APPLICATION OF COMPUTERS FOR PRODUCTION-PROGRAMMING IN THE HOSIERY INDUSTRY

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Summary

The study gives a method for the adjustment of products to be manufactured and machines used for their knitting on basis of a computer aided survey and sorting. It gives a concrete example for the application in the field of coarse hosiery machines

Introduction

It is a long way from the product designed on a sheet of paper to its production. One stage is to find the machine best suited for the given product. In factories with few types of machines, machine selection causes no problem at all, a technologist with some practical experience can do it. In factories, however, where great many different products and knitting machines have to be matched, consideration of the possible machine types does not always cover the full range. It is an especially difficult problem for products (e. g. hosiery) with several properties confronted with the corresponding characteristics of knitting machines to find the coincidence suitable to match product and machine.

Automation of this problem has been set as the aim of our research. A method has been developed for the computerized survey of all available knitting machines, and to file machines with the desired—specified—properties according to a computer program. To ease the final choice, the computer determines theoretical machine knitting output for the given product.

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Illustration of the method on coarse-gauged hosiery knitting machines

Data basis of coordinating product and knitting machine

To compare product and machine characteristics, a data base has to be set up containing technology data and technical characteristics of both the knitting machines and the given product. Univocal matching of products and machines is granted by the following data in the data basis:

from among characteristics (capabilities) of the knitting machine:
— machine type;
— number of needle beds;
— diameter;
— number of needles;
— maximum number of work units (separately for welt, shank, heel, etc.);
— number of yarn carriers in each work unit;
— machine facilities for knitting, shaping variants of different product parts (e. g. welt forming, shank patterns, varieties of sole, heel, loopers course);
— facilities for tightness variation;
— column and row numbers of the pattern drum; for calculating the performance:
— r.p.m. alternatives;
— number of courses corresponding to a link in the revolving and swinging motion of the needle-cylinder;
— total number of switch knobs;
from among the product characteristics;
— style number;
— size
— range of needle counts for maximum width;
— minimum number of work units for knitting welt, shank, heel, etc.;
— number of needle beds needed;
— minimum number of yarn carriers for different yarn types (ground yarn, welt, rubber, heel, toe, loopers course);
— knitting, forming alternatives for different parts of the hosiery (e. g. rib welt with rubber inlay, lace shank with tuck stitches plain sole, shaped toe, heel reinforcement with yarn change, plain loopers course);
— methods required for changing the thickness;
— maximum width;
— column and course numbers of the repeat;
— number of courses for knitting each part of the product.

The enumerated data have to be filed but once for the entire machine park, and/or changes in the machine stock have to be transcribed occasionally.

Programs for matching product and machine

Assignment and listing of the selected machines is made by an executive program. Further programs provide for handling the data base, such as recording, modifying and checking programs.

A flowdiagram of the executive program simplified to contain but logical steps is seen in Fig. 1.

Starting of the executive program involves to open files on product data $C(j)$ and machine data $G(i)$. Within a file, the data of all products or machines are in a row (record) each, of the same length since they contain identical number of data.

At the start of the executive program, the programmer may give an instruction to decide whether to examine all products or only those to be designated by him. Either each product $C(j)$ is considered in turn, from the first member $j=1$ of the file to the last one $j=j_{max}$ to examined or not, or—for an available data set—the data of the product to be examined are imprinted, when, e.g. of introducing new products.

The style number and size of the examined product are printed out (listed) by the computer.

In the subsequent stage of the program, after product data input into the operative memory of the computer, also machine data $G(i)$ row $i=1$ is read. First, the program performs fast search: each of the five basic conditions (number of needles, number of needle beds, number of knitting units, number of thread carriers, repeat sizes) has to match in order that the computer can further examine the aptness of the given machine type for knitting the given product. (Failure of any basic condition induces the computer to read another machine data row.)

Examination according to the five basic conditions involves five sub-programs. For instance, logical examination according to needle counts contains maximum and minimum needle counts permitting to knit the given size. The program examines whether the number of needles among the considered machine data is within the range included among the product data.

If the five basic conditions show the knitting machine to be suitable, further machine and product data are compared item-wise. If each item is up to the aspects of comparison, then the program instructs the computer to print out if the examined knitting machine suits to produce the product, indicating the time theoretically needed to knit product parts, as well as the overall theoretical machine time.

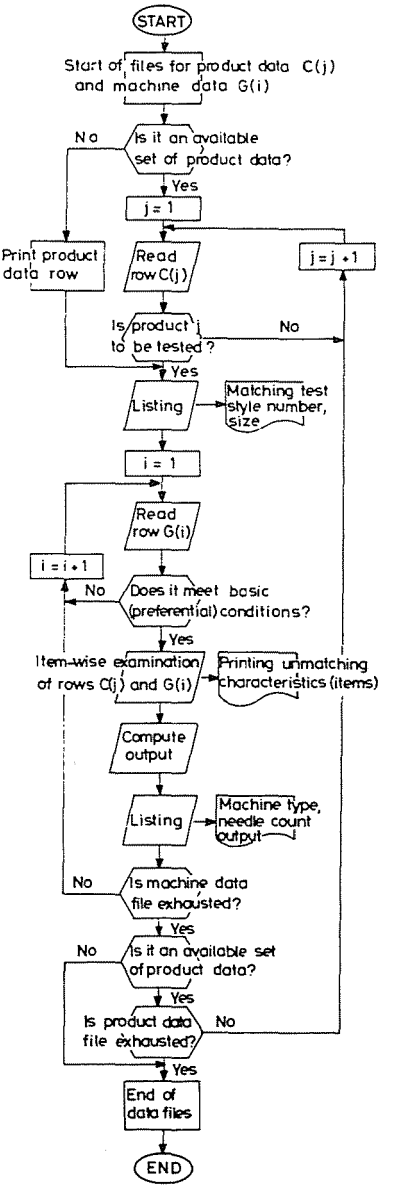

Fig. 1

Rather than till the first wrong (inadequate) item, the comparison continues all along. These items namely include product characteristics modifiable in certain limits. Hence, the computer prints out characteristics failing the condition of suitability.

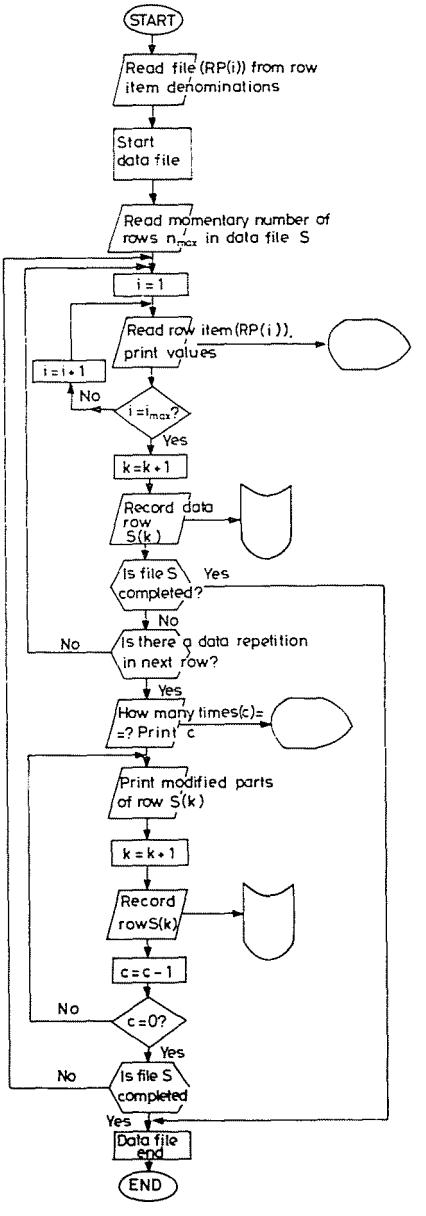

Fig. 2

Thereafter the program checks whether all members of the machine file have been examined and tests the fitness of the subsequent machine until the last member, $i = i_{max}$. After surveying the machines, consecutive products are examined till the last product, $j = j_{max}$.

There are several programs to handle the data base. Use of the introduced executive program requires primarily to prepare the file of basic data (product and machine data). Flow chart in Fig. 2 shows the denomination of data $RP(i)$ in rows to be read off first, followed by the serial number n_{max} of the tested file from the data set. Thereafter items in the first row are read one by one from $i=1$ to $i=i_{max}$, their actual value printed and displayed.

Now, the next data row $S(k)$ is recorded and if the file is not yet complete, the subsequent data row is examined for any repetition of former data. (Namely, to cut running time, re-examination of data already encountered inprevious machines has to be avoided.) Without any repetition, row items are scanned from $i=1$. For a repetition, the number of repeated rows (c) is asked, printed in, together with the content of variable items in data row $S(k)$. Turning to (recording) the next row, $S(k)$, the cycle goes on until rows containing repetitive items are zeroed. If completing the data file is not yet finished, the content of subsequent rows from $i=1$ on is consecutively read in, to end with closing the data file.

The complete product and machine data file needs "updating". "Updating" programs are expected to check data (information) content of files and modify, if needed. Checking the information content is facilitated by recording data on two data carriers (magnetic tape, punched tape or disc).

A special updating program cares for the erasure of machine data. Erasure affects a data row of one machine to be omitted from examining. After having read in the original length of the data file (row number n_{max}), the program (Fig. 3) scans each row, prints it and decides if it is to be erased or not. If not, the examined rows are shifted by one. If yes, the original number $k=i+1$ of the row after the erased one is reduced by one to $w=i$ and printed in place of the erased row $w=i$. This operation is repeated until the numeral of the last row equals the original file length n_{max}. Now the file length is changed to $n_{max}-1$ due to the erased row. If several rows are to be erased, this process is repeated and, after the erasures the final length n_{max} (row number) of the remaining file is printed. Thus, after erasures, the program automatically compacts and re-numbers the data file.

Another updating program serves for replacing a data row of an obsolete machine type by that of a new one with unchanged numeral. The modified data are recorded on the data carrier. Another program in use finds the end of the prime data file and, beginning from there, it records new data rows printed by the operator—numbered consecutively—,and then transcribes the file length (maximum number of rows).

Information content of a magnetic tape or punched tape data carrier is checked by another updating program. A row each from the magnetic tape and the punched tape is read into the operative memory and the data compared item-wise. Wrong items in the given row are printed out (listed). If every item is

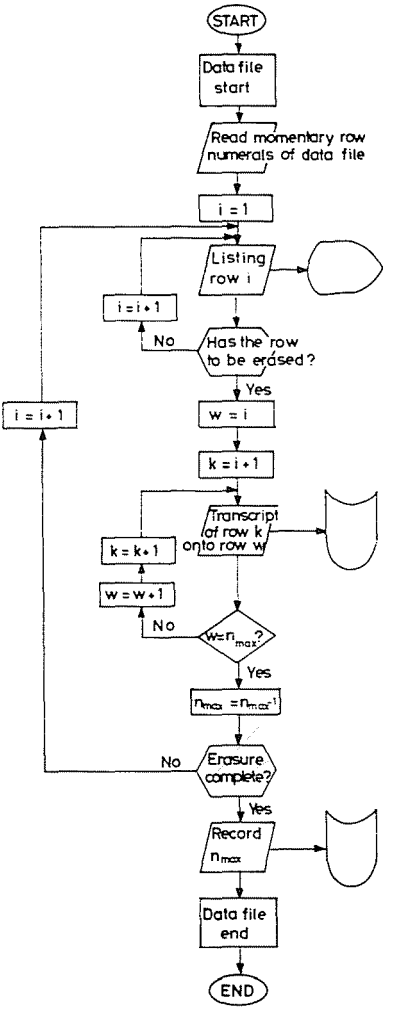

Fig. 3

correct, the next row is checked. Observed errors are printed out and the other program part becomes effective with the error-correcting program being activated. The error is corrected through the keyboard (from the basic document), and the corrected row is recorded on the magnetic tape. After correction of all errors observed, the corrected magnetic tape will be the basis of the new, error-free punched tape.

There is a special program for organizing the mentioned updating programs. It lends itself to select the actually needed updating (erasing, transcribing, continuously completing or data checking program).

Presentation of all utilized programs will be omitted. The program has been run for several products of the Budapest Hosiery Co. It is functioning well and can be run on any computer after suitable adaptation.

Fields of use and advantages of the method

The computer method of machine selection serves for a flexible production organization system. By matching product and machine, the technological system of production engineering provides for the following optimization possibilities:

selection of the best machine type for

— knitting (manufacture) suitability;
— capacity;
— machine loading and attendance;
— pattern adjustment;
— scatter of sizes in pilot manufacture;
— material consumption standard (percentage).

Decisions based on information by the program permit to optimize production from several aspects.

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