INFORMATION FLOW IN THE FLEXIBLE PROCESSING SYSTEMS

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Abstract: The flexible automation represents the integrated component within the system of flexible integrated production by the instrumentality of the computer and governs the process of production from the long-term planning of the constructive design of products, continuing with preparation of production, ensuring the supply and delivery of the materials and ending with testing and controlling the products and analysis of the processing.

Keywords: Flexible integrated production, process of production, analysis of the processing, decisional analysis, adopting the decision, cost of production, decisional methods and techniques.

JEL Classification: M11, M15, L61

The concept of flexible automation is a direct consequence of the requirements for an efficient using, such as the increasing the complexity of the management equipment, automation, control, supervision; raising the usability of the technological installations; increasing the products quality and the controllability opportunity in coupling the technology sub-processes; high requirements for the safe functioning.

Achieving these goals can be obtained through decentralization of the functions simultaneously with the hierarchical structuring of the systems; numerical processing of information; using the multiprocessor systems; spatial distribution of intelligence; realization of human-machine communication with graphic terminals; using the concepts of the artificial intelligence.

Among the elements that define the flexible processing is the information flow. It determines the structure of flexible automation as a possible concept to be implemented by using some calculation configurations of multiprocessor type and by creating a modular system of functionally oriented programs. The information flow is materialized into an information network that includes on the one hand the internal communication of the operational conditioning between the machine tools, the coordinator computer and the supervisory staff and on the other hand the external communication with the computer on the higher hierarchical level.

FPS technological design is subject to the modular conception of the system: to each module are allocated the specific technological components. The technological project in the flexible automated production must follow three directions:

- 1. Establishing the accurate needs and achieving the optimum production flow, using appropriate software resources;
- 2. Direct supply with data of the intelligent processing devices in the SFF (M.U., CNC, robots, transfer systems, automatic control machines, etc.).

- 3. Direct leadership of manufacturing the pieces by data terminals, constantly updating the production image in the computer.

FPS modulated structure and the related functions are shown in Figure no. 1. To each function is corresponded an information flow.

Achieving the material flow from the entry of the products as the gross pieces until to deliver them as the finished pieces, involves operations of pooling resources, charging, authorization and operational control.

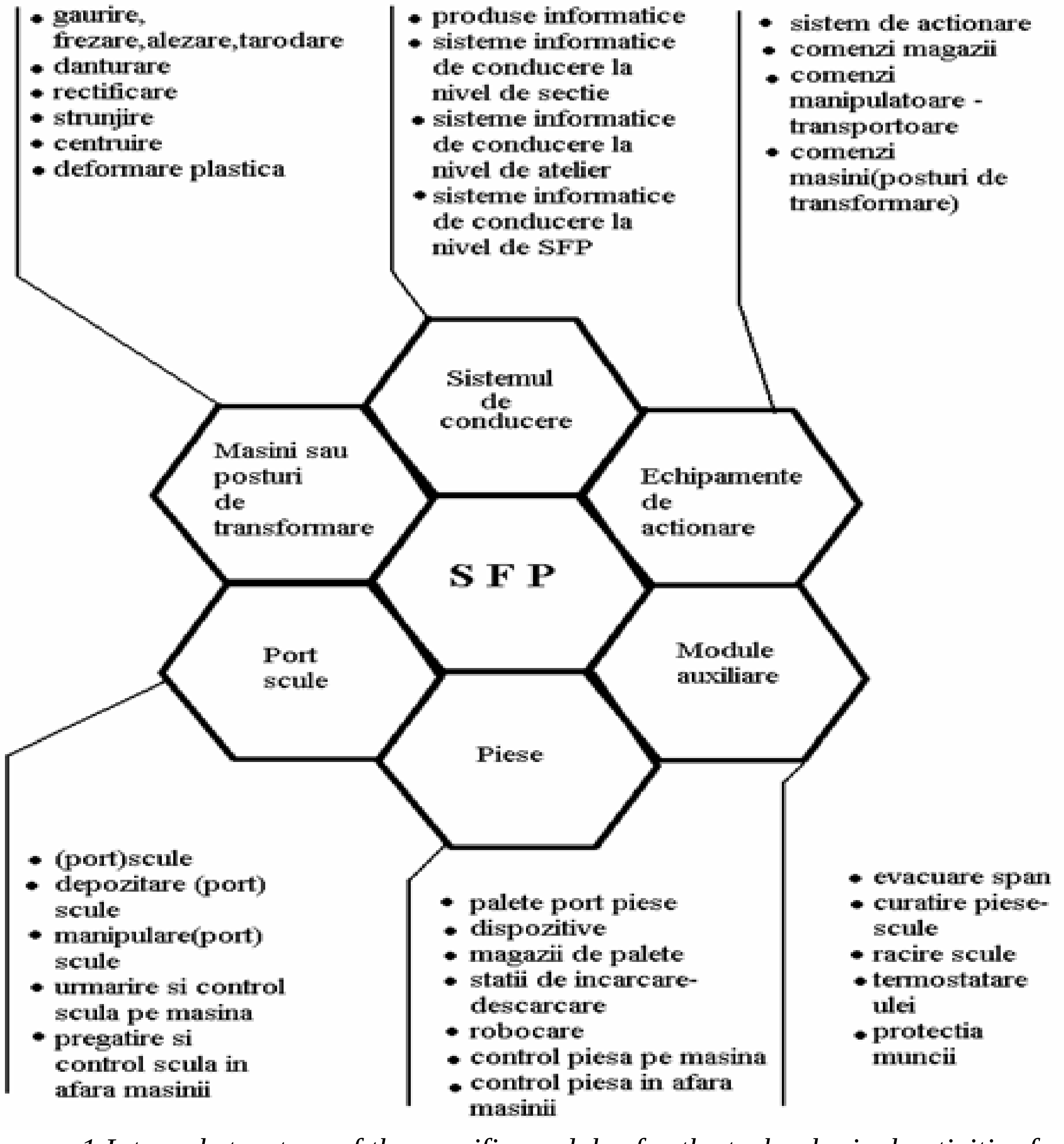

Figure no. 1 Integral structure of the specific modules for the technological activities from the structure of a FPS

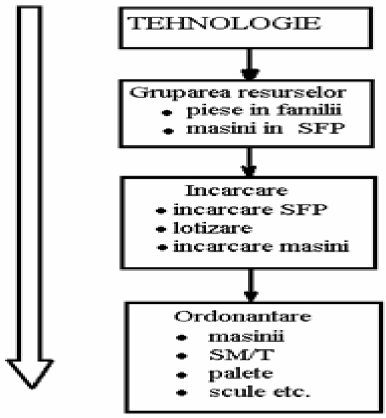

Figure no. 2 Succession of the technological sequences

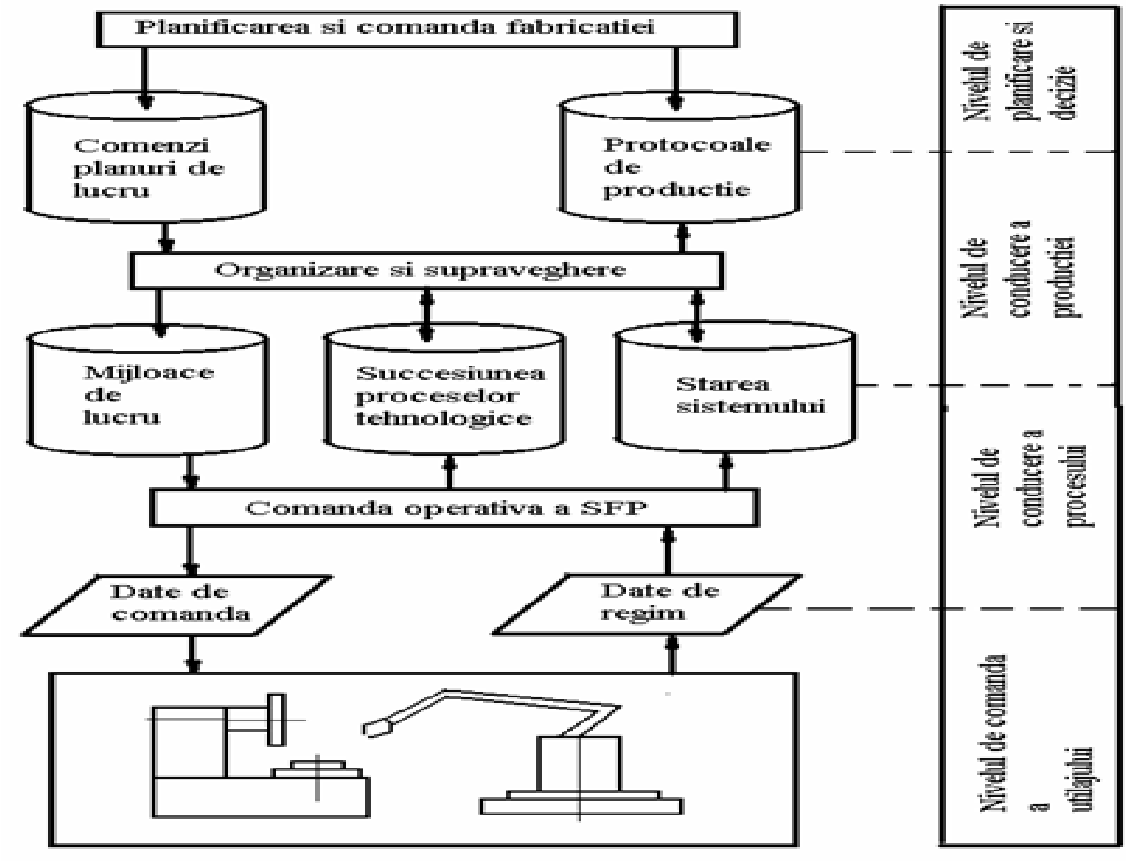

Figure no. 3. Succession sequences - the logical schema

Hierarchy of the information flow structure is shown in Figure no. 4.

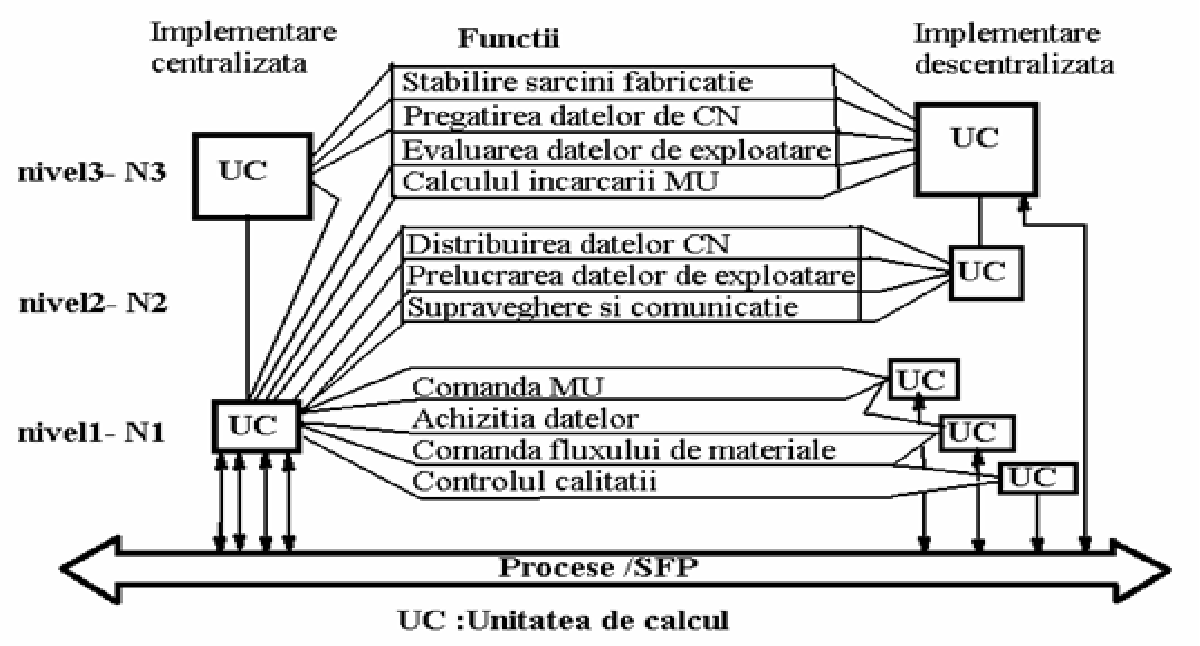

Figure no. 4. Hierarchy of the information flow

- Level of the machinery command - targeting the automation devices of the intelligent machines (programmable automates, numerical controls CNC and DNC).
- Level of the process conducting - aimed conducting with the computer of more automated manufacturing devices in the FPS, warehouses management, transport management systems, assurance the products quality.
- Level of the production management - issues the documentation - issues the manufacturing documentation and through the reaction circuit determines what operations were made, what abnormalities occurred and what corrections are necessary.
- Level of planning and decision - manages the applications of production, materials and the capacity of production.

Each of the components shown in the modular structure of the information system in FPS requires for operation an information flow whose supporting structure (as programs) is shown in Figure no. 5.

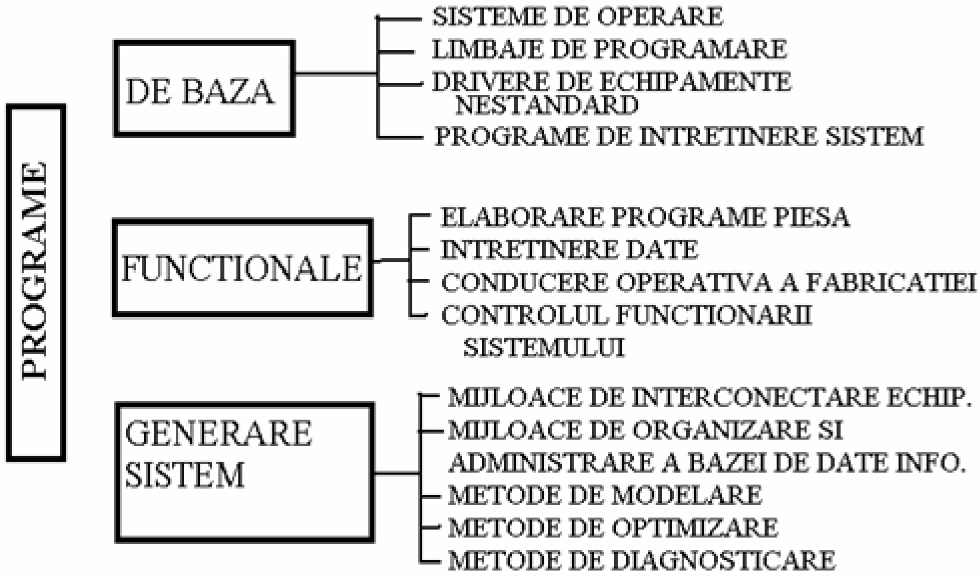

Figure no.5 Organizing the information in FPS

Information, as well as automation actions of the technological processes associated with a flexible system for processing are subject to organize three hierarchical levels for calculation and command functions:

I. Technological preparation and manufacture planning;

II. Command and coordination of the technological and informational processes;

III. Local command and supervision of the flexible system elements of processing.

Each of the three hierarchy levels contain three groups of activities that are distributed and executed by elements and computing and automation equipment ON-LINE and OFF-LINE, which are:

A) Activities for conducting the manufacturing processes;

B) Activities to organize and command the material flow;

C) Activities for acquisition and processing the data.

The combination of the hierarchical levels with the groups of activities leads to establish, in detail, the information flow components, as follows:

I. A) Technological preparation of the manufacture includes:

1 - Elaboration of the technology for the sequence of operations and phases, choosing and designing the devices, choice and design the checkers, choice and design the tools, choice and design the auxiliary tools;

2 - Development and management of the NC off-line programs;

3 - Preparation of the means of exploitation, managing files (libraries) for manufacture preparation (tools, machines, materials, devices and semi-manufactured).

I. B) Command for manufacturing:

1 - Cycles diagrams of the manufacturing times, loading the machines, vehicles and handling, change of tools, change of the port-pieces palettes;

2 - Processing of the exploitation data for manufacturing: following the tasks execution, recognition of the tight places, calculation of the necessary for processing and materials, decisional reactions to

alerts in case of damage and faults from the functional units of FPS);

3 - Ordering and grouping of the information: statistics, comparative tables and graphs.

II. A) DNC functions for direct numerical management:

1 - Online administration (relative with the technological processes in FPS) NC programs, consisting of:

- Reading, storing, broadcasting, copying, protocol and deleting the NC programs;

- Searching the NC programs;

- Protection (to the transmission) of NC data;

- NC compressing files;

- NC data correction (permanent).

2 - Sharing of the NC data, consisting of:

- Preparation the NC program (accessing the NC program by the organized file to the external memory, checking the start parameters of the program, preparation the buffer zone emission);

- NC data transfer (processing the NC program codes, NC emission programs, management of the working memory areas of the central calculation system and its output buffer zones).

II. B) Organizational command of the flow of materials:

1. - partial functions of the production management, consisting of:

- processing of the information on the FPS endowment;

- developing the guidelines detail (processing the endowment plan based on objectively defined criteria: machine maximum load, minimal power time, re-equipment and processing);

- Preliminary scheduling of time and of the manufacturing processes order for each functional unit (machine, equipment);

- Supervising the conduct of manufacturing as a whole, of the availabilities;

- Elaboration the commands and the material flow reconfiguration as a result of the failure analysis and restarting the equipment;

2. - Control function for the material flow;

- Processing the state information and analysis the development of the manufacturing process;

- Command of the transport operation (identifying the state information about the transmission, eventual, the emission of the positioning command for ST elements);

- Synoptic scheme control on transportation and the storage of materials.

II. C) Acquisition of the exploitation data at the management level of the entire manufacturing process

1. - Acquisition and data storage consisting of:

- Partial estimating of the exploitation data from the command data base from B;

- ADE from the connecting interfaces with the processes;

- Primary processing of data: logic correlation, completing, decoding, temporary storage, control loading in the plausibility limits;

2. - Data processing consisting of:

- Arithmetic calculations, interpolation data;

- Updating the files of existing materials and tools and the information relating to the temporal performance of the manufacture;

- Cyclical supervision of the processes and local automation equipment;

- Modification of the command data and reporting to the higher hierarchical level through the DNC protocols.

III. A) NC data processing includes:

1. - Processing of the geometry data: interpolation, position adjustment, speed control in the regime of acceleration/deceleration, auxiliary functions;

2. - Processing the technological data: conventional commands, sequential, changing the tool, switching the energy flows;

3. - Logic processing of the command and state signals associated to the machines;

4. - NC data correlation (partial)

III. B) Processing the command data of ST, SS, SM;

1. - Stored command, local storage and buffer zones storage for pieces;

2. - Identification of the transported materials (especially pieces);

3. - Estimating the location of pieces;

4. - Establish the routes for the material flow and command of the transport operation;

5. - Command of the transport and handling devices.

III. C) Acquisition the manual exploitation data, partially or fully automatic at the level of the local automation devices.

1. - Acquisition of the state information regarding at:

- MU (functional status, energetic consumption, labour times, auxiliary time);

- Material flow (state, travel times, pieces type);

- Pieces (processing condition, processing time, data on the control quality);

- Tools (wear durability).

2. - Primary processing and temporarily storing of the exploitation data;

3. - Retrieving the messages from the process and their processing;

In Figure no. 6 is shown the interconnection of the functional modules of the information flow associated with "n" number of FPS, their hierarchy manifested both vertical of the I-II-III levels, and horizontal activities A, B, C.

The basic function of a flexible automation system is coordination of the information flow, with the materials flow of comprising: pieces flow, tool flow, devices flow and flow of load and download of the MUCNs.

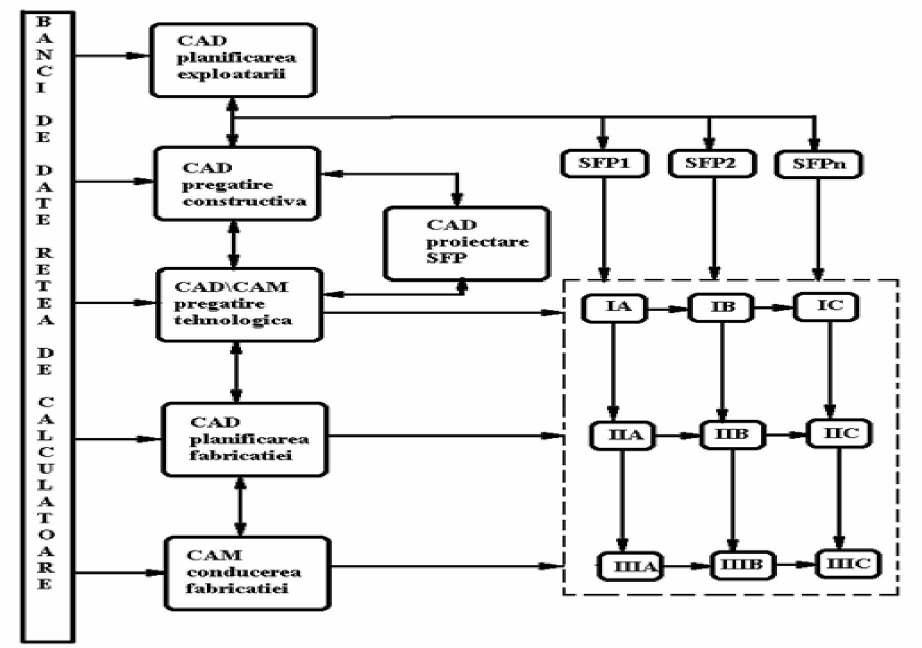

Figure no. 6 Functional modules of the information flow

Basic operations in a flexible processing system are coordinated through the information flow. This requires interfacing the information flow with the material one.

Under this method, a personified palette seeks a free machine tool, ready for processing and able to execute the frequency of the necessary operations. This is done by comparing the palette code with the number of the machine tool in the system. Personification (inscription) of the palette is usually done through a chip and considers the type of piece, its series and its state (phase, operation etc.). With this method, the choice of the machine tool is random (it is chosen the one that is free at the moment) and all of the information is in the central computing unit, from where it is distributed to the various machine tools as required.

Because of this, it cannot be done any association between the piece and the machine tools; the numerical control machine doesn't have availability for any decision on the piece. This procedure allows a high degree of flexibility but the pellets personification is more expensive.

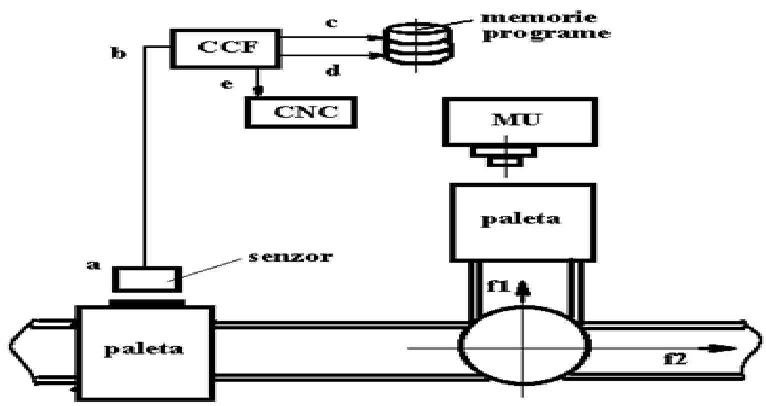

Figure no. 7 Scheme of calling the information flow through the piece

Under this procedure, the processing program is total transmitted at NC, waiting until on the band or in the transport system appears the piece associated with the program. That is the moment when is selected and distributed the machine-tool.

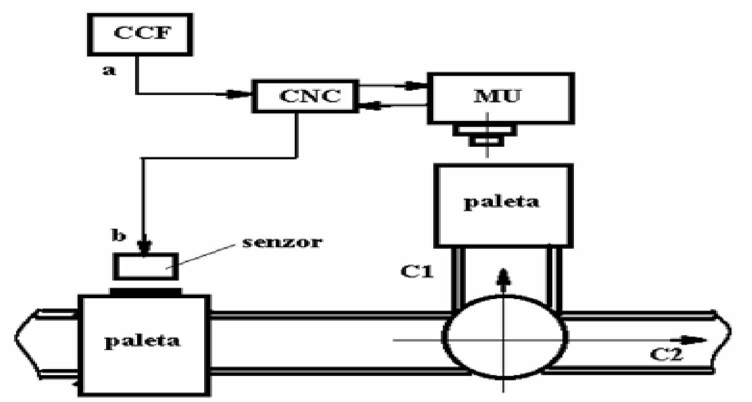

Figure no. 8 Scheme of calling the piece through the information flow

This method requires an exchange of lower information with the central calculation unit and allows association the sequences of the pieces processing with certain FPS machine. Inscription of the pellet is simpler and cheaper, and the procedure is specific to the systems with less flexibility.

Conclusions:

Introduction and judicious exploitation of S.F.F. ensures high efficiencies and increase the economic effects of the production. The most important are:

- reducing the number of workers up to five times compared to the conventional production;
- reducing the staff for the manufacture preparation of approximately 2.5 times;
- reducing by 50% of the technological equipment;
- reducing by 20-40% of spaces necessary for the production;
- increasing the labour productivity by 200-400%;
- increasing the index of using of MU to 90-95% or more;
- reducing the scrap and increasing the index of using of the materials;
- shortening the technological preparation cycles of the production;
- increasing the annual production;
- Increasing the degree of MU typing and devices resulting to decrease the terms of design, execution and maintenance of S.F.F.;
- reducing the manufacturing cycle time by 50-70%;
- decreasing by 40-45% of the production costs and additional expenses by up to 85%;
- shortening the time for processing the pieces on MU by 50% and increasing the quality of production;
- Decreasing the machines adjustment time for modifying the processed pieces by 80%.

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