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How they build the Bridgeport

Below: Operator checks thickness of a cast-iron workpiece machined by new 4-hp vertical mill.

METALWORKING IN AMERICA

How they build the Bridgeport

'A lathe, a grinder, and a Bridgeport put you in business,' it's said. Imagination and skill combine to produce the world's most successful—and most copied—milling machine

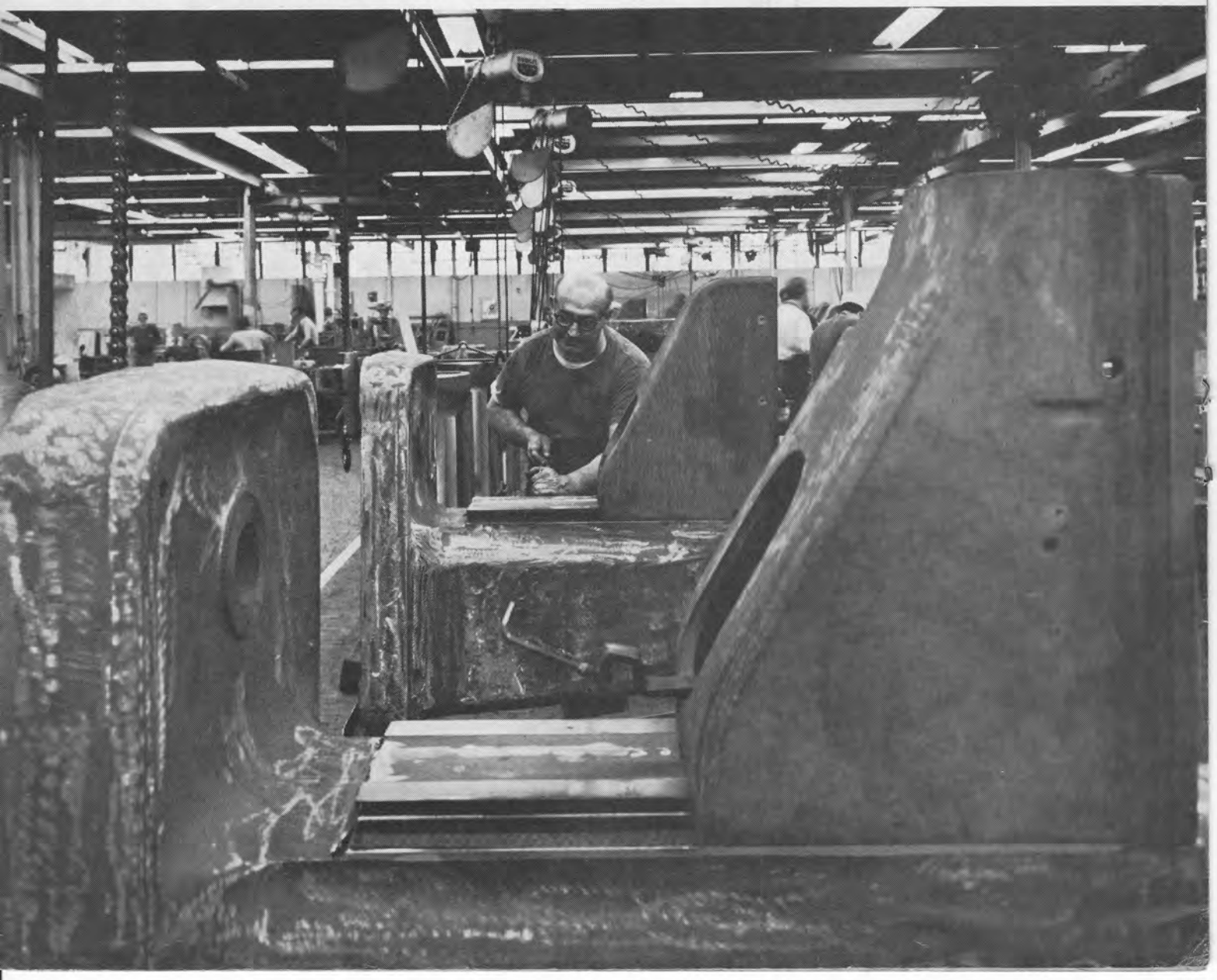
Just 32 years ago this month a machine tool was shipped to Precision Castings Corp. in Syracuse, N.Y. That machine made history. It was, first of all, a unique piece of equipment at that time. But, more than that, it has become the prototype for the most ubiquitous machine tool ever built, a machine tool that's familiar in shops around the world, and a machine tool whose users range from the world's largest manufacturing corporations to hobbyists in basement workshops.

That machine, of course, was a Bridgeport turret milling machine—carrying Serial No. 1.

Nearly 140,000 "Bridgeports" have been built in the years since that shipment on Aug. 1938, and the little Bridgeport mill holds tenaciously to a position in the machining world that is analogous to that once held by the DC-3 in air transportation.

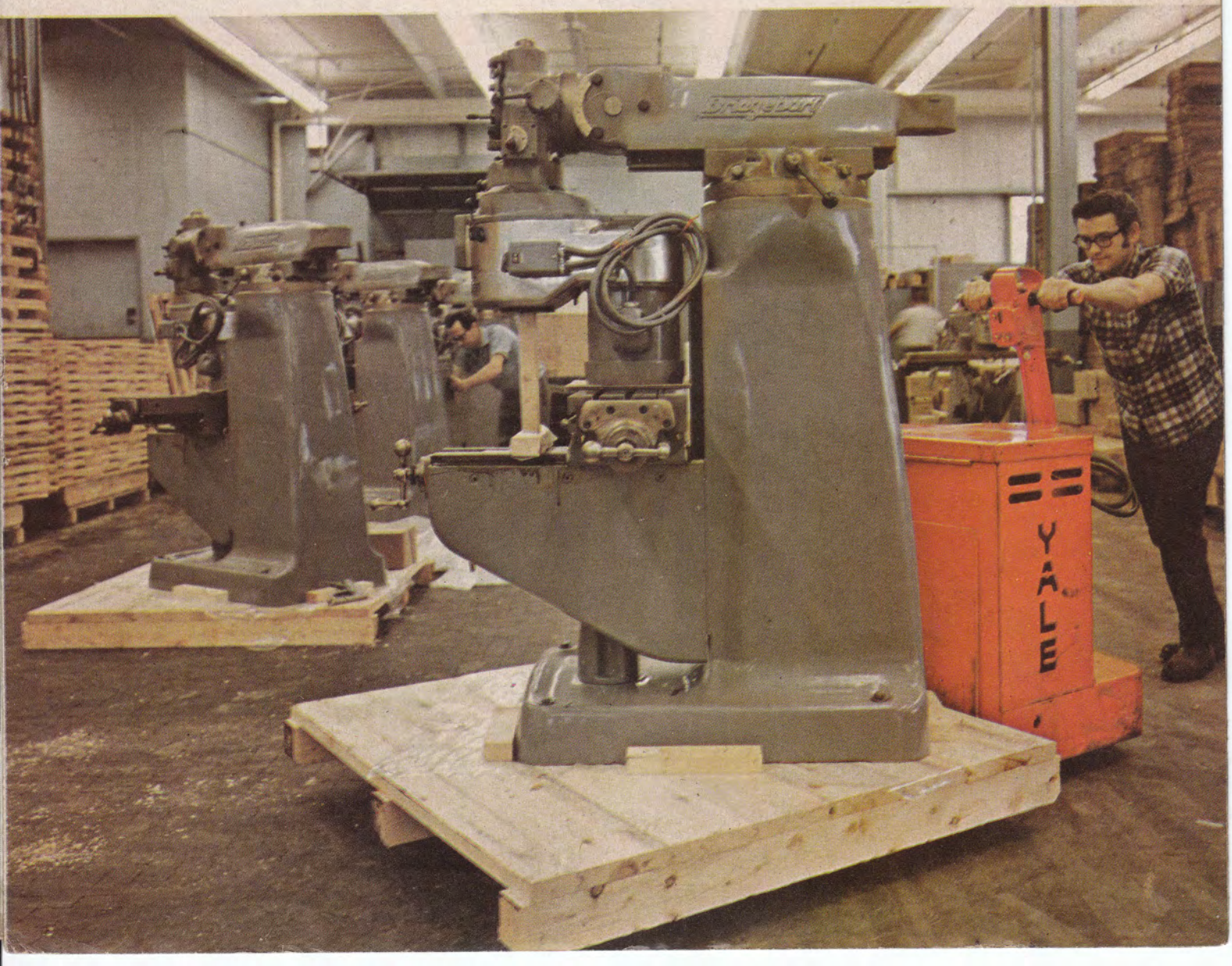
"The machine is so basic," explains Ernest H. Noren, vice president of Bridgeport Machines, "that if somebody wants to start a tool and die

Mating knee to column ways of a standard Bridgeport demands high degree of skill in hand scraping. Variation of standard knee casting in foreground is for 3-D tracer model. AM photos by Joe Ruskin



Named president of Bridgeport early this year was former Waterbury Farrel executive vice president France Wilson (foreground). Leaning on table of Bridgeport Mill No. 1 is vice president Ernest Noren. Shipped on Aug. 8, 1938, to Precision Castings Corp. in Syracuse, N.Y., No. 1 was re-acquired, cleaned up, and put on display at Bridgeport

Bridgeport Mill No. 138,057 was crated for shipment in June. Its destination was Machinery Sales Co., Los Angeles, one of the company's network of 43 U.S. dealers (below)



shop, or a toolroom, or something similar, a Bridgeport is what he needs. Add a lathe and a grinder, and he's in business."

The simple truth in this statement has not gone unrecognized by other builders of machine tools, and other machines are available today that provide the features that made the Bridgeport unique in 1938. But Bridgeport's running headstart has kept the New England firm well in the lead, and its volume production has enabled it to keep unit production costs—and prices—low.

One confirmation of this enviable position came from a machine tool importer that has made quite a business of having lathes, milling machines, grinders, and other machine tools built overseas to its specifications. The company does this in a big way, frequently placing an order for 1000 or more of a particular machine.

At one time the importer tried to line up a Japanese company to build a copy of the Bridgeport milling machine (on which the patents had already expired). A new Bridgeport was sent to Japan with the understanding that if a satisfactory copy could be made at a good price there would be an order for 1000.

Ultimately, the importer received two copies of the Bridgeport. Both were beautifully built, and the parts were interchangeable with the original. But the deal fell through because of price. The Japanese quotation was nearly double the market price of a Bridgeport-built Bridgeport.

The head came first

Origin of the Bridgeport milling machine dates back at least to 1929, when Magnus Wahlstrom joined Rudolph F. Bannow at the Bridgeport Pattern & Model Works. Bannow, a patternmaker by trade, had joined the firm in 1923 and worked his way up through the ranks, finally purchasing it in 1927. Wahlstrom, a toolmaker, had bought some wooden parts from Bannow in 1928, and the two Swedish immigrants hit it off together.

When they joined forces, it was for the purpose of developing an electric hedge-clipper, but the idea of a self-contained high-speed milling attachment took precedence. Powered by a ¼-hp motor, this unit could easily be mounted on a machine tool, and it provided the high speeds needed for using small cutting tools. The first of these was delivered in 1932 (to Atlas Tool, of Bridgeport), and despite the economic conditions prevailing, it proved a commercial success.

But the partners didn't stop there. They sought to improve the utility of that early Model C head, and in 1936 they brought out a new version incorporating a quill. This version, now with a ½-hp motor, added the ability to perform drilling and boring operations as well as milling, and the fledgling company began to grow.

The next logical step was to build a machine on which to mount this multi-purpose machining head—and the basic concept came to Bannow as he was delivering a pattern (the firm was still in this business). Thus was born the Bridgeport turret milling machine: it was sketched on a paper bag as Bannow sat in his half-ton truck.

U.S. Patent No. 2,275,291 covering a "machine tool operating at universal angles in overall locations" was granted to Bannow on Mar. 3, 1942. The essence of this was a conventional knee-and-column machine but surmounted by a turret carrying an adjustable, cylindrical overarm at the forward end of which was a self-contained machining head. The head-to-overarm mounting was fully articulated. The combination provided the ability to machine a workpiece at virtually any angle and in any plane other than the bottom. In all, 23 claims were made and granted.

Machine No. 1 was shipped long before that patent was granted, of course, and the quick acceptance of the unique Bridgeport mill quickly led to company changes. The pattern-making portion of the business was sold, and in 1939 the firm was incorporated as Bridgeport Machines Inc. There was no doubt now what business Bannow and Wahlstrom were in.

Pricetag on that initial model, the ½-hp BHM, was $995.

And people bought the machine. Even before the patent was granted, it was necessary to build the first addition to the factory, and a second addition was built in 1944. Early in 1945, the 5000th Bridgeport mill went out the door.

World War II ended, and the U.S. economy shifted from bullets to butter—demanding a new addition to the factory in 1946. Where it had taken six and a half years to build and sell the first 5000 Bridgeports, it now took less than four to ship the next 5000. No. 10,000 was sold in Oct., 1948. Another 4475 Bridgeport mills were built in that plant up until Dec., 1951, when the present plant was opened at 500 Lindley St.

No. 20,000 was shipped in Mar., 1954, and with capacity expansions in '55, '57, and '60, the total was raised to 50,000 by June, 1960. Along the way Adcock & Shipley was licensed to build Bridgeports in England, and the True-Trace Corp. was purchased.

The pricing and development history of the standard Bridgeport mill contributed as much to corporate growth as the physical plant expansions. The $995 pricetag on the ½-hp BHM stood firm from 1938 to 1950, when it was boosted to $1115. The improved Model J head, with a 1-hp drive motor, supplanted the Model M as the standard head about 1954, and the Model BHJ milling machine was priced at $1370. The original cylindrical overarm was replaced by the present ram in 1956 at a price of $1575 for the Model BRJ mill. That price was to hold steady for 12 years.

The decade of the '60s, however, brought more changes to the corporation than it had experienced before.

Rudy Bannow, the immigrant patternmaker who had purchased the nucleus firm, who had invented and patented a new concept in milling machines, who had headed not only Bridgeport Machines, but also the National Assn. of Manufacturers in 1960, died suddenly in the summer of 1962.

Magnus Wahlstrom then took over as president of Bridgeport Machines. And growth continued. New facilities were added to the plant in '63 and in '65; employment grew from fewer than 500 to 700 by the end of '66; and in Mar., 1967, the 100,000th Bridgeport milling machine came off the assembly line.

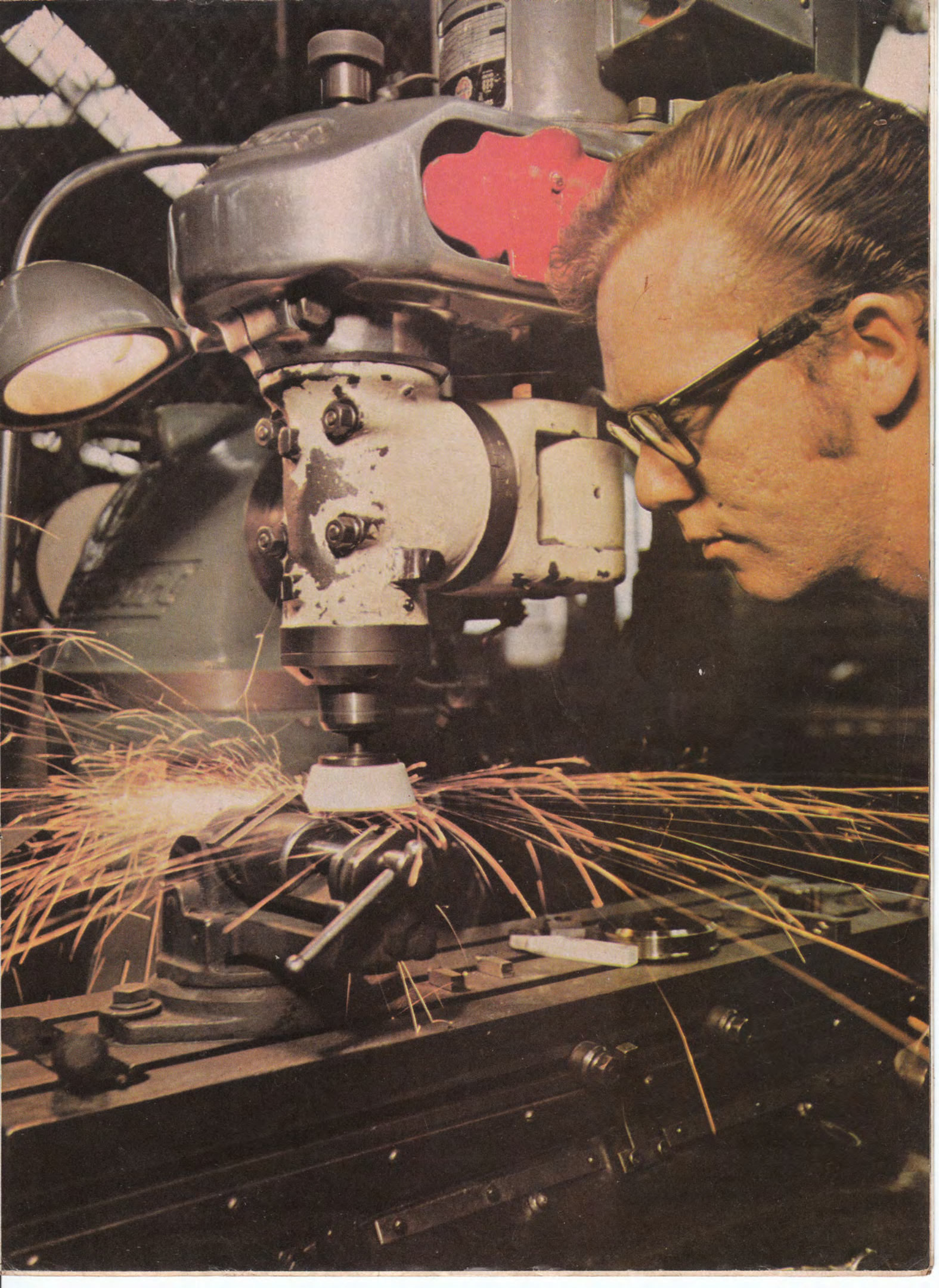
The pace of inflation was quickening, however, and the basic Model BRJ milling machine, priced at $1575 since its introduction in 1956, was raised to $1745 in 1968. Popularity of this model, with a 9-in. cross travel, was giving way before demand for the Model 12 BRJ, with its 12-in. cross travel. The latter model, carrying a $75 premium at $1820, had now become the standard, and a 10% boost on Jan. 1, 1970, has brought the price to $1992 for today's standard Bridgeport, the Model 12 BRJ.

Textron takes over

The decade of the '60s was aiso the era of the corporate conglomerate, and Bridgeport Machines was acquired by Textron early in 1968.

Wahlstrom remained at the helm as president and chief executive officer of Bridgeport Machines until early

Versatility of the basic mill is highlighted throughout entire plant in such applications as backing off the steel shank (hence the sparks) of this brazed carbide lathe tool with an aluminum oxide grinding wheel



this year when, at the age of 66, he retired from his active role and was named chairman of the division.

At this point France Q. Wilson became the third president of Bridgeport Machines and the first one from outside the company. An electrical engineering graduate from the Univ. of Kansas, Wilson had been in industrial sales engineering in other firms when he joined Waterbury Farrel (another Textron company) as sales vice president in 1960. In 1963 Wilson became executive vice president and later chief operating officer (with A. S. Nippes as chief executive officer).

Wilson describes his years at Waterbury Farrel as "challenging, exciting, and fulfilling." The first task was to modernize and streamline the company, which had been acquired by Textron in 1958. And as soon as stability had been achieved, Jones & Lamson was purchased. This acquisition was followed by a period of realignment and integration of many of the parallel functions of the two firms. That done (and a Belgian operation acquired), it started all over with the purchase of Thompson Grinder. In the ten years Wilson was with Waterbury Farrel, corporate volume rose five-fold.

There had been an almost continuous process of growth, consolidation, streamlining, and new acquisition, and, in Wilson's works, "it certainly was never dull."

Installation of a man with this background as president of Bridgeport could hardly help but create a feeling of uncertainty among the firm's old-line employees. Virtually any takeover is almost invariably accompanied by feelings of foreboding.

But Wilson emphasizes the differences between Waterbury Farrel in 1960 and Bridgeport in 1970. It's true that Textron keeps close tabs on its member companies, particularly in the financial area, but it allows almost complete autonomy in other areas as long as the company conducts its operations in a businesslike manner.

And Bridgeport is a good and long-term successful operation. There is no need, Wilson notes, for any crash program of rapid change and rebuilding at Bridgeport. "With Textron's backing," Wilson predicts, "Bridgeport should be able to expand as the need and opportunities present themselves. We will continue to grow and go even further than we have by building on the base we now have."

Wilson's right-hand-man is vice president Ernie Noren, who's been with Bridgeport since shortly after World War II. Credited with a prime role in making the Bridgeport mill the world's most famous machine tool, Noren became the company's sales manager in 1948, and his duties have since expanded to include involvement in both corporate policy and daily operations of the firm. He became vice president in 1963 and was asked to remain in that capacity when Textron took over.

Bridgeport today

Bridgeport's manufacturing facilities are unusual, and in many ways unique, in the machine tool industry. As Noren says, "Nobody builds machines the way we do. Because of the tremendous market and the volume that we've had, we were able to tool up for it. We've built

Ram is assembled to turret after wiping down dovetails (above) in line that feeds into three main assembly lines (right) where completed machines are built up. Machines move on wheeled pallets

many special machines for particular operations, and there's a continuous flow of the same parts that go through week after week, month after month."

A walk around the Bridgeport plant quickly confirms this. One is especially struck by the great number of unfamiliar-looking special-purpose machines mounting the familiar Bridgeport head with its shiny aluminum belt-drive housing. There's a tall "Bridgeport" for a deep boring operation, and "side-saddle" ones for horizontal jobs. And there are several with paired vertical and horizontal heads for simultaneous operations. The photo on p101 shows one of a number of only slightly modified Bridgeports used for cutter grinding.

Three parallel assembly lines (see photo on p103) for the standard Bridgeports take components and subassemblies from other departments and build up complete milling machines at rates of up to one every ten minutes.

Both Wilson and Noren give considerable credit to the members of the work force, numbering some 750 production employees of a total approximating 800. As Wilson puts it, "The employees are about as dedicated as you can find," while Noren adds, "and they've done a good job for us."

Skills are spread

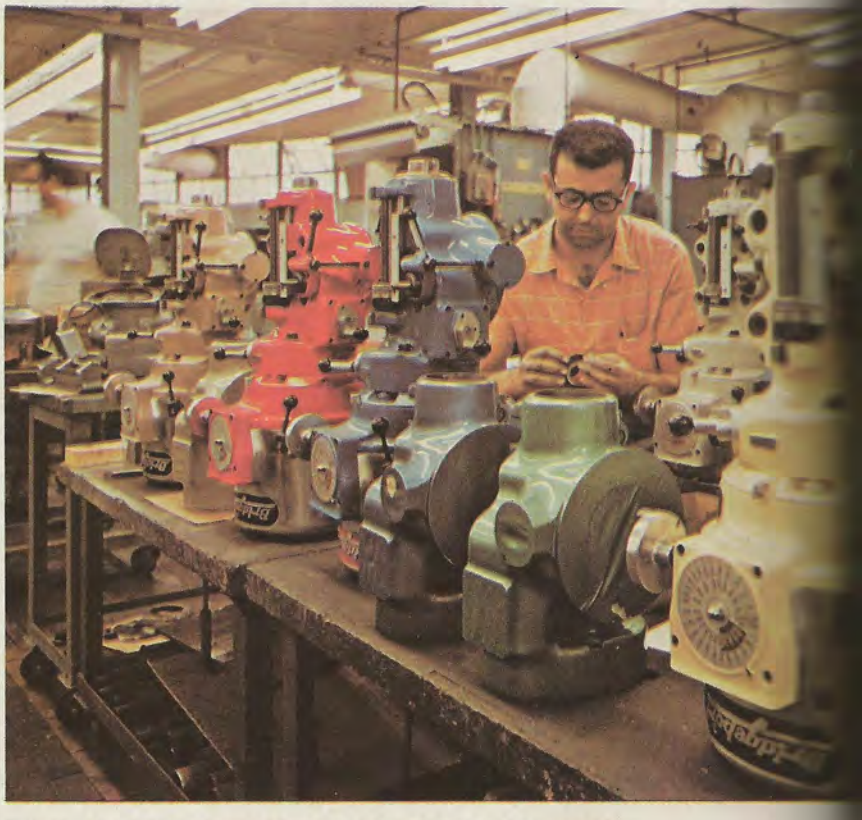
Considerable skills go into the manufacture of a Bridgeport, as they must in any well-made machine tool. But because of the high production volume these skills can be distributed among many workers. Operations tend to be specialized, and they have to be performed so many times that an individual worker need not generally acquire a great variety of skills. This simplifies the company's training necessities, and Bridgeport does not have any elaborate training program.

It's also true that Bridgeport has been a good employer, especially in an industry that's been noted for its ups and downs. Following the Korean war there was a slump in general machine tool sales, and Bridgeport didn't escape it. Sales were off, and the company cut working hours but kept on building Bridgeports—for inventory.

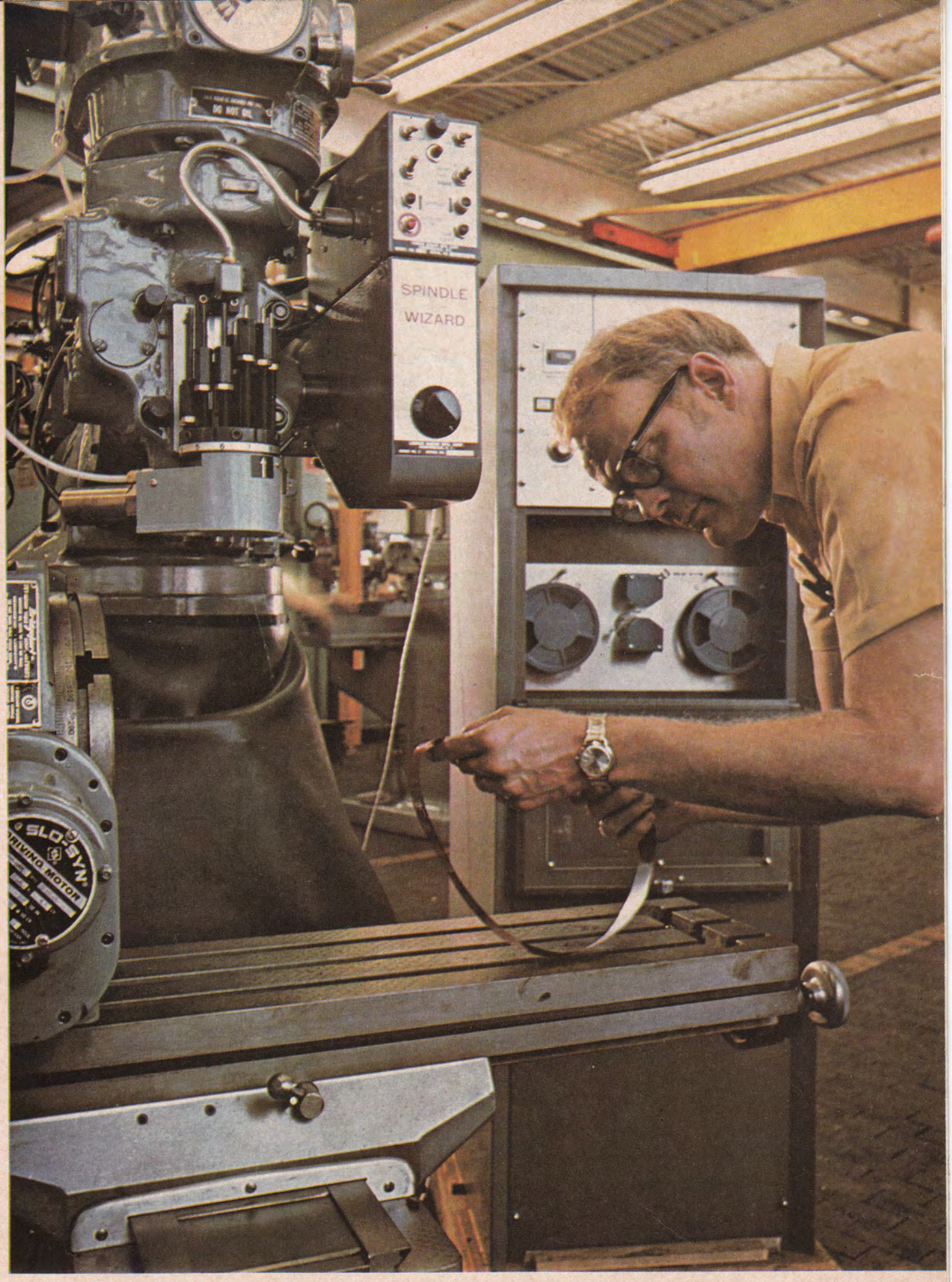
A similar situation prevails today. "We've cut back," Noren admits. "We're down to 40 hours now instead of 50, and we don't have a big backlog anymore.

"Up until a short while ago the machines were at a premium, of course, and our backlog grew. A customer would have been foolish not to place an order for a Bridgeport because he had nothing to lose: He could cancel if he didn't need it when delivery time came, and, of course,

Broad range of attachments and accessories enhances overall utility of basic machine. Here contact points are adjusted in power feed unit



Colorful display is planned for the Machine Tool Show this fall. A variety of paints were tested before final selection of colors for exhibit



Bridgeport went NC early this year with Slo-Syn controls, stepping motors, and ballscrew drives. Operator checks a looped test tape for control of rotary table by third axis of NC system

this is what happened in most cases. Or he could sell it for more than he paid for it. Or he could even sell his old one and get as much for that as he had to pay for the new one.

"That's changed now, and business isn't what it was. That's for sure. And I don't look for anything to move very much before late fall. The summer months are always slow because of vacation shutdowns, but there's still a big market for our machines."

And Bridgeport today is getting ready for the tomorrow when the machine tool cycle rebounds again. The Bridgeport line, of course, now includes far more than standard manual machines. There are 1-D, 2-D, 3-D, 3-DA, and Synchro-Trace models that represent a marriage of multi-headed T-ram versions of the Bridgeport mill with hydraulic tracer and copying systems built by True-Trace. Then there's the Bridgeport Line-A-Mill, combining essentially the same T-ram mill with an optical line-tracer control system.

Earlier this year Bridgeport also introduced four numerically controlled versions of the basic milling machine. Using Superior Electric's Slo-Syn tape control systems, the four versions are two-axis point-to-point ($13,500), three-axis point-to-point ($16,500), two-axis contouring ($20,650), and three-axis contouring ($22,750).

These machines, incidentally, are far from standard Bridgeports retrofitted with NC. Among the modifications incorporated to better suit the Bridgeport to tape operation are 1¼-in. ballscrews, stiffened nut brackets on table and saddle, stiffer bearings, chrome-plated ways, and automatic lubrication systems.

But the big news for Bridgeport in 1970 will be the introduction of the all-new Bridgeport Series II milling machine scheduled for the Machine Tool Show this fall. Pictured below and on the front cover of this issue of AM, the Series II is more than just a scaled-up Bridgeport. It represents the current thinking of the company that has built more turret milling machines than any other machine tool builder in the world And, like its older little brother, it is designed to be the nucleus of a complete line of machines, accessories, and attachments.

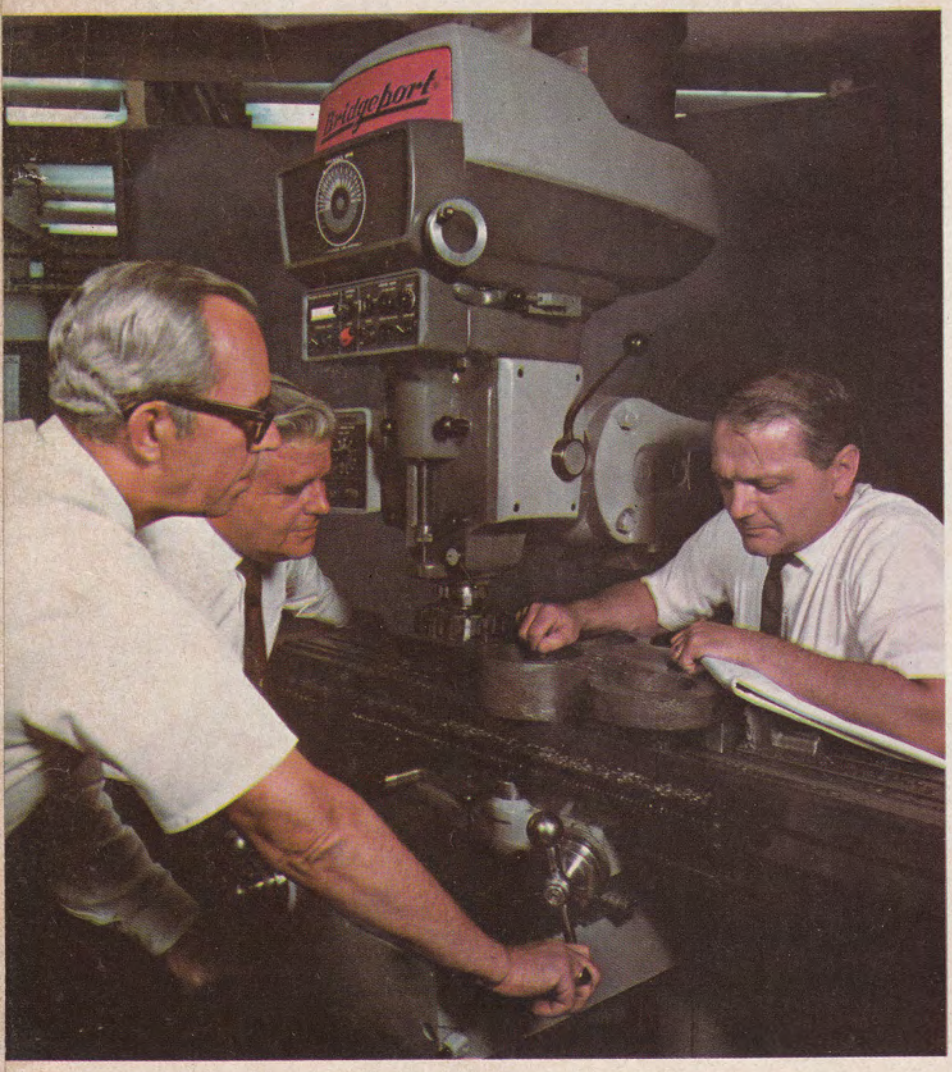
Starting with its 4-hp spindle drive, the Series II presents a totally new list of specifications for Bridgeport. Weighing in at 4300 lbs, the Series II provides an 11 x 58-in. table with 15 x 30-in. horizontal travel at feedrates of from ¾ to 24 ipm and a 16-in. vertical knee travel at ¼ to 12-ipm feedrates.

Available basically as a manual machine, the Series II can be turned into a power-feed machine with easily attached modular transmission units that do not require any major disassembly.

Chrome-plated rectangular ways of generous proportions provide for maximum stability with heavy and overhanging loads. Non-floating gibs yield identical "feel" as table or saddle is cranked in either direction. Leadscrews are 1½-in. diameter, 5-pitch Acme thread or ballscrew.

The spindle, which incorporates infinitely variable speed adjustment from 50 to 3500 rpm (much like the Model 2J head for the "Series I" Bridgeport), has a No. 40 taper and provides for both drawbar tool retention and the Bridgeport quick-change toolholding system.

As this issue of AM went to press, no price had yet been established for the Series II (firm quotes hadn't yet been received on castings and other subcontracted items).



Bridgeport Series II, to be launched at Machine Tool Show, is discussed by sales manager Ed Forstrom, vice president Ernie Noren, and assistant chief engineer Frank Hogan. Machine has 4-hp head

See it at The Show

The Series II line of machines is planned to include hydraulic tracer and optical line-follower versions as well as tape-controlled models. Bridgeport's planning for the Chicago Machine Tool Show this September includes two NC models of the Series II mill. One will be a three-axis continuous-path machine with Slo-Syn controls, and the other is scheduled to be a point-to-point unit with a General Electric Control system.

Thus, while Bridgeport's Wilson feels that it's still too early to predict the company's future, the Textron division is currently striving to broaden its line internally, rather than by the acquisition route. And with such events as the introduction of the first NC Bridgeports by the company itself and the launching of the entirely new line of Series II machines, 1970 will have produced more changes at Bridgeport Machines than any previous year in its history.■