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Bezeichnung der Erfindung:
Title of invention:
Titre de l'invention : A sequence controller for a machine tool and a method of preparing and executing sequence program for sequence controller used in machine tool control

Klassifikation / Classification / Classement : G05B 19/04

ENTSCHEIDUNG / DECISION

vom / of / du 15 November 1988

Anmelder / Applicant / Demandeur : FANUC LTD

Patentinhaber / Proprietor of the patent /
Titulaire du brevet :

Einsprechender / Opponent / Opposant :

Stichwort / Headword / Référence :

EPÜ / EPC / CBE Article 56

Schlagwort / Keyword / Mot clé : "Inventive step (denied)" - "obvious use of feature known in the art"

Leitsatz / Headnote / Sommaire

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Case Number : T 379/86 - 3.5.1

D E C I S I O N
of the Technical Board of Appeal 3.5.1
of 15 November 1988

Appellant : FANUC Limited
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Decision under appeal : Decision of Examining Division 062 of the European Patent Office given on 19 March 1986 and notified on 22 May 1986 refusing European patent application No. 80 303 261.4 pursuant to Article 97(1) EPC

Composition of the Board :

Chairman : P.K.J. van den Berg
Members : W.B. Oettinger
E. Persson

Summary of Facts and Submissions

I. European patent application No. 80 303 261.4, filed on 17 September 1980 claiming a priority of 18 September 1979 and published under No. 28 068, was refused after oral proceedings, held on 19 March 1986, by Examining Division 2.2.06.062.

In a written decision dated 22 May 1986, the refusal was based on the reason that the subject-matters of Claims 1-4 filed on 24 July 1985 lacked an inventive step.

Claim 1 reads as follows:

"A sequence controller for a machine tool, the controller having a memory for holding sequence programs, prepared from ladder diagrams employing relay symbol representations, for controlling operational functions of the machine tool, wherein the controller is equipped with subroutines appropriate for controlling respective operational functions of the machine tool, each subroutine operable in dependence upon one or more control conditions applicable to the subroutine concerned, which control conditions control selection of and/or initiation of a processing operation to be carried out by the subroutine, each control condition being indicated by a single bit and being representable by a relay symbol or a combination of relay symbols, and each subroutine being operable to carry out a processing operation to provide a processing result in accordance with one or more parameters required by the subroutine, wherein the memory stores data values indicative of the control conditions and stores data values indicative of the processing results of processing operations carried out by the subroutines, and wherein a sequence program held in the memory comprises instructions

for reading one or more control condition data values from the memory, for identifying a subroutine, for taking one or more parameter values, and for storing the result of operation of that subroutine in the memory."

Claims 2 to 4 refer back to, and are fully dependent upon, the independent Claim 1.

For the prior art, reference was made, inter alia, to the following documents:

(D1) US-A-4 038 533
(D2) Maschine + Werkzeug, Sondernummer Oktober 1978, pages 44-46
(D3) Siemens Zeitschrift, Volume 51, No. 8, 1977, pages 594-595.

Having regard to the prior art, the subject-matter of Claim 1 was considered to be obvious, in particular because the use of a microprocessor in the numerical control art, as known from the citations, implies also the use of sub-routines (known from D2, D3). The use of subroutines in computer programs, a software feature, may moreover be considered to constitute common general knowledge. The use of subroutines may, furthermore, thought to be only the obvious extension of the use of macroinstructions in numerical control (known from D1) to a higher level computer language.

II. On 25 July 1986, the Applicant lodged an appeal against that decision, having paid the appropriate fee two days before, and on 1 October 1986 he filed a statement of grounds of appeal contesting the Examining Division's findings.

III. In a communication dated 29 July 1988, the Board expressed its own reservations, in particular against Claim 1, and summoned the Appellant, according to his request, to oral proceedings.

In respect of the skilled person's understanding of the expressions "macroinstruction" and "subroutine", the Board further referred to the following document:

(D7a) A. Ralston and C.L. Meek: Encyclopedia of Computer Science, First Edition, Van Nostrand Reinhold Company, 1976, pages 838-840

(D7b) ditto, pages 1372-1373.

IV. In the statement of grounds of appeal and in the oral proceedings, held on 15 November 1988, the Appellant argued, in support of Claim 1, essentially as follows:

(a) D1 discloses a numerical control system for machine tools combining a numerical control processor with a programmable controller. In contrast, the claimed invention is a sequence controller functioning as an interface between a numerical controller and the machine tool.

It is significant for the system of D1 that it operates cyclically, interrupted approximately every 10 ms. During the interruptions, macroinstructions execute machine dependent software in a predetermined sequence. It consists of very simple instructions examining the status of single bits in a system flag table and setting, for instance, only a timer, counter or the like without any dependence upon control conditions or parameters from outside. In contrast, the claimed invention relies on computer programs of

a higher level language including sub-routines, influenced by control conditions and requiring parameters.

The statement at column 19, lines 7-11 in D1 does not suggest any specific generalisation in the direction of the claimed invention.

Historically, sequence controllers using microprocessors and memories have evolved from hardware implementations employing relays. No cross-fertilisation between this technique and numerical control has taken place and the person dealing with sequence controllers can be said to have had a "blind spot" for other techniques used in numerical control. It was his natural wish to retain the ladder diagram description of a sequence controller and he saw no possibility of combining this with any other technique than that which is disclosed in D1.

(b) Considering also D2 and D3 or the general knowledge including the well known facility of e.g. home computers to work with sub-routines, it may, prima facie, appear obvious to use higher level languages in sequence controller programming and thus make use of their sub-routine facility, but then the natural thing to do would be to abandon completely the relay ladder diagram (Figure 12B of D1) approach. In the claimed invention this is deliberately not done. The phrase in lines 3-4 of Claim 1 is intended to express this restriction.

(c) For the machine tool, the function of the claimed sequence controller and that of the numerical control system of D1 may, in effect, appear to be the same but the programmer need not be proficient in assembly

language programming. There is, moreover, no similarity between the different controllers themselves.

V. The Appellant requests to set aside the decision under appeal and to grant a patent on the basis of the aforementioned Claims 1-4 filed on 24 July 1985, this request implying the inclusion of the description as amended on 19 July 1983 and on 24 July 1985 and the drawings as published.

Reasons for the Decision

1. The appeal is admissible.

2. Claim 1 is primarily based on the original Claim 13 as the only claim initially filed in the apparatus category.

Insofar, however, as Claim 1 refers to the way in which the sequence program is prepared, namely from ladder diagrams employing relay symbol representations, it relies on the original Claim 3. That claim was, together with Claim 2, to which it was appended, directed to this feature in combination with a method of preparing a sequence program, defined in the original Claim 1.

Even though the original Claims 1 and 13 were formally independent of each other, their possible combination follows from the cross-reference, in the description, between the machining centre of Figure 1 and the relay symbol ladder diagram of Figure 4 (page 5, lines 8/9 and 23-25; page 6, lines 4-10 and 20-22).

The amendments which eventually led to the present Claim 1 thus comply with Article 123(2) EPC.

3. The Board is satisfied that the subject-matter of Claim 1 is new.

Its novelty follows from the differences of the claimed sequence controller from the numerical control system disclosed in D1 and from the fact that none of the other documents considered discloses a sequence controller.

As to D1 and the differences therefrom, the following is noted:

The numerical control system of D1 combines, as the Appellant has correctly stated, a numerical control processor and a programmable controller. The latter is, in effect, a sequence controller.

The differences therefrom lie in the fact that the claimed sequence controller uses subroutines whereas the known system uses macroinstructions.

Firstly, it is to be recognised that the difference between subroutines and macroinstructions is not only a matter of the level of the programming language used. Although D7 discloses a possible "subroutinized version of the macro" (D7a, page 839) or subroutines and macroinstructions being "related" (D7b, page 1372), in fact there is a clear-cut difference between them (D7a, page 839): A macro is replaced, as often as it occurs, by the instruction sequence it stands for, so that n copies are inserted in the main program, whereas a subroutine involves, as often as necessary, a break in the flow of the main program, and a jump to, and return from, only one copy of the instruction sequence it represents.

Secondly, in the claimed sequence controller the subroutines are operable in dependence upon control conditions and they require parameters for their carrying out a processing operation. At least if these features are understood in the sense of the description, the "control conditions" are of a quality different from the microinstruction which, according to D1, initiates a macroinstruction, and the "parameters" are of a quality different from the individual variables used in the instructions of the microroutine constituting said macroinstruction in D1. The "control conditions" are understood as being influenced, in the claimed invention, by movement capabilities of the machine tool magazine and the like, and the "parameters" are understood as relating to actual machine tool and workpiece positions, whereas in D1 the macroinstructions are excecuted periodically, i.e. unconditionally, and they determine whether, in those periodic instances, a particular operating device such as a timer or counter, should be energized or de-energized according to the image of the state of the control system provided by a system flag table (column 24).

4. However, in the opinion of the Board, the subject-matter of Claim 1 lacks an inventive step for the following reasons, and the decision under appeal must therefore, in effect, be confirmed:

4.1 As has been pointed out before, the prior art document considered to represent the nearest starting point for the claimed invention, is D1. Its disclosure even includes the relay symbol ladder diagram approach for sequence programs (Figure 12B) operating the discrete digital devices associated with the machine tool (column 19, lines 7-11).

Highly relevant are, however, also those documents which do not disclose sequence controllers in particular, but relate only to numerical control in general. These fields are so closely related that a person skilled in the art of sequence controlling must be assumed to be aware also of prior art in numerical control. This follows already from the submitted function of a sequence controller as an interface between a numerical controller and the machine tools to be controlled.

Even if there may have been, on the side of the person skilled in the art of sequence controllers, some lack of appreciation of, or reluctance to adopt, a technique known from numerical controllers, there cannot be considered to have been any real prejudice against such an adoption.

The Board cannot, therefore, accept the submission that in such an adoption of known techniques the skilled person had to overcome a prejudice by an inventive consideration.

4.2 As a consequence, it cannot agree that it was non-obvious to introduce, in sequence controller programming, a non-assembly, or higher-than-assembly, language which was known in the numerical control field, with the consequential use of all well-known facilities given by such a higher level language, including subroutines. This the less so, as the use of subroutines was known even in the art of numerical control, viz. from D2 and D3.

4.3 It is further not seen that this improvement would have led the skilled person to abandon altogether the relay ladder diagram description. On the contrary, it would rather have been his wish to retain this model for the apparent reason that it is quite expressive.

4.4 As to the remaining features in Claim 1, these appear to follow all from the obvious implementation of a sequence

controller, when using a higher level computer language, with subroutines. It is clearly general knowledge in the art to associate a subroutine to some kind of control conditions. In the computer art in general, it is quite common to call up a subroutine in dependence upon a condition, and it is clear that, when subroutines are applied in the art of numerical control or, more specifically in sequence controllers, this facility adds to the flexibility of the system.

Similarly, it is obvious that a subroutine can be carried out in dependence upon parameters. From D3 (page 595) this is known for numerical control in general and the flexibility following from this feature will apparently also be achieved when subroutines are used in a sequence controller.

5. The only independent Claim 1 falling for these reasons, the dependent claims cannot be allowed either.

Order

For these reasons, it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

S. Fabiani P.K.J. Van den Berg