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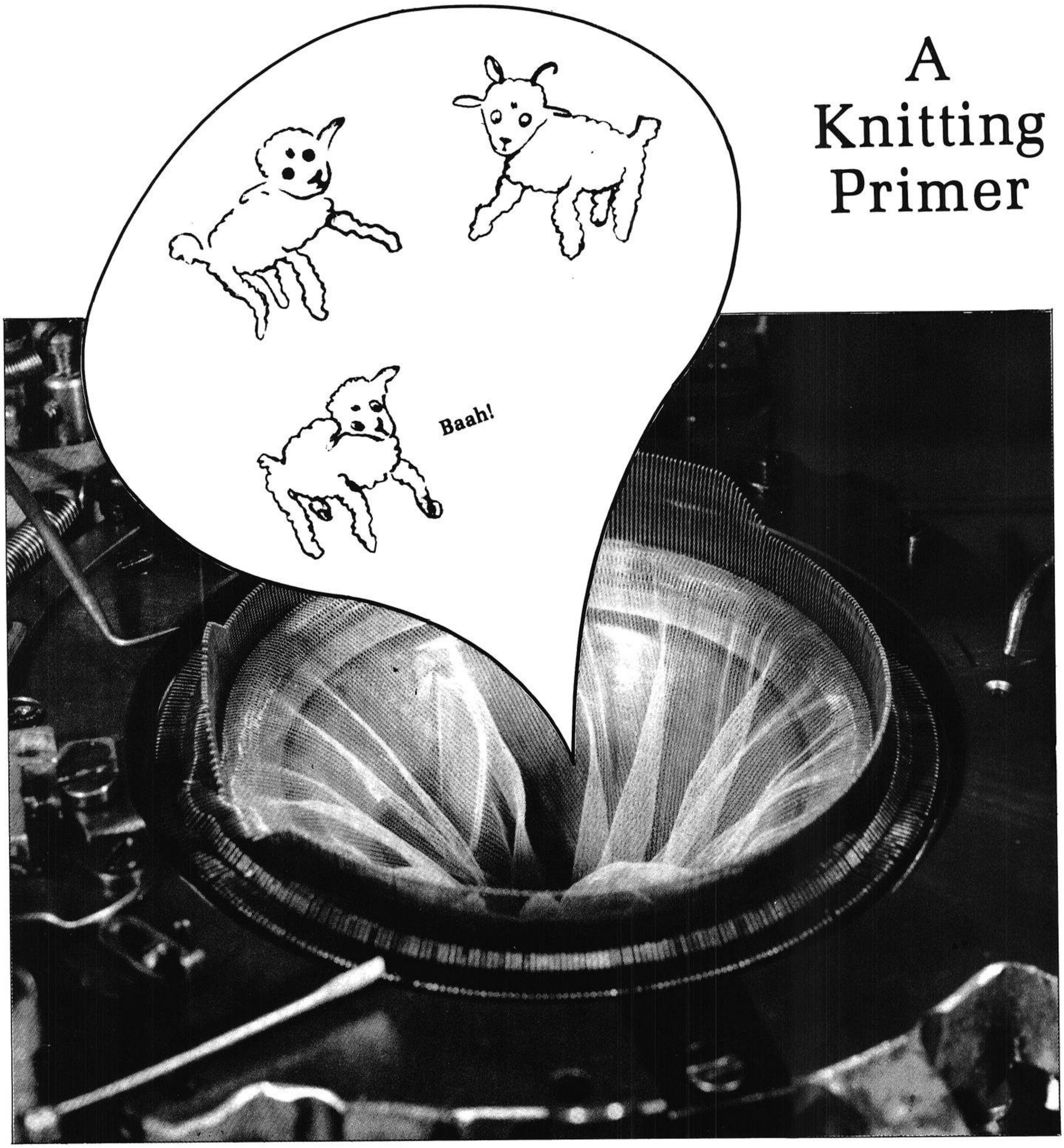
wisconsin engineer



A Knitting Primer

Is the leg mightier than the atom?

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PUBLISHED BY THE ENGINEERING STUDENTS of the UNIVERSITY OF WISCONSIN.

Photos and graphics in A Knitting Primer courtesy of Torrington Co. and Wildman-Jacquard Co.

Contents

Warning—don't hand this article to your grandmother. It's not for her, it's for you. You may not be interested in how knitted goods get from the sheep to you, but this author got a job because he studied just that. Now that's interesting!

Koshkonong has been in the news for a long time now, and will most likely continue to be. Who's doing the hollering about the plant, and why? *Turn to page 8.*

If we hear you complaining about how women and minorities are getting ALL the jobs one more time, you may not pass Go and you may not collect $200. You may not read this magazine anymore. And go to bed without supper.

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A Knitting Primer

by Peter Scheer

Mention the word knitting and you might think of your grandmother working on a pair of socks. Mention knitting needles and you might think of two long things that grandma used to make those socks. But mention a knitting machine and you probably wouldn't know what to think.

Because the primary manufacture of knit goods has not been in the home since the early part of this century, we grow up today with very little knowledge of how the knitted garments we wear are manufactured.

To get a better idea of how a knitted product is made, the knitting process of a sweater will be explained along with a description of its associated machine and needles. Bear in mind that the sweater is only one of thousands of products that make up the knitting industry.

Beginning with the knitting cycle, we examine how yarn is formed into fabric. There are two basic types of knitted fabric: weft and warp knits. The type we see most in our sweaters, socks and hosiery is the weft knit. Warp is seen mostly in bulk material goods such as curtains. Only the weft knitting cycle is explained here since we will be following the manufacture of a sweater.

Fig. 1 follows the weft knitting cycle. After yarn has been fed into the hook, the needle moves to the right. The tension in the old loop riding over the latch closes it and allows the new loop to be pulled through the old one (cast off). The needle now moves to the left and the loop tension opens the latch exposing the hook for the next loop.

The needles do not necessarily move in a horizontal plane as pictured. In the circular machine pictured in Fig. 2, the needles move up and down in a vertical plane. In all cases however, the needle moves forward or back relative to the yarn being fed.

The result of this knitting cycle acting upon many needles moving in parallel is shown in Fig. 3. The basic or plain stitch results from all needles following the normal weft cycle. All loops are formed the same way and have equal size and tension.

The control and feeding of knitting needles is accomplished with a knitting machine. A knitting machine is basically composed of a needle bed and yarn carrier. The needle bed can be either flat or circular in shape. Yarn carriers of a flat-bed machine move back and forth over the bed in a reciprocating manner producing a continuous, single piece of fabric. A circular machine has multiple yarn feeders moving around the circumference of the machine. The yarn is fed and knit in a helical fashion with the fabric coming out in a continuous flattened tubular shape. A circular knitting machine and its components is pictured in Fig. 2.

Yarn on large spools is fed up to one of the large rings on top of the machine and back down to the yarn feeder and into the needles. The yarn passes through several stop-motion devices on its path through the machine. Stop-motion devices are electro-mechanical mechanisms which can detect yarn breaks or lumps and stop the machine before serious damage occurs.

The machine in Fig. 1 is a 10 cut (10 needles per inch of circumference) with a 30-inch bed

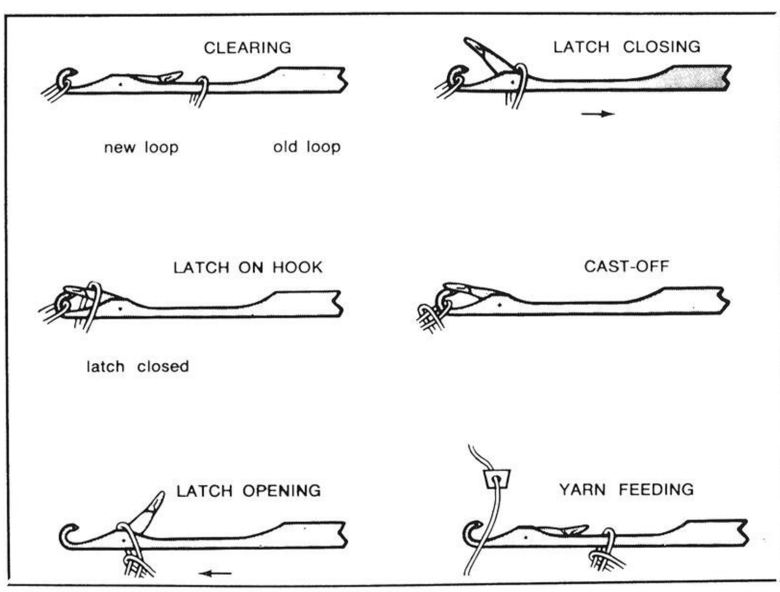

Fig. 1 The weft knitting cycle shown should be read from left to right. The arrows indicate the movement of the needle relative to the loops.

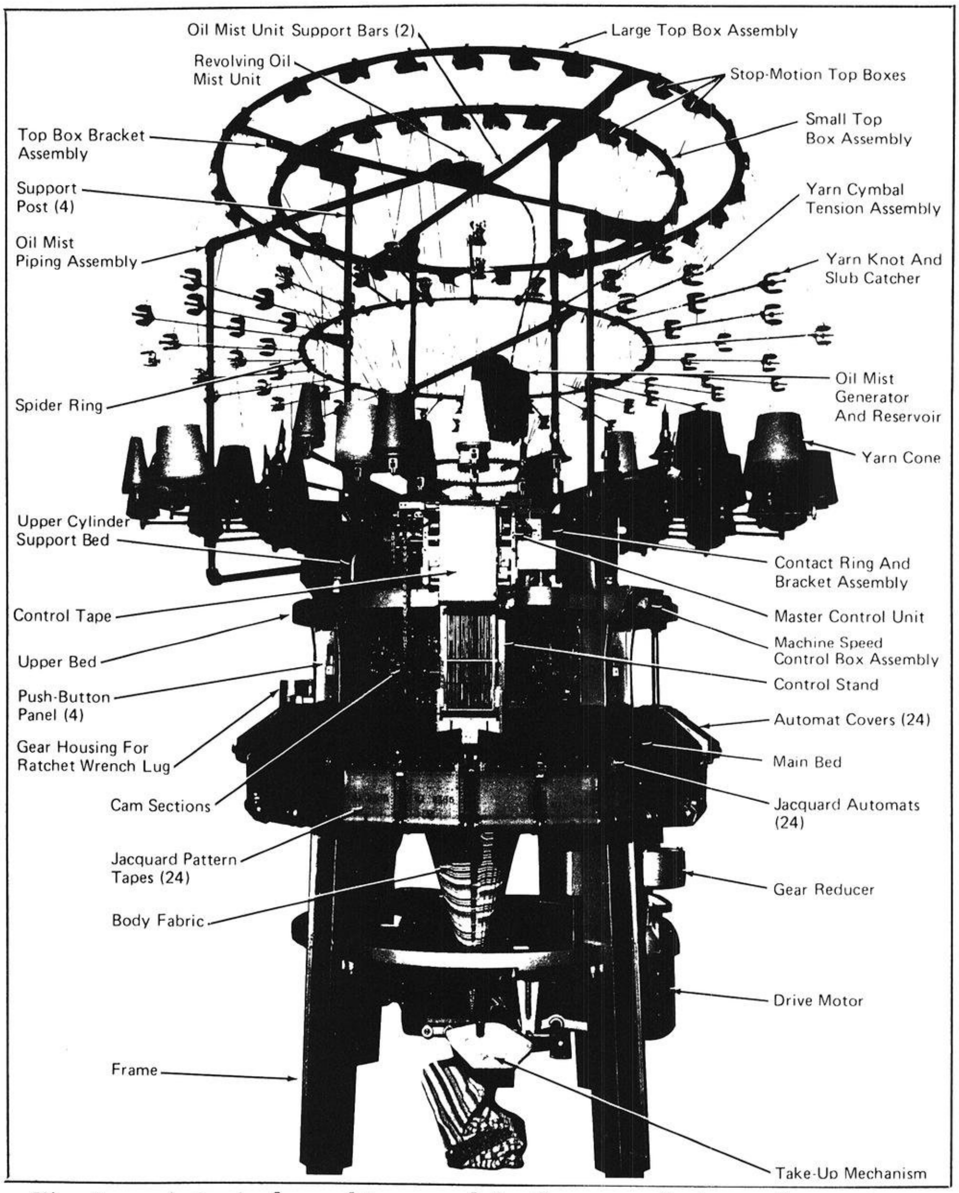

Fig. 2 A typical machine used in the manufacture of sweaters. Dimensions of this machine are: Height, 140"; Weight, 5585 lb.; Maximum diameter at yarn cones, 92". The yarn is carried from the spool to the stop-motion boxes, back down and knit producing the body fabric as shown. Notice the Jacquard pattern tapes hanging from their drums.

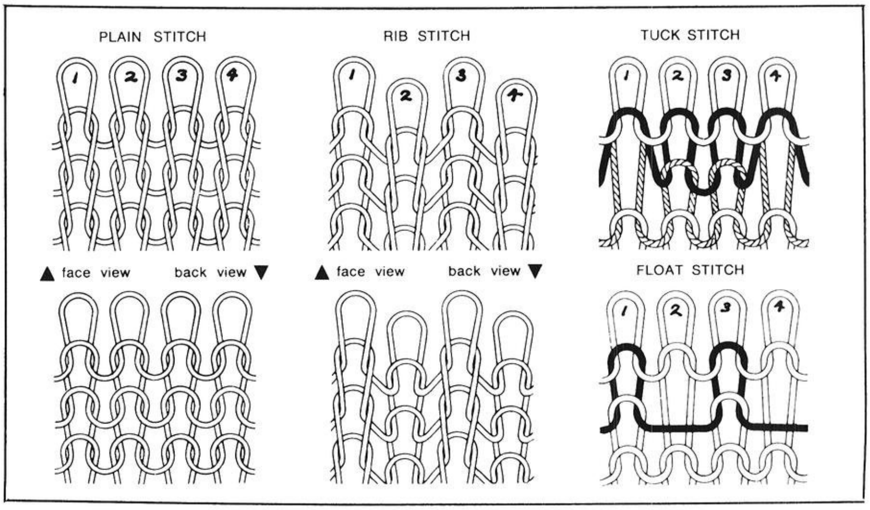

Fig. 3 Basic knitted structures.

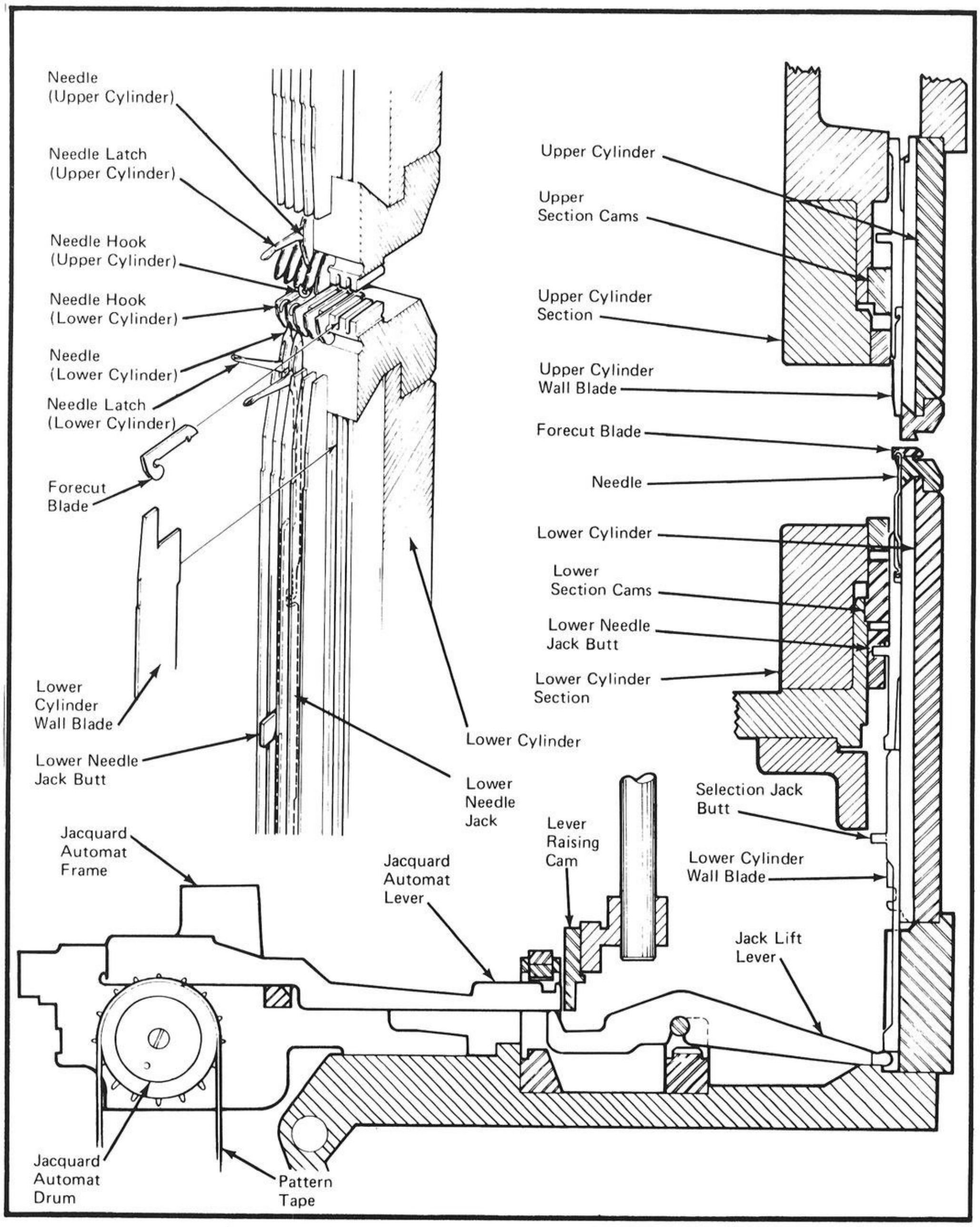

Fig. 4 Cross-sectional view of cylinders.

diameter holding 942 needles. Knitting machines come as fine as 32 cut with as many as 3316 needles in a 33 inch diameter needle bed.

This type of machine commonly has two needle beds, the upper and lower cylinders. See fig. 4. The advantage of a double cylinder machine is in the increased versatility in pattern selection. In this machine, a needle can knit in either the top or bottom cylinder according to the stitch desired. Such a machine employs a double—headed needle which can knit at either end.

The needle itself is very interesting to examine. The most widely used knitting needle is the latch needle. Fig. 5 shows one type of latch needle. According to the Torrington Company, manufacturers of every type of knitting and sewing needle, there are several thousand different types of latch needles in use in modern knitting machines.

Made of either wire or flat stock, all latch needles have a common head design of hook and latch. The latch pivots about a pin and sits in a narrow slot milled through the center of the needle head. The challenge of manufacturing these needles can be appreciated when one considers the thickness of some hosiery needles to be less than 1/64th of an inch.

Major causes of needle failure are hook breakage and latch fatigue. As machine speeds increase, needle loads and failures increase as well. Research done by the Torrington Company has traced one of the causes of hook breakage to the repeated inertia loading experienced by the needle as it knits. To get an idea of needle speeds involved, the needles of a hosiery machine running at 700 rpm advance and return at approximately 48 times per second.

These frequencies along with linear cam actuation impart a

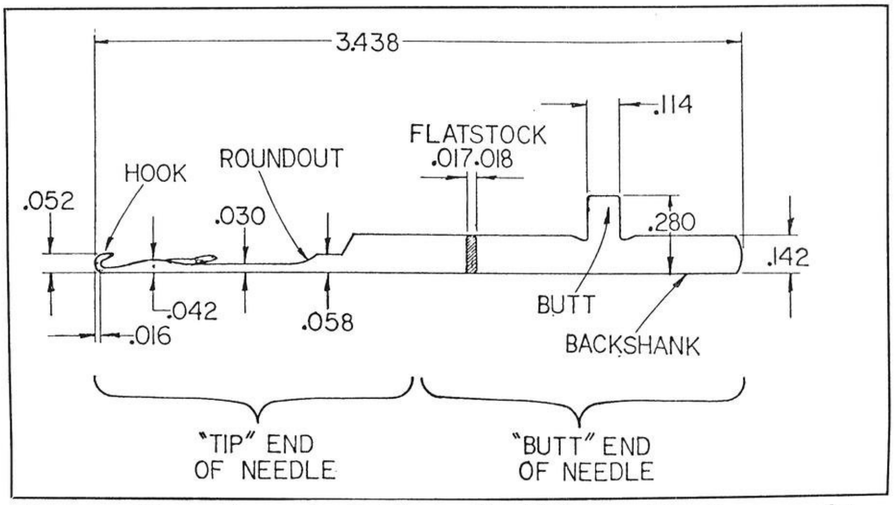

Fig. 5 Dimensions of a latch needle. This is not the type used in the machine in Fig. 2.

tremendous acceleration to the needles. These accelerations are enough to affect even the small mass (approx. 10 lbs.) of the hook. The latch also opens and closes at this frequency. At these speeds the latch severely impacts the needle at each end of its travel leading to deformation and eventual failure of the needle. With the trend toward higher machine speeds, the design of a knitting needle, while appearing quite simple, becomes increasingly a complex problem in dynamics.

If all needles follow the normal weft cycle, a smooth or non-textured fabric results. By varying the loop tension during knitting, various stitches will result (See Fig. 3).

One variation is called the tuck stitch. This effect is achieved by allowing needles 2 and 3 to knit normally while needles 1 and 4 advance and accept yarn for two consecutive cycles without pulling back far enough to cast off the old loop. This causes a localized bunching effect in the fabric and results in a textured appearance.

The float stitch is also used in varying the tension between loops. Here needle 2 does not advance at all for one cycle and the yarn is carried to needle 3 to be looped in the normal fashion. The float stitch has less tension in it than adjacent normal or tucked stitches and this again results in a different texture in the knitted fabric.

The rib stitch is achieved by having the needles knit in both cylinders. The rib stitch in Fig. 3 is called a 1x1 because one needle knits from above while the adjacent needle knits from the lower cylinder. A 2x2 rib results when a pair of needles knit from above with the next pair knitting from below and so on. This type of stitch can be found in the cuff of sweaters, in socks and in many other places where a tight stretchable knit is desired. It is as commonly used as the plain stitch.

Different patterns can also be knit into a fabric. This is accomplished by using varying combinations of the tuck, float and plain stitch while knitting. Since each needle must advance or hold back according to the stitch desired, some means of controlling needle action is necessary. The solution to this problem is a pattern tape developed by a Frenchman named Jacquard in the 1800's. It was the first use of automatic control in an industrial manufacturing operation. The same basic principle is used in knitting today. The following is an illustration of this process.

Fig. 6 shows a cable pattern knit on a circular machine. The first to be knit is the cuff, a 2x2 rib stitch. After several revolutions the machine begins its pattern sequence.

The way the pattern is generated in this machine is by varying the stitch of each needle. The impulse given, or not given, to a needle is determined by a pattern tape hung on a Jacquard drum (see Fig. 4). The drum is a cylinder with longitudinally milled slots. The drum rotates (clockwise in Fig. 4) intermittently, and after each increment one of the slots is at the top center of the drum. A spring—loaded pin in the automat lever drops into the slot at top center and the next motion of the drum pushes the lever forward. By means of a pivot the lever exerts a downward force on the rocker arm (jack lift lever). The rocker in turn pivots and pushes the two jacks up allowing the needle to move up and accept yarn in the normal fashion of the weft knitting cycle. The needle and jacks are pushed down again by cams revolving around the outside of the needle bed. This brings all the parts back to a normal position ready to move again by lever actuation.

This entire sequence is dependent upon whether the lever advances or not. Since each movement of the slotted drum would move all levers and needles at the same time, the pattern tape is needed to selectively allow the lever pins to drop into the slot and be moved. The pattern tape is the means used to control needle movement and hence the stitch. The pattern tape for the sample is shown in Fig. 7. The tape as shown is lying flat and must be glued together at the ends to make a continuous loop in order to be hung on the Jacquard drum. The tape is made of either plastic—coated linen or a plastic

Continued on p. 12

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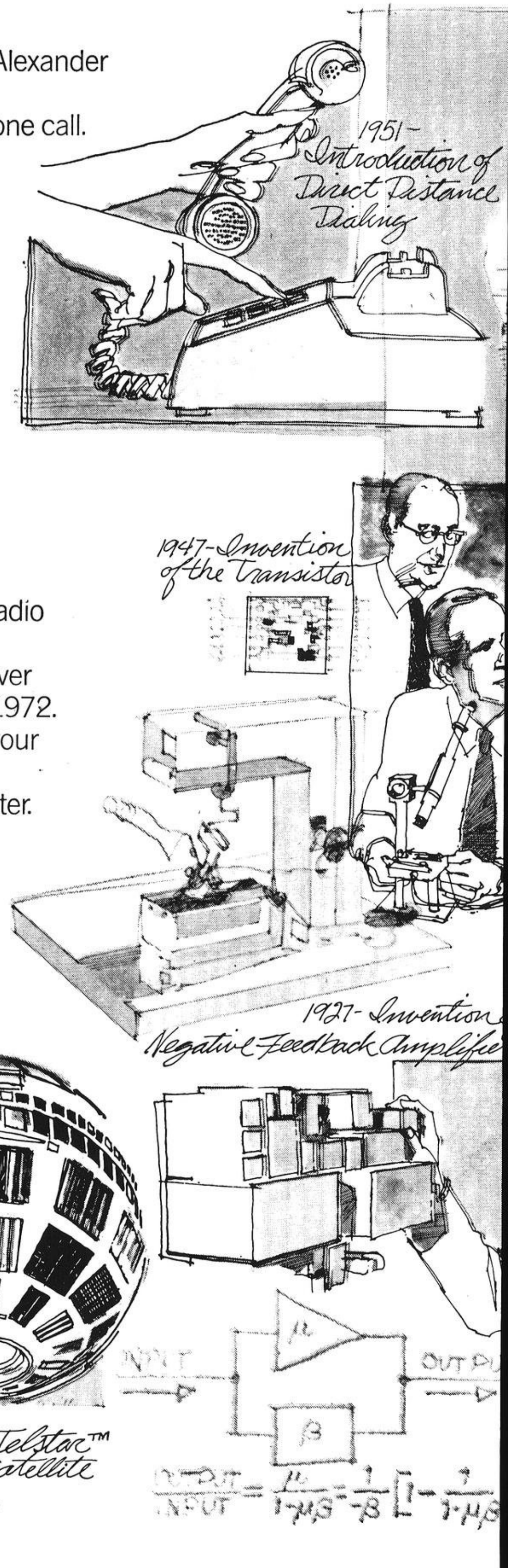

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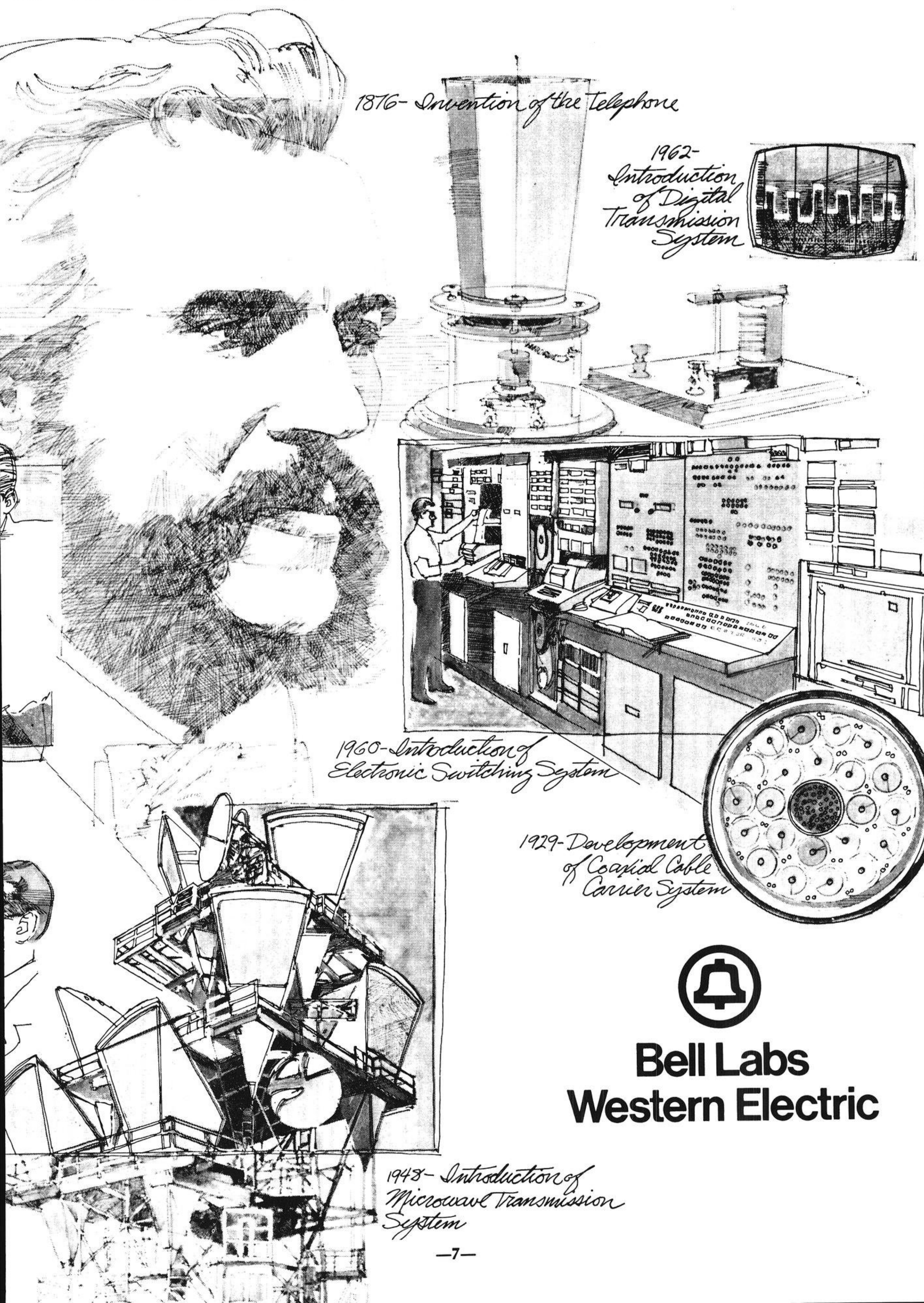

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Weighing Koshkonong Technology Against Ecology

by Lauren Schlicht

"Until such basic questions can be adequately answered, no intelligent decision can be made about the proposed Koshkonong plant."

The Lake Koshkonong Nuclear Power Plant debate started in July of 1974. Since then it has been one of the biggest ecological controversies in Wisconsin, pitting scientists against environmentalists. Questions about the safety and need for nuclear power plants are being brought up again this time in Koshkonong township.

The proposed plant is to be built on 1,410 acres of land in southwest Jefferson county, 30 miles southeast of Madison. Building will occupy 20 acres and an additional 73 acres will be in a fenced exclusion zone. Most of the remaining land, needed for security reasons, will be leased to area farmers. A large portion of the wooded regions will be left untouched by construction.

Four Wisconsin power companies, Wisconsin Electric, Wisconsin Power and Light, Wisconsin Public Service and Madison Gas and Electric are working together to finance the 1.2 billion dollar plant. Wisconsin Electric, holding the largest share, will operate the Koshkonong plant. Two 900 megawatt reactors are planned for the site. The plant is expected to run near maximum capacity for at least 30 years.

The Koshkonong site was chosen out of 84 possible sites. It has both solid rock for foundations and an adequate supply of water from the Rock River. Being closer to the areas in southeastern and south central Wisconsin needing the most electricity, the electricity doesn't have to be transported over long distances.

Water for cooling will come directly from Lake Koshkonong. This has many area residents worried about the adverse effects of the plant on the lake. They fear recreation on the lake and it's shore will be affected. The Koshkonong plant will have three separate water systems, as do most nuclear power plants. Lake water will be used in only one totally enclosed system, leaving little possibility of radioactive materials leaking into the lake. Lowering the water level by removing water for cooling is of greatest concern. Of

Lauren Schlicht *is a freshman in Nuclear Engineering. She is following the footsteps of her grandfather and uncle, both graduates from this university.*

the water removed, two-thirds will evaporate in the cooling towers while only one third will be returned. Estimates as to lowering the water level run from 1 to 3.6 inches annually. The power company believes using the Indianford Dam to control the Rock River's flow into the lake can keep the water level fluctuation at a minimum.

Dredging and winter melting of the lake are also of concern. The plans call for dredging only in the intake and return areas. Partly cooled water will be returned to the Rock River just above the dam, thereby not melting the ice cover of the lake. In this way skating and snowmobiling on the lake would not be affected.

The plans are set, land is being bought, so why the delay? A certificate of authority from the Wisconsin Public Service Commission and a permit from the U.S. Nuclear Regulatory Commission are needed before construction can begin. Both were applied for in 1974. Processing of the applications is now in operation.

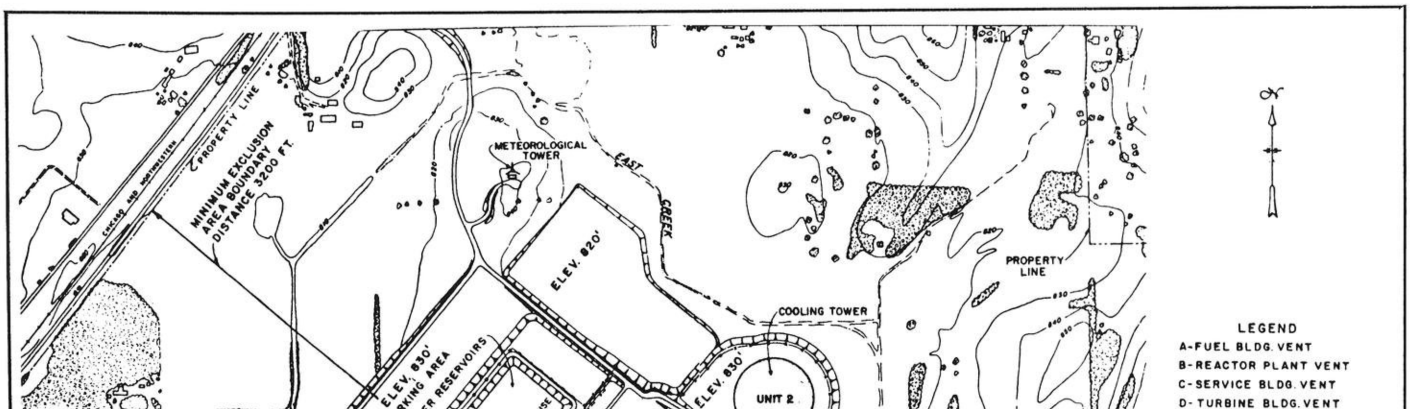
Wisconsin Public Service Commission is looking into the need of such a plant as well as the environmental impact. The Department of Natural Resources is expected to complete its State Environmental Impact Statement by March, 1976. With this additional data the PSC is expected to hand down its decision by June, 1976.

Nuclear plant design and safety will be examined by the U.S. Nuclear Regulatory Commission. Although Wisconsin Electric has a good standing reputation with its other two Wisconsin nuclear plants, Point Beach and Kewaunee, every proposed plant must be examined. Public hearings on safety are being held in Fort Atkinson. The permit is expected to be granted shortly.

Provided there are no more delays in the PSC or NRC investigations, construction will start this summer. Before the summer of 1983, the first reactor will be working, the second soon to follow.

Residents in the area aren't leaving all the decisions up to state and federal commissions. Those against the plant are trying to use the government to stop construction. State Senator Dale McKenna of Jefferson and Representative Harout Sanasarian of Milwaukee have introduced a bill calling for a five-year moratorium on construction of nuclear power plants in Wisconsin. If this bill is passed, the Koshkonong Plant construction would have to be postponed at least five years, while further studies are carried out.

The controversy over the Lake Koshkonong nuclear power plant all comes down to the controversy over nuclear plants in general. Are these plants needed? How safe are they? Can nuclear wastes be safely transported and stored? How damaging are the thermo effect on the environment? Until such basic questions can be adequately answered, no intelligent decision can be made about the proposed Koshkonong plant.



White Male for Hire: Is He Under Fire?

by Mallory Boush

Are women and minority group engineers discriminated against when they apply for a job, ask for a raise, or come up for promotion? Has the pendulum swung back in the other direction, squeezing white males out of the most interesting and best paying jobs? The answers to both questions are of interest to engineering students and professionals alike, especially in today's tightening job market; and the answer seems to be a qualified no.

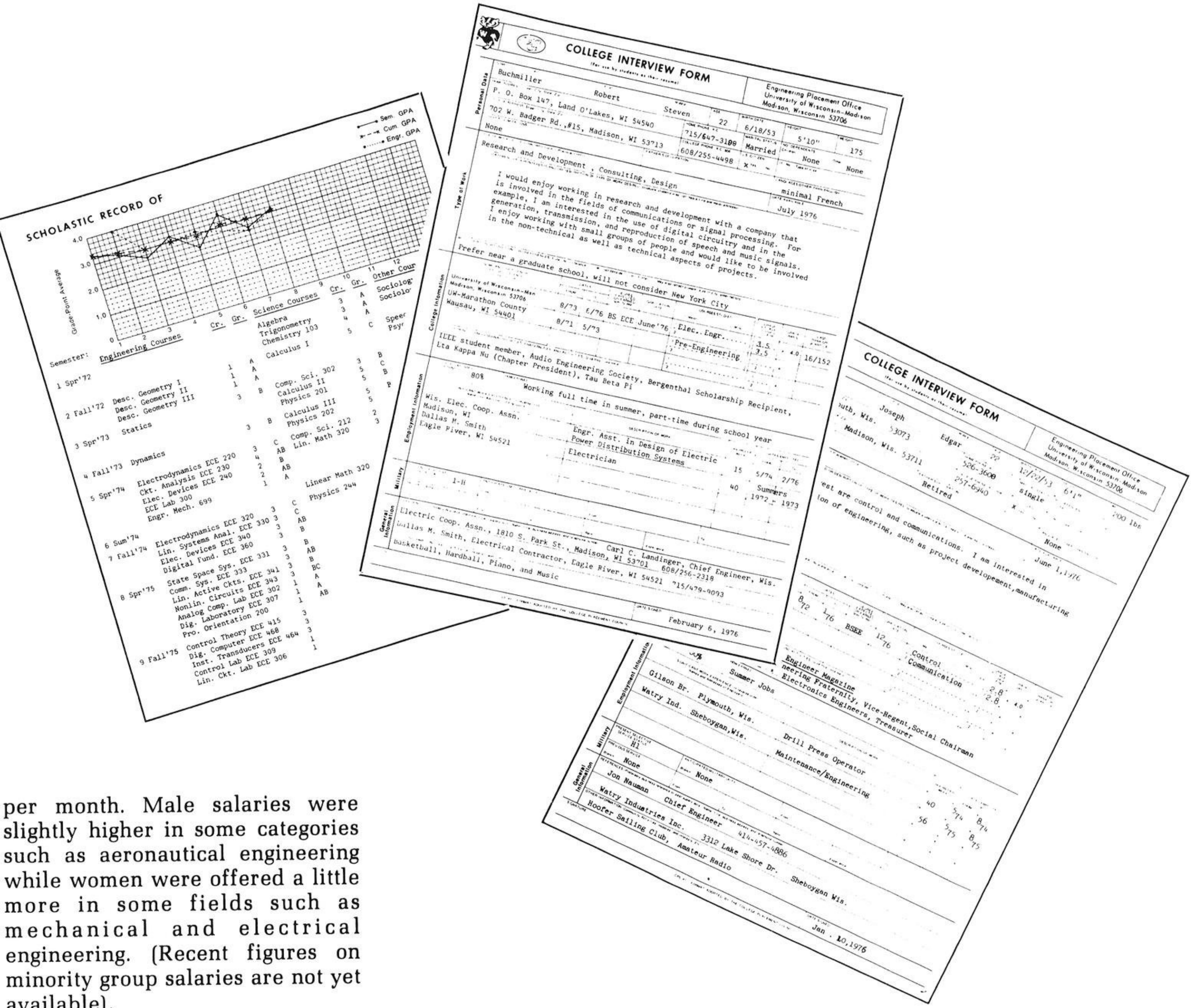
Not that there is absolute equality in hiring. Frederick Leidel, Dean of Freshman in the University of Wisconsin College of Engineering, says that engineering is probably the only profession where women perehaps are being offered even better jobs at higher pay than men. A quick polling of job placement services around the country pointed up the same preference. Ed Francfort, of New York's Engineering Employment Services Inc., says that "for some reason a female seems to get a job." A spokesman for Chicago's Chemical and Engineering Personnel Inc. says that he wishes there were thousands of female graduate engineers and that "if a woman engineer walked into this office right now we could place her anywhere in the city of Chicago."

Bob Barnes, of the Wisconsin Department of Highway Engineering, says that there is so much competition to hire women and minorities that private companies consistently out-bid the government and hire nearly all of them.

This recent surge toward hiring of women and minorities is essentially an outgrowth of federal legislation that began over 10 years ago, with the passage of the 1964 Civil Rights Act. Title VII of that act prohibited discrimination on a number of bases, including sex and race. In 1972, anti-discrimination efforts were enhanced by the Equal Opportunity Employment Act which set up a special agency, the Equal Employment Opportunity Commission (EEOC). The EEOC investigates complaints of job discrimination, seeks voluntary compliance from the employer, and ultimately can take him or her to federal court. The Commission looks mainly for discriminatory patterns so legal action generally takes the form of class action, rather than individual, suits. Besides court action, an organization not complying with proscribed employment policies can be denied federal aid, as recently happened when the Chicago Police Dept. was told it had too few black officers.

To stay in line with federal policy, many organizations have established special Affirmative Action Programs. These can be completely voluntary, part of voluntary compliance with the EEOC, or in some cases they can be directly imposed by the Court. Under Affirmative Action Programs an organization sets definite goals and timetables for hiring women and minorities.

Does this spell trouble for white male engineers? Perhaps not. For one thing the salaries offered to graduate engineers in 1974-1975 were about the same for both sexes. Joan Slowitsky, a U.S. Department of Labor analyst says that none of the average salaries offered to male and female engineers in the same category differed by more than about $20



per month. Male salaries were slightly higher in some categories such as aeronautical engineering while women were offered a little more in some fields such as mechanical and electrical engineering. (Recent figures on minority group salaries are not yet available).

The second reason men should not feel threatened is that, though women are increasingly drawn to engineering schools, the absolute numbers are still small. In 1974-75, for example, only one to two per cent of the engineers who were offered jobs were female. Wisconsin Department of Highway Engineering's Bob Barnes says the impact of women and minorities is very slight. "A few years ago when the State Patrol was under pressure to balance its work force we heard that the white male doesn't have a chance," Barnes says. "Now it's 95 instead of 99.9 per cent male. The hue and cry that we white males are putting up is really kind of silly."

Finally, everyone seems to agree that the important factors in getting a job in engineering today have nothing to do with sex or race. Ed Francfort, who has been placing engineers for 14 years, says that employers are looking specifically for experience, that "what an engineer has done is the deciding factor." The other big variable is of course the economy and the job market itself. A few years ago offers were up because of the energy crisis. Today they are down again. And that, regardless of sex, creed, color, or place of national origin, is something we can do little about.

Mallory Boush *is a graduate student in the School of Business. He is co-author of the forthcoming Public Service Commission booklet "Wisconsin Looks at Energy."*

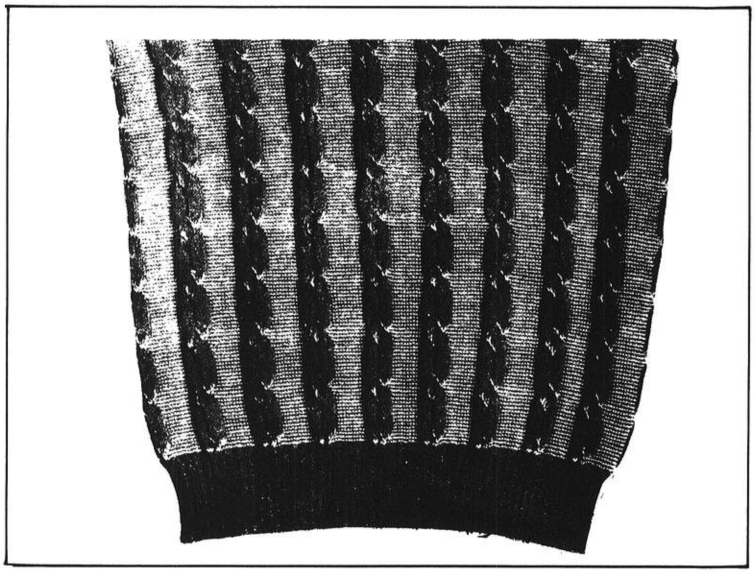


Fig. 6 **Sample fabric knit with a cable pattern.**

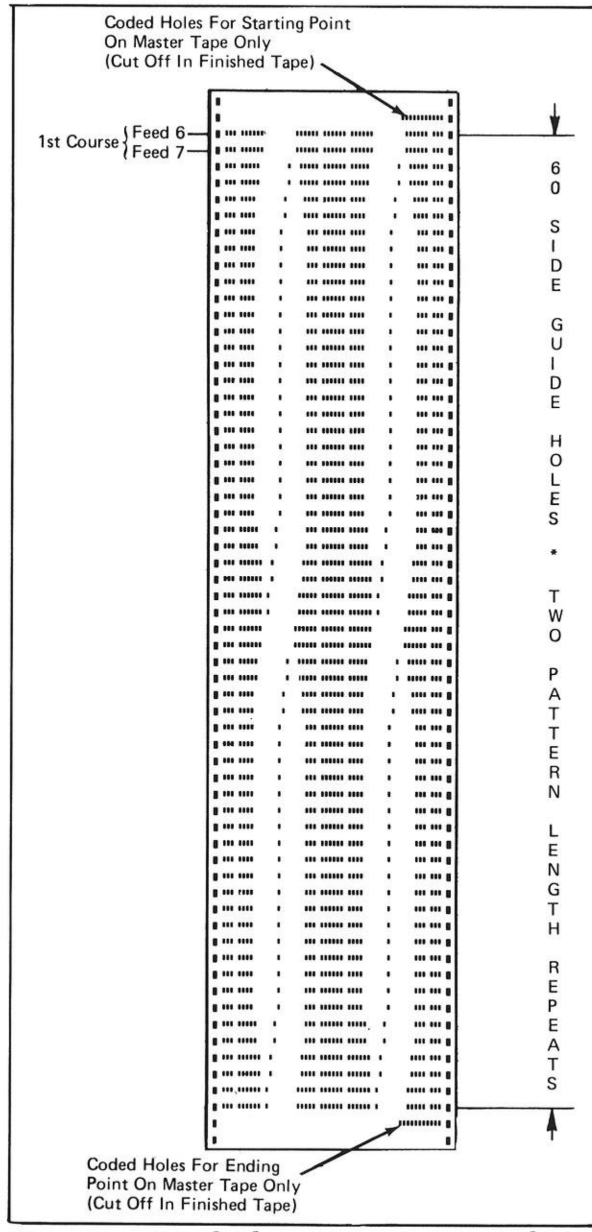


Fig. 7 Punched pattern tape used to generate the cable pattern used in Fig. 6.

sheet. Notice the similarity between the pattern in the tape and the fabric. Since one tape controls only 39 needles (about 4 inches width on this machine) several tapes and drums are needed to control the entire circumference of needles. The entire set of pattern tapes can be seen on the machine in Fig. 2.

Multi-colored patterns are controlled in a similar way. Pattern tapes work in conjunction with a master tape which controls the selection of colored yarn to be fed to the needles at a particular time. For example, if we wish to make a two—color pattern, both colors are fed during each revolution and by use of the pattern tapes each color is selectively knit with the other being floated on the reverse side.

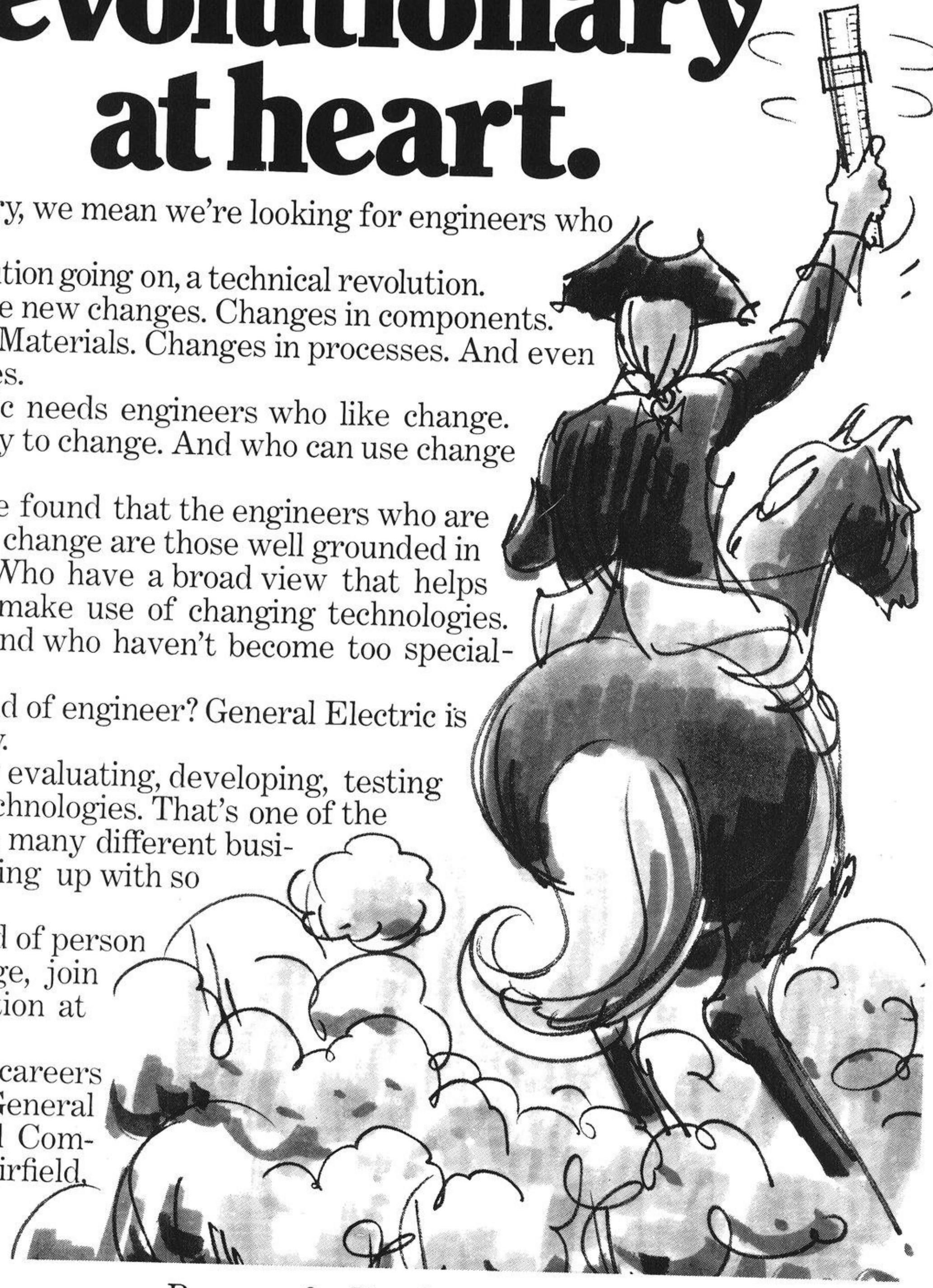
With these pattern tapes it is a fairly quick and simple matter to change patterns, an important factor to the manufacturer where versatility and speed of production are highly desirable. Certain applications such as socks or underwear require the plain stitch only, therefore the pattern tapes and associated mechanisms are unnecessary and are not built into the machine. In this case, the needles are actuated by cams alone.

The sweater used to illustrated the knitting process here is only a very small part of the knitting industry. Through the examples shown here however, one can get a good idea of what is involved in the manufacture of a knitted product.

Knitting today is much more than a domestic craft. It has grown from handwork to a multibillion dollar industry involving highly engineered precision machinery.

Peter Scheer *is a December graduate in mechanical engineering. His interest in knitting stems from his past work experience. He spent several years working part time for a knitting mill in New York City. A past editor of the Wisconsin Engineer, he now works in the needle division of The Torrington Company.*

We're looking for engineers who are revolutionary at heart.



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