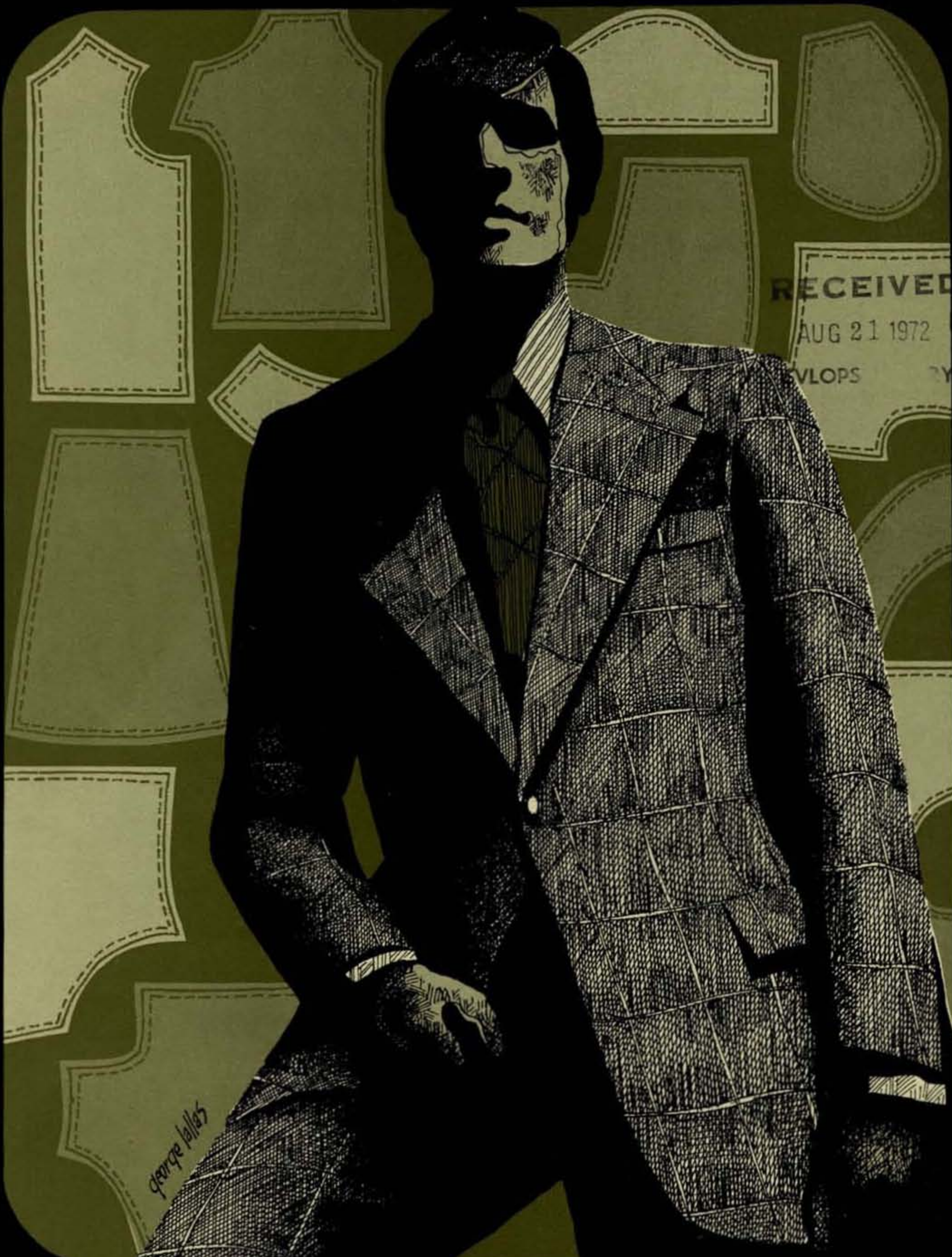
NC SCENE

AUGUST 1972

Numerical Control Applications in the Textile and Apparel Industries



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August 1972

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CONTENTS

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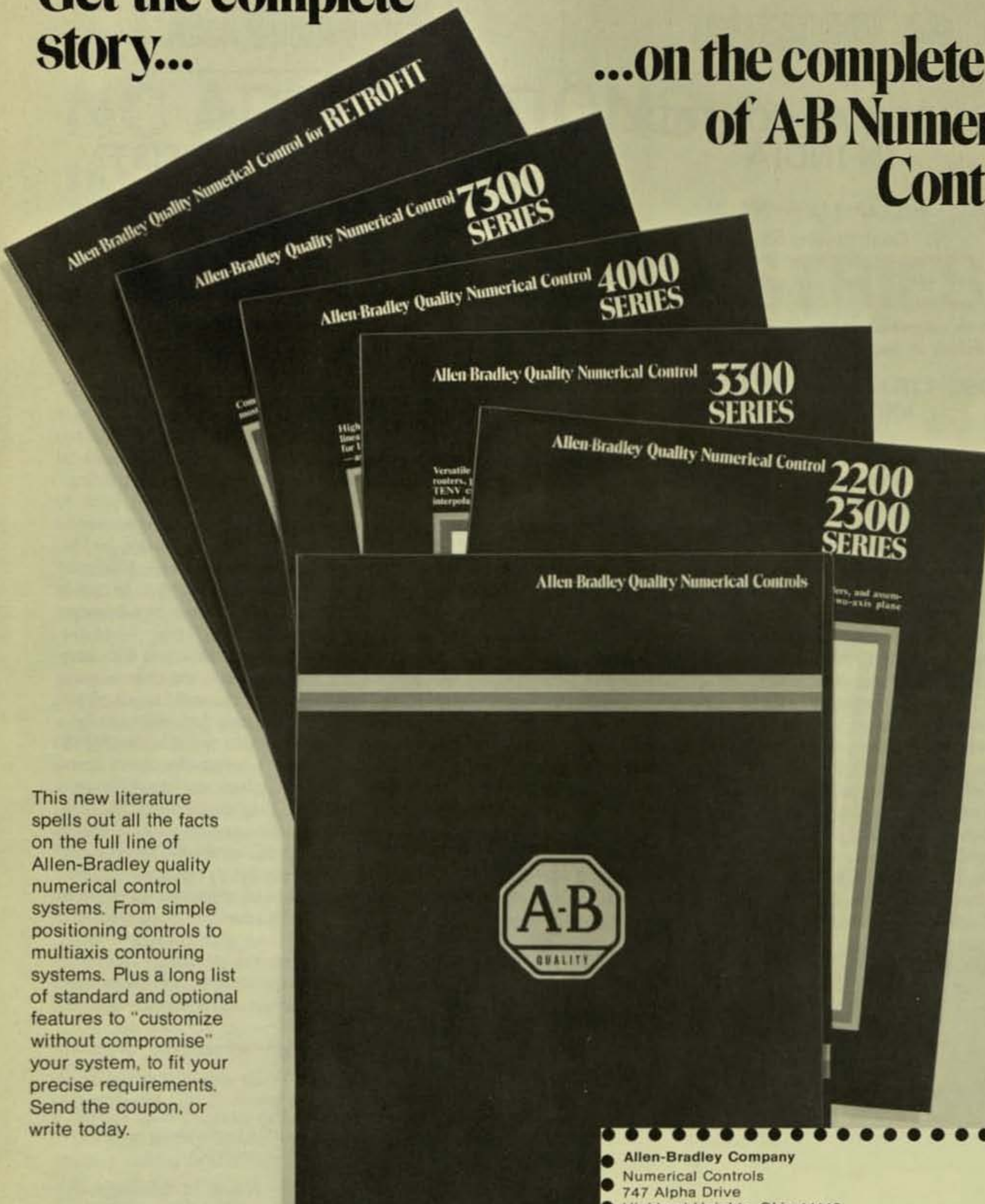

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NC EDUCATION

NUMERICAL CONTROL IN INDIA

WILLIAM M. RYNACK
Contributing Editor

Four-week seminar leads to development of first NC machines in India.

PSG–COLLEGE OF TECHNOLOGY AND POLYTECHNIC

A four-week seminar at P. S. G. included not only general introduction and programming, but coordinate measuring, laser interferometer, NC lathes, hydraulic and pneumatic devices and circuitry, NC management, NC maintenance, and a trip to Bangalore to visit the Hindustan Machine Tool Plant (HMT) and India's Central Machine Tool Institute (CMTI). What is important to remember at this point is that HMT and CMTI are both part of India's public sector, whereas P. S. G. is totally private.

Almost all of the U. S. major NC firms, at the editor's request, sent literature, films, and other valuable information, so much at a premium in India although taken for granted in the U. S.

Throughout the ten years of foreign collaboration (see last issue of *NC Scene*) the main effort was the development of major production equipment, but quite unfortunately there was an almost complete disregard in the production tooling, tool design, and automatic feed areas. Because of the interest, excellent P. S. G. plant cooperation, and the engineers' good knowledge of hydraulics, it was possible to design, develop, and install hydraulic, pneumatic feeds on some existing basic machines. Figure I

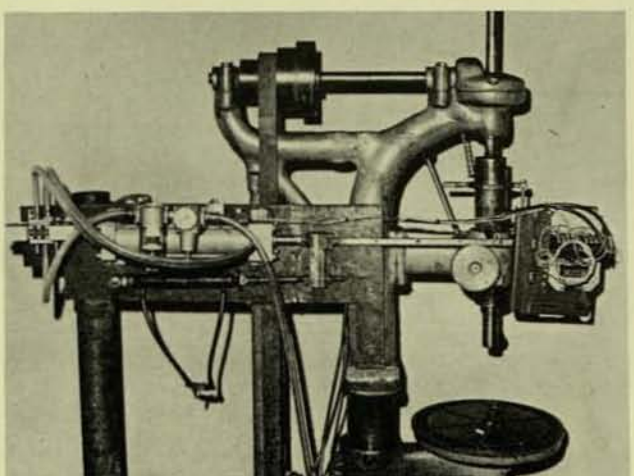

Figure I. Drill press feed.

continued on page 10

NC PANORAMA

NC MYTHS WHY DO THEY PERSIST?

JAMES J. CHILDS
Contributing Editor

Vague and inaccurate technical reporting allows numerous NC myths to continue.

In spite of fact–myths seem to persist. And, unfortunately, numerical control has had an unwarranted share. It may appear unreal to those working in the field, but it is still not unusual to hear the now classic comment that "numerical control is not for us since we produce in small quantities." How this misunderstanding ever came about is hard to determine; perhaps it resulted from the fact that numerical control is a *form* of automation, and automation implies transfer lines and big quantities; therefore, NC must "logically" be equated to big quantities. Not that, in certain cases, it is not suited to relatively large quantities, however, its forté lies in the small-lot field.

Another and equally disturbing myth is that the computer complicates the life of an NC user and therefore any system that doesn't *require* a computer must necessarily be better. This may very well be the case for relatively simple *point-to-point* parts, but it is simply not the case for the great majority of contour parts[1]–even with systems having circular interpolation. Indeed, there are many contour parts, especially lathe parts, that could most likely be handled more efficiently on a conventional machine than to program them manually for an NC machine. This is because all end points as well as tangent points must be calculated with an NC machine, whereas with conventional machines having rotary tables and other accessories, this is very often not necessary.

It is sometimes hard to determine whether NC myths are *generated* by overly ambitious salesmen, or misinformed reporters, or simply *developed* through ignorance. Take the

1. An interesting note is that the total number of NC contouring machines shipped during the last quarter of 1971 was more than *double* the number of point-to-point machines, which portends a growing trend toward the computer. The figures for the system trend are as follows. (Source: Commerce Department)

	Quarter	Contouring	Pt-to-Pt	%Contouring/Pt-to-Pt
1971	4th	223	108	67.4
	3rd	148	108	57.8
	2nd	175	133	56.8
	1st	162	131	55.3
1970	4th	194	165	54.0
	3rd	193	218	47.0
	2nd	196	306	39.0
	1st	199	345	36.6

continued on page 10

NC APPLICATIONS IN THE TEXTILE AND APPAREL INDUSTRIES

By JOHN M. MURRAY

There are more than twenty-three thousand apparel manufacturing units in the United States operating more than a million industrial sewing machines, and there is a probable potential market of a quarter million numerical control applications. Presently, about 30 numerical control sewing machines are operating, leaving 249,970—so it's not too late to capitalize on this opportunity.

At this point no one in the Textile and Apparel Industries knows very much about numerical control—and even worse, those in numerical control know absolutely nothing about the Apparel Industry. Unless the two can somehow get together and learn each other's opportunities and problems, NCS will be having its 19th annual conference 10 years from now and someone will still be reporting that there are only 30 or so NC sewing machines operating in the Apparel Industry.

Applications

The first *serious* application of numerical control in textiles—or the one that probably attracted most attention—was accomplished by Barry McQueen at Evershed and Vignoles in England in 1961. He put a numerical controller on a V Bed knitting machine, and Time Magazine reported that he was knitting a sailboat.

The first *major* application was the Moratonic—a circular knitting machine on which a type of numerical control replaced the conventional cam and jacquard units which control the stitch design, collars, and the type of knit stitch. There are perhaps more than 1,000 of these machines now in operation. Last year North American Rockwell, through their Textile Machineworks Division, introduced their own version of numerical control on a circular knitting machine operated from magnetic tape cassettes.

The first NC point-to-point, or continuous-pass equipment was used in the Apparel Industry on what is called pattern grading. Companies such as Cal-Comp and Gerber Scientific Instrument Company in the U. S., and Zuse in Europe, built systems to grade the sample size patterns up to larger sizes and down to smaller sizes.

Some of these systems drive an ordinary drafting machine to draw the nested patterns, while others actually cut out the full-size patterns. Some cut miniatures—usually one-fifth scale which are used to plan the best layout for cutting garments' parts in the same way that you plan sheet metal optimization.

There are probably half a dozen of these computerized or NC pattern grading systems operating internally in the U. S. (in apparel companies) and at least four or five service bureau operations such as Graphical Technology, Compusize, Cal-Comp, Arcon Comput-O-Grade, and others.

The first application of numerical control on cost cutting was announced by the Cincinnati Milling Machine Company in 1969, quickly followed by Gerber Garment Technology, a subsidiary of Gerber Scientific Instrument Company. Both of these used reciprocating knife cutters conventionally used in the Apparel Industry. Next came D. H. J. with an abrasive wire cutter directed by numerical control, and the Bendix Corporation announced experimental work with a water jet, using it at 100,000 per square inch for cutting apparel fabrics.

continued next page

It's time that someone in the textile and apparel industries learned something about NC—and vice versa—because in the apparel industry alone there is a potential market for a quarter million NC sewing machines.

In the spring of 1971 Genesco, through their Greif Division in Fredricksburg, Maryland, announced a numerically-controlled laser fabric cutter.

Shortly afterwards a French research institute, C. E. T. I. H., announced a small laser cutter, and last fall United Shoe Machinery also announced a laser (numerically-controlled) for cutting leather. They had previously shown a punch type of numerically-controlled cutting table for leather.

About the time of the Genesco laser cutting announcement, the Arrow Shirt Company announced placing an order with the Gerber Garment Technology for the Industry's first group of industrial sewing machines. They ordered approximately 100 machines at a cost of around $12,000 each. About $1,000 of that would be for the stitching head or the sewing machine and the remainder for an XY table, the numerical controller, and assorted accessories.

At the Paris I. T. M. A. (International Textile Machinery Association) Exposition, Juke, a Japanese sewing machine firm, and Necchi also announced numerical control sewing machines, and last fall at the Shoe Machinery Show in Atlantic City, the United Shoe Machinery Corporation (U. S. M.) demonstrated its first numerical control sewing machine.

The publicity resulting from an announcement of cutting systems excited the interest and imagination of apparel manufacturers everywhere. They are all anxious for numerical control in sewing. However, the task of applying numerical controls to the sewing machine itself–either to move the sewing machine in an X, Y, and pheta direction or to move the fabric in these directions–is very simple. The problems to be resolved don't really relate to NC in itself. The main problems confronting us lie in the limp fabric handling and in the requirements of stitching limp fabrics under

COMPARISON OF NC IN METALWORKING AND CUTTING OPERATIONS WITH STITCHING OPERATIONS

Most NC is cutting or shaping.	NC on sewing is always assembly.
Most NC alters shape by a reduction process.	Sewing alters shape by adding parts together.
NC ordinarily does not affect the basic dimensions of the clamped part.	Stitching always alters the dimensions of fabric parts
Most NC is continuous feed.	All stitching is intermittent feed.
There is no analogy for a needle penetration into the fabric. When drilling holes, the X-Y table must be stationary.	Stitching is the equivalent of drilling holes.
Drilling usually requires considerable time–at least seconds.	Stitching occurs at 8000 stitches per minute–130 stitches per second. The needle is in the fabric approximately 50 per cent of the time so the X-Y pheta motions must be stationary during that period.
Speeds are relatively slow.	At 8 stitches per inch, speeds up to 1000 inches per minute are required. Effect of needle on fabric: At 8 stitches per inch, each stitch = 1". At 8000 stitches per minute, each stitch = 130 stitches per second. 130 stitches per second = 8 milliseconds per stitch. Assuming 50 per cent stationary time, 4 milliseconds per stitch is available for moving 1/8". 1/8" x 250 = average velocity 30" per second. Maximum velocity, assuming acceleration and deceleration = approximately 40" to 60" per second and: speed of 10,000 stitches per minute are on the horizon.
The cutting speeds are relatively slow, and form a large portion of the total operating cycle.	Sewing speeds are very fast, and form a very small portion of the total operating cycle.
Metal can be clamped almost anywhere.	Fabric must be clamped near the edge only.

machine control, or numerical control, as opposed to sewing machine operator manual control.

Cutting vs. Sewing

Most early NC was applied to cutting. There are basic differences between cutting and sewing that suggest the difficulties of attempting to transfer automatic guidance techniques via numerical control from the one to the other.

(1) The cutting operation involves a reduction process—the whole is reduced to many smaller parts as they are cut out of the fabric lay. In most sewing operations, small parts are joined to create larger entities.

(2) Fabric remains in the same plane during cutting, and therefore an NC guidance system is concerned primarily with the movements of a cutting tool along the X-Y axes. This is not true in sewing, during which parts may move through several planes relative to each other.

(3) Manipulating single pieces of limp fabric during sewing has no counterpart in cutting. It represents a far more difficult problem than handling large pieces of fabric in uniform stacks of many plies during automatic cutting.

(4) The cutting operation requires substantially more time than any sewing operation, and therefore set-up and handling time are not as critical. They are a time-cost factor affecting hundreds of garments. In sewing, the same preparatory costs must be borne by fractions of a garment. Thus, the economics of setting up an auto-

continued next page

COMPARISON OF NC IN METALWORKING AND CUTTING OPERATIONS WITH STITCHING OPERATIONS

Clamping can be done at remote points to minimize interference with the machining operations.	Fabric must be clamped along the lines of stitching.
Tools cut in any direction.	Tangency must be maintained for chain stitches, zig zag stitches, and multiple needle stitching and cover stitches.
Point-to-point NC is sometimes possible. Access is usually no problem.	Stitching must always be continuous pass, and must frequently sew all sides.
Metallurgy, and metalcutting is a science.	Thread handling is an art on the sewing machine—and most drop stitches are not always understood.
A jig and fixture technology is well developed in other industries.	In the Apparel Industry there is neither jig and fixture technology nor tool and die technology.
Skilled craftsmen have been trained by metalworking industries.	Apparel Industry has very few craftsmen—even among its sewing machine mechanics—very few skills, and little knowledge to equip them for NC application.
Metalworking has a technical background.	Apparel Industry is esthetic, fashion oriented, and not technically oriented.
Machine Tool Industry and Metalworking is capital oriented.	Apparel is a low capital industry.
Metalworking Industry is tools oriented.	Apparel is not staffed to maintain equipment.
No problems in feeding tapes, elastics, ribbons, buttons, etc.	Many operations combine several stitching functions together—feeding tapes, elastics, and other strip materials.
Previous operations are usually carried out with good precision and specified tolerances.	Manual stitching operations are (prior to NC operations) subject to wide variations from the previous operator.
Parts to be joined are usually of equal length.	In stitching operations most parts are of unequal length along the lines to be joined together—usually the first operation is only the flat one, in setting it makes it necessary to join parts of unequal length.

matic sewing operation are a heavy consideration.

For these and other reasons, the application of NC to sewing machines represents a distinctly different problem than its application to automatic cutting.

In apparel assembly operations, concern is always with stitching at least two parts together, usually at an edge, and most often along a previously-shaped line (the pattern perimeter).

Clamping Metal vs. Clamping Fabric

Manipulating a limp fabric part or parts automatically represents the greatest challenge to the successful application of NC in sewing.

In automatic metalworking equipment, numerical controls are used to guide the clamping mechanisms which carry a rigid part in X, Y, and Z directions. The clamp may also rotate the part in one or more axes.

Because the metal part is rigid, it moves when the clamp is moved in a uniform manner, at a uniform rate, and without distortion.

Clamped fabric can also be moved by numerical control in exactly the same manner, but only the clamped edges can be relied upon to move uniformly with the clamp in the same direction at the same time. Unless appropriate tension is applied, distortions in the fabric are inevitably introduced. (And, tension also produces distortions in the fabric.) In short, numerical control guides the clamp, not the fabric, but it is the fabric that must be stitched.

Conclusion

When you approach NC for the Sewing Industry you must make it clear to your engineers that they will have to tackle the entire set of problems—both NC and non-NC—to capitalize on the exciting potential for automating the Apparel Industry.□

Author Murray first presented this paper at the NCS Ninth Annual Meeting and Technical Conference, April 17, 1972, Chicago, Illinois.

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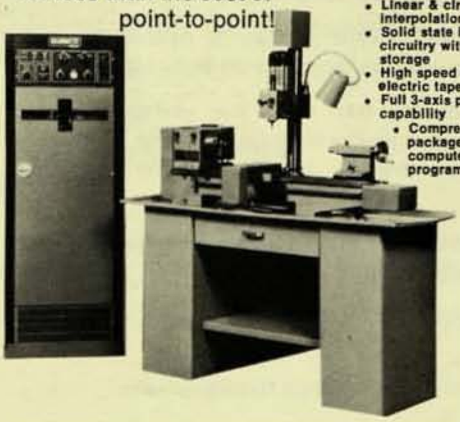

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(sample only)

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MINICOMPUTERS IN MANUFACTURING

BY CARL NATONI

From a San Diego Chapter meeting, presentation by Walter Uhl, Teledyne Ryan Aeronautical Company.

Working closely with controls manufacturers for over fifteen years, Cincinnati Milacron people toyed with their concept of an ideal minicomputer. Today, the Cincinnati Information Products CIP/2000 Series is a reality: a new low-cost digital computer for both dedicated and general-purpose use. Core memory is expandable to 32K in modules of 4K, transistor-transistor logic (TTL) is used throughout and software support is available in Fortran IV—all within a price range of $3,000 to $20,000.

In addition to the software programmable, general-purpose configuration, Cincinnati Milacron uses the CIP/2100 minicomputer in the Acramatic Scanner and the Acramatic Program Editor. Primary attraction of the mini route was elimination of hard-wire limits on design and long drawn-out manufacturing response. With soft-wired controls, applications can be readily tailored to user specs; items can be supplied faster and at a lower cost. In addition, control prices tend to become somewhat standardized in spite of offering a much greater range of capabilities: tool change, tool offset, cutter compensation, spindle speed and feed logic, adaptive control, built-in diagnostics—all these features, and more, are possible in the stored program control.

Housing a tape punch, a CIP/2100 minicomputer, and input/output devices in a portable floor cabinet, the Acramatic Scanner allows any one of several Vertical Hydro-Tels, or similar machines, to be used to generate a ready-to-use tape of a free form shape or some part too complex for economical computer programming. Working from a model or actual part, a hand-guided tracer with feedrates of up to sixty inches a minute is used; actual machine feedrates are independent of scanning rates and are established by teletypewriter input. Tracing can be performed in the X-Y, X-Z, Y-Z, X-Y-Z, or Z only axes; pickfeed direction, amount, and rate are selected by push buttons. Upon completion of a part, the tracer can be used as an inpsection tool by scanning the finished part to produce a print-out for comparison with the engineering print. An automatic scaling feature allows the machining of parts either larger or smaller than the model.

Also console mounted on casters, the Acramatic Program Editor consists of a tape reader, a CIP/2100 minicomputer, two magnetic cassette recorders, a cathode ray tube (CRT) and keyboard, plus a high-speed tape punch. With a plug-in interface behind the tape reader of the machine control, the programmer can debug, optimize, or even create a program by punching out a new and/or corrected tape without the excessive travel, wait, and turnaround times of conventional proofing techniques. Designed specifically for the shop environment, the Program Editor shows considerable promise—twelve are already in use with eight being placed into service just this year.

At the heart of the Program Editor is the CIP 2100 minicomputer which, among its manifold tasks, provides buffer storage for the parts program being edited on the CRT. Fifteen blocks of program information are displayed at one time on the CRT. The active block is noted for the programmer through use of an arrow. Upon detection of an error, the program can be stopped and alterations made through keyboard entry on the CRT. A restart can be made at any point to verify the correctness of the alteration on the machine tool. Blocks of information work their way up off the CRT and onto one of the tape cassettes as an edited or optimized program which can later be converted into a finished punched tape. As a rule, original part information is stored on one cassette while corrected information is placed on the second.

According to Cincinnati Milacron, this low-cost Program Editor (approximately $30,000) can increase machine use up to fifteen per cent while decreasing program proofing time up to forty per cent.

Mr. Uhl mentioned several areas which the basic minicomputer is now handling: management information systems, batch control systems in the cement and asphalt industries, on-line justification in photo printing and printed circuit board testing. It was also indicated that Teledyne Ryan Aeronautical is investigating the possibility of replacing "black boxes" in their Firebee drones with minicomputers for both diagnostics and actual flight operations.□

CALL FOR PAPERS

Numerical Control Society
Tenth Annual Meeting
and Technical Conference

April 16-18, 1973
Hotel Americana, New York City

GUIDELINES FOR PAPERS

The papers to be presented will be separated into three groups and the international aspects of NC will receive considerable attention:

I. Papers focused on solving today's cost-price problems. Special emphasis will be placed on how-to-do-it, practical guidelines, description of successfully operating facilities, from small shops to large concerns, and any other topics that will help end users in the audience to get into NC or to use their existing NC facilities more effectively;

II. Papers on trends, techniques, new developments, new applications, etc., that will be broadly encompassed under the title "the state of the NC art"; and

III. Tutorial papers on basics of NC economics, use, realization, and standards

TOPICS

Design: Product Design for NC Manufacturing; NC Drafting; Computer-Aided Design; Quality Control.

Programming: Software, What-How-Why; New Software or Post Processors; Techniques in Program Verification; Graphics; Time-Sharing.

Manufacturing: Manufacturing Planning for the NC Shop; Controlling NC Manufacturing; Management Information Systems; Tools and Fixtures: Cost Saving Techniques; Adaptive Control; Computer-Aided Manufacturing; Productivity Through Effective Maintenance; Quality Control for the NC Shop; NC Inspection; Automated Factory.

Training: Educating Management; Engineering; the Shop; the Maintenance Man; the Computer Programmer; and the Salesman.

The State of the Art in NC: NC Abroad; New Developments; New Applications; New Techniques; Trends and Projections; Non-Machine Tool Applications; Total System Approach; Any Other Topics Related to Numerical Control.

DEADLINES

Abstracts: 6 copies of one- to two-page, double-spaced abstract, accompanied by biographical sketch, must be submitted by October 1, 1972 to the Chairman of Technical Program, George Putnam, IIT Research Institute, 10 West 35 Street, Chicago, Illinois 60616, 312-255-9630.

Papers: 3 copies of the final paper for presentation and publication in the conference proceedings, typed, double-spaced, and accompanied by supporting 8 x 10 glossies and/or slides, with drawings in pen and ink, are due December 1, 1972. Submit one copy to Chairman of Technical Program, above address; one copy to National Meeting Coordinator Howard Abbott, Xenex Corporation, 1 Gill Street, Woburn, Massachusetts, 01801, and submit the original with original art and photos to Editor Mary A. DeVries, NCS, 183 Loudon Road, Concord, N. H. 03301.

Howard Abbott, National Meeting Coordinator
Louis V. Capasso, Conference Chairman
George Putnam, Technical Program Chairman

NCS NEWS

NCS PLANS TENTH CONFERENCE

The 1973 Annual Meeting and Technical Conference marks the tenth anniversary of the Numerical Control Society. Along with technical program sessions and tours, a special anniversary celebration is planned for the April 16–18 meeting at New York City's Americana Hotel.

Filling the post of national meeting coordinator this year is Howard Abbott of Xenex Corporation, while Louis V. Capasso of Farrand Optical Corporation takes on the duties of general conference chairman. And called back for a repeat performance as technical program chairman is George Putnam of IIT Research Institute.

Watch the *NC Scene* for further details on the 1973 conference and tenth anniversary celebration.

ERIEVIEW RECEIVES NCS CHARTER

Erieview officially became NCS's twenty-seventh chapter with the presentation of a charter on May 9. Chairman of the new Cleveland-based chapter is Jay Taylor, project engineer at Reliance Electric Company.

BAY AREA NAMES OFFICERS/AWARD WINNER

Officers for 1972–73 were elected by the Bay Area (San Francisco) Chapter at a June 13 meeting: David Martin, chairman; Howard De Ferrari, vice chairman; Lawrence Adams, secretary/treasurer; Robert Gulden and Collen Hausen, program directors. Named Chapter Man of the Year was David Christy.

NCS FORMS QUALITY CONTROL COMMITTEE

Edward E. Miller, secretary on the NCS board of directors, will head a newly-established Quality Control Committee to examine QC/NC interactions and manufacturing requirements in producing quality products.

A survey of NC users is planned to determine present QC practices, and among specific items slated for consideration are: (1) appropriate areas for CAD/CAM applications; (2) relationship between quality and tolerance standards; (3) relationship between NC and trade practices; (4) standards of tool holders, tool geometry, tool setting, and software; and (5) reliability of machine tools, controls, tools, and over-all systems including programs.

Information and recommendations for further study will be welcomed by the Committee. Contact E. E. Miller at No. 1264, Western Electric Company, 3300 Lexington Road, Winston-Salem, N. C. 27102, 919-784-2969.

selected

NC COLLOQUIUM PAPERS

1972: Paris, France

P72-100. Automation in the Seventies, by Joseph Harrington, Jr.

P72-101. Need for Cooperation Among Educators, Industry, and Government to Spur Acceptance of NC, Automation, and Related New Technology, by Dr. Herwat Optiz

P72-102. Computer-Aided Manufacturing Technology Through International Development Programs, by Dr. Gastone Chingari

P72-103. Status of Soft-Wired Control in the U. S., by Howard Abbott

P72-105. UNIAPT and Manufacturing's Dedicated Computer, Step-by-Step to DNC, by John Wright

P72-108. State of the Art in Fluid Power Control, by Theodore Pearce

P72-110. Manual NC for Automated Systems, by Merlyn E. Schlenker

P72-112. Performance and Service Evaluation of DC Servo Motors, by S. Noodleman

P72-113. DC Servo Drives Benefit from High Inertia, by Roger G. Hill

P72-114. Velocity Profile and Coupling Ratio Optimization in Incremental Motion Control Systems, by Dr. Jacob Tal and Steven R. Wilhelm

P72-118. Status of Development of Programming Systems for Numerical Control in Western Europe, by Roland Weill

P72-123. The Development of Solenoid Pilot Operators for Pneumatic Valves, by John H. Goodrich

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NC EDUCATION *continued from page 2*

shows a drill press feed which contains a hydraulic cylinder (used with air), and because no hydrochecks were available, Professor Venkatraman suggested and donated his automobile's shock absorbers, which were modified for this purpose.

Figure 2, a hand-operated and normally dangerous top-heavy, abrasive, cut-off machine, was also designed, fabricated, and installed by the seminar participants.

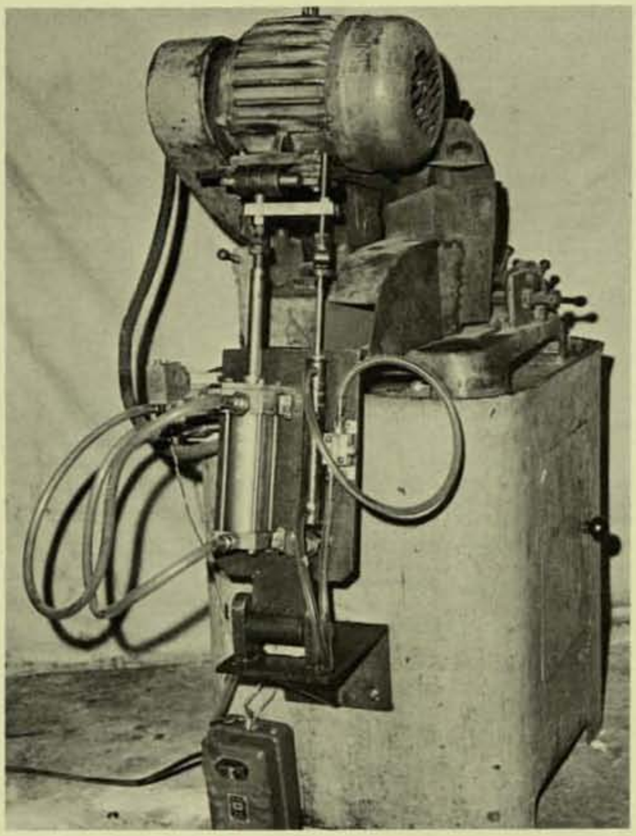

Figure 2. Hand-operated cut-off machine.

Everyone was willing to devote time to these efforts since hydraulics and pneumatics are such a necessary, integral part of NC and automation in general. Hopefully it will be possible someday to concentrate on various phases of multiple tools and tooling.

Joint Venture

This seminar was truly amazing and gratifying and was set apart from one of the "pure theory" type because of the efforts of P. S. G.'s Professor Venkatraman and the directors of C. M. T. I.–Sri Kumar and Sri Gejji. This unique collaboration between these two institutions developed the first two NC machines in Southern India.□

Further reports on "NC in India," based on Education Editor Rynack's NSF-US-AID assignments, will follow in the next issues of the NC Scene. See the January 1972 and July 1972 issues for preliminary reports.

NC PANORAMA *continued from page 2*

recent case of a magazine article wherein the reporter ostensively had no ax to grind and could appear impartial. One paragraph in the article ran as follows:

> Yesterday's $20,000 to $30,000 open-loop stepping motor controls are expensive by new, emerging NC standards. Contouring with a computer assist, a mile-long tape, and a high-paid programmer are no longer the order of the day.

While the precise time relationship of "yesterday" may be a bit vague, if what is meant is approximately ten years ago, this *possibly might* be true. However, if "yesterday" means what most readers think it means, it is inaccurate by a factor of two or three. Except for a few specialized cases, most of "yesterday's" open-loop point-to-point systems ranged between $8,000 and $13,000, and open-loop contouring systems (with CI) ranged from $12,000 to $18,000. As a matter of fact, one of "yesterday's" three-axis open-loop contouring systems (with CI) sells for less than $8,500.

From the second sentence it would be inferred that the computer is some kind of culprit that likes to produce mile-long tapes. Actually the computer is an innocent bystander and if a contour part requires a mile-long tape, it's going to require it whether a computer is used or not. And our sympathies are with the person that would have to *type* out a mile-long tape.[2]

Also, it's doubtful that many parts programers would agree that they are "highly" paid, as noted above. It would probably be more to the truth to say that they are *fairly* paid, and not *all* parts programmers would even agree with this. Few can argue, however, that a good parts programmer, using computer-assisted parts programming, is not well worth his money, assuming that the parts are amenable to computer assistance.

In any event it is hard to see the connection between open loops and computer-assisted parts programming. If it is possible to be so far off in one little paragraph, imagine the potential misguidance in consideration of all the NC articles that have and are being written. And not only with NC but with all technical reporting. Fortunately, the great majority of reporters, editors, and publishers appreciate their responsibility and exercise the care and study that is necessary for accurate reporting.□

2. A mile of tape would require 633,600 characters to be typed. At an average typing speed of 30 characters per minute good for most parts programmers, it would take approximately two man-months (without coffee breaks) to prepare, providing no incorrect tapes were hit. A computer could produce the equivalent in approximately two hours of unattended time.

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Fees are $95 for AIIE members and personnel with MHI member companies and $110 for all others. Contact AIIE, 25 Technology Park/Atlanta, Norcross, Georgia 30071.

1972 IMTS

Nearly twenty countries will be exhibiting at the 1972 International Machine Tool Show sponsored by the National Machine Tool Builders' Association. The Show is scheduled for September 5 to 15 at Chicago's International Amphitheatre and McCormick Place.

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