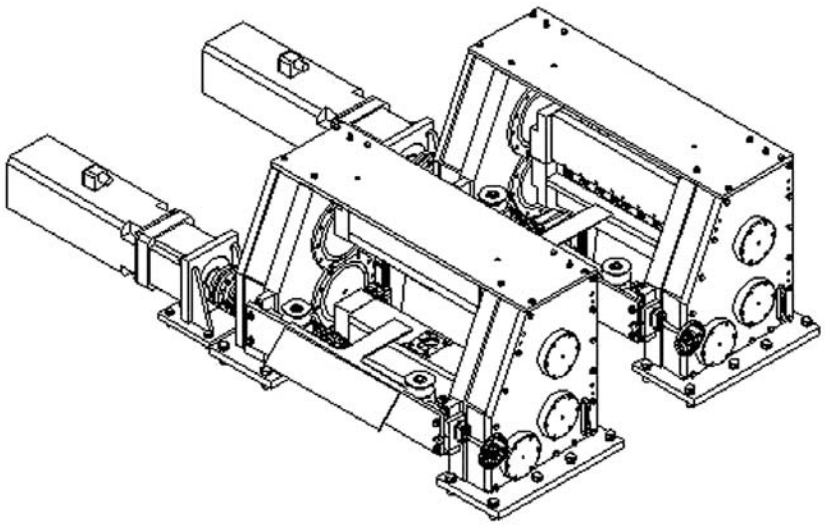

Illustration courtesy of The Bradbury Group.

Engineering drawings detail the punch (foreground) and shear. The punch is shown in the open position, with the upper and lower eccentric heads at top dead center. The shear is closed, with the heads at bottom dead center.

movement of a large tooling mass, Phil Bradbury pointed out. "A flying die has to accelerate from a standstill, find its location, cycle the press, decelerate to a standstill and return to the home position," he said. "With dies large enough for 10-gauge steel, the size of the dies and presses limits line speed.

"The mass of the Viper tooling is less, and the rotational motion is in only one direction," he added. "There is no reverse stroke."

Small footprint

Bradbury's reciprocating technology is compact because there are no tracks or ways on which tooling travels. "The footprint of the Viper is smaller than it is for flying dies, an average of 6-feet shorter," Smith stated. "We don't require additional space for linear movement."

When the Viper eccentrics are at top dead center, there are nearly 11 inches of clearance between the punch and die. This enables Bradbury to offer hands-free threading for the line. "You have to have the leading edge of the strip accurately oriented to pass between the upper and lower drums on a rotary punch, said Ryan Durst, Bradbury's senior manager of sales and marketing. "For threading the Viper, each servomotor stops the eccentrics in the open position."

Viper punch and cutoff technology was introduced in the steel framing industry, but it isn't exclusive to that market. "The Viper may be a can-

The Viper punch and shear initially have been integrated into Bradbury's structural roll forming lines for the steel framing industry. The next phase: Marketing the technology to custom roll formers.

didate for any application in which repeated punch and cutoff patterns are required," Durst stated.

He acknowledged that the punch form is fixed, unlike feed-to-stop presses with automatic die gagging to produce a variety of patterns from one tool. "We can program the spacing of the punch to vary the centers on each part setup," he said. "We are not limited to 24-inch or 48-inch centers. But the shape of the punch can't be varied without changing the tooling."

After 18 months in the steel framing market, the 10-gauge to 20-gauge Viper punch and cutoff are being augmented by versions for 20 gauge to 26 gauge. Designated the DW Viper, the machines are designed for the drywall market.

"The original Vipers were for structural members used in exterior walls," Durst noted. "The DW is aimed at light commercial and residential track and stud profiles. We will be running studs at 500 feet per minute, punching and cutting off within ⅛ inch." ■

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