SPECIFIC EQUIPEMENT FOR TOOL FLOW WITHIN THE FLEXIBLE MANUFACTURING SYSTEMS

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Abstract: One of the main characteristics of the flexible manufacturing systems is the high complexity systems used. There are several systems each with their own characteristics and specific equipments. The tool flow system is a major system in a flexible manufacturing systems and therefore the paper aims to present the specific components used to realize the tool flow.

1. Definition of the tool flow.

Due to the interdependency of the several components of a flexible manufacturing system it is not possible to make a classification regarding their importance. Basically it is no possible to state that one of the system is more important than other because if one of the system false will determine the failure of the entire a flexible manufacturing system. Of course is debatable the aspect of time. If the raw material flow will stop, the flexible manufacturing system can work using the materials previously loaded in the system, this statement being true also for the tool flow but for the information flow, the failure of this system will immediately stop the entire manufacturing system. In the conditions requested by the market (by the users) these are irrelevant because the flexible manufacturing systems must be able to work whiteout supervision for long period of times.

In order to be able to analyze the specific equipment used for the tool flow system in flexible manufacturing system we must analyze first the functions it must fulfill. The first function is the storage function, either general system storage or temporary storage for the ordering functions. Another major function is the transport function, eater from the storing to the machine tools or from the machine tools to the storage. Depending on the complexity of the manufacturing system the transport can also include transport of the broken tools outside the system to an dedicated area. An special function in the flexible manufacturing systems is the ATC function, which is present in most CNC machine tool.

For each function necessary to be realized there is available several type of equipment, choosing the right type being a key factor for the success of the project. Choosing the equipment has to take in account several factors in three areas: technical, economical and logistic. Mainly the equipment must be valid from a technical point of view. It has to fulfill the criteria's requested by the designer and the user. The equipment must be economically viable in order to maintain the project on budget. The third factor is the logistic one, meaning that the equipment must be available.

2. The storage function.

The tools in a flexible manufacturing system must be stored eater in a general storage to be used by one or multiple machine tools, or must be stored temporarily for loading in a machine or even to make place for a most important flow/function as established by the ordering function of the flexible manufacturing system.

The general storage is generally realized using storage systems. There are several types of storage systems; the most used one being the regal type. This system is also called XY coordinate system. It is easy to implement due to the relative easy construction

and also this system can be used in combination whit several additional system (for example robots).

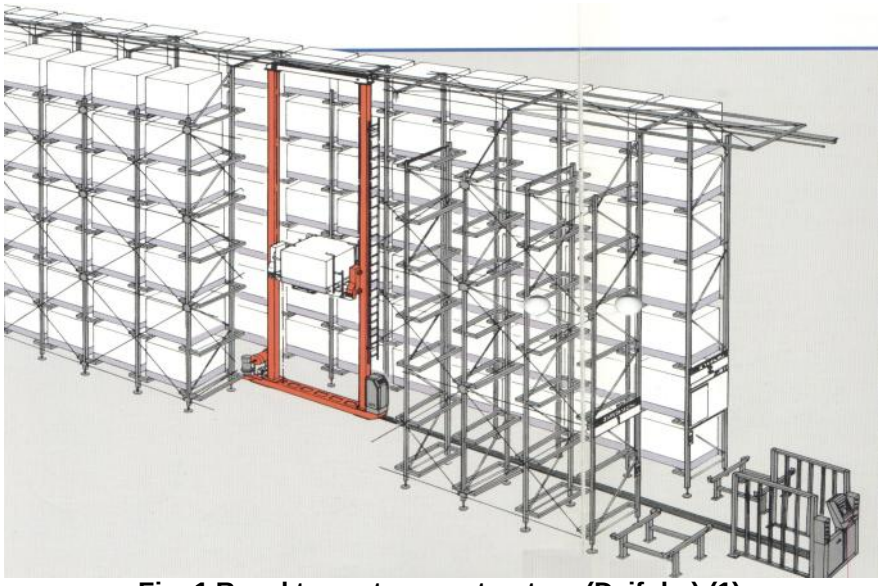


Fig. 1 Regal type storage structure (Daifuku) (1)

This storage system has a fixed type management or variable type management system, the search algorithm is the shortest path from the previous position to new position and can run into the store entries of articles, article output. (2)

In figure 2 is presented an example of organization of a regal type magazine.

Raw						
4	1.4	2.4	3.4	4.4	5.4	6.4
3	1.3	2.3	3.3	4.3	5.3	6.3
2	1.2	2.2	3.2	4.2	5.2	6.2
1	1.1	2.1	3.1	4.1	5.1	6.1
0	1.0	2.0	3.0	4.0	5.0	6.0
Column	1	2	3	4	5	6

Fig. 2 Organization of a regal type magazine

The temporary storage of the tools can be realized on pallet storage stations. In figure 3 is presented an tool storage pallet used at the CPFUS 50CF system. (2)

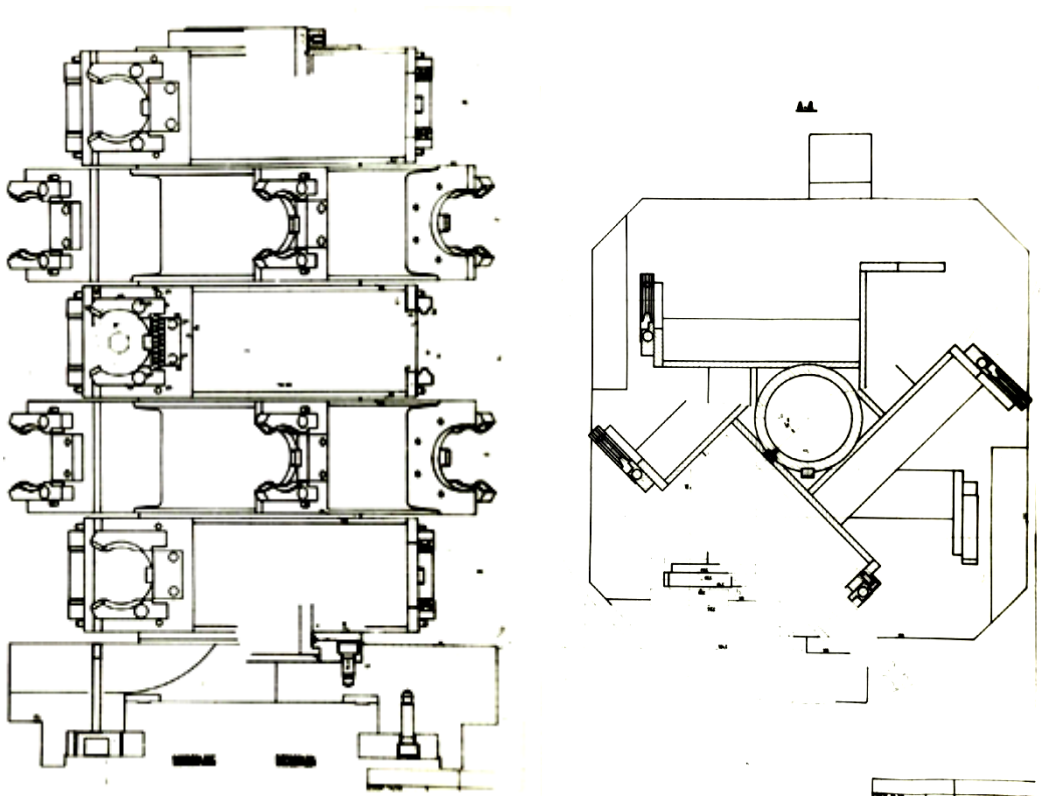


Fig. 3 Tool pallet storage system at CPFUS 50 CF (2)

3. The transfer function.

Trough these tools must be removed from the storage unit and transferred to another point in the flexible manufacturing system. The transfer can be realized eater individually for each tool or by transferring the entire tool pallet storage. Several system are used for the transfer function, dedicated manipulator robots, conveyors, or automatic guided vehicles.

In all manufacturing system the transfer of tools is realized by a combination of the previously mentioned system. In order for the tools to be placed in the storage system robots or mechanized hands are used. This system can't cover longer distances or high loads, so conveyors are used. In some rare exceptions is possible that the entire tool transfer can be realized by a robot mounted on a track.

For the regal type storage system simple manipulators are used, but more complex serial type robots are sometimes used. This is caused by the fact that the system used for tool transfer is also used for other systems such as material flow. At the TMA AL 550 flexible cell in the Computer Integrated Manufacturing Laboratory at Oradea University and serial type ABB IRB 1600/1.2 robot is used for tool transfer. The robot is situated on a track in front of the regal type storage system. The robot and the track are presented in figure 4.

In figure 4 position 1 is the ABB IRB 1600 robot, and position 2 is the track that enabled the robot to access all the columns of the regal storage system. In this case the tools are transferred one by one because of several reasons. Firstly the capacity of the robot and the fact that the temporary storage based on pallet is located on in the other part of the system.

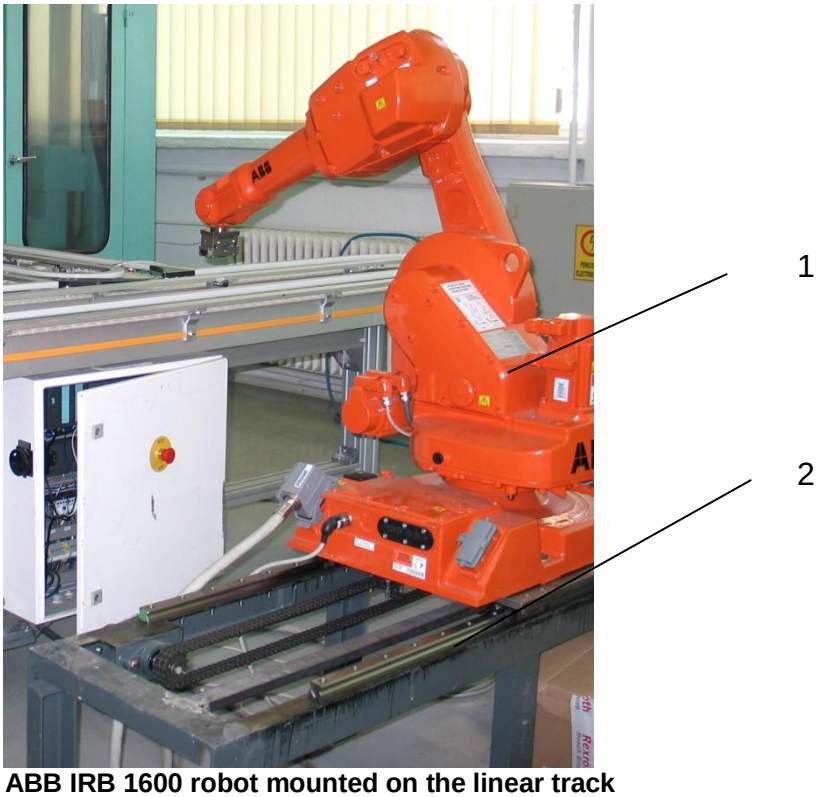


Fig. 4 ABB IRB 1600 robot mounted on the linear track

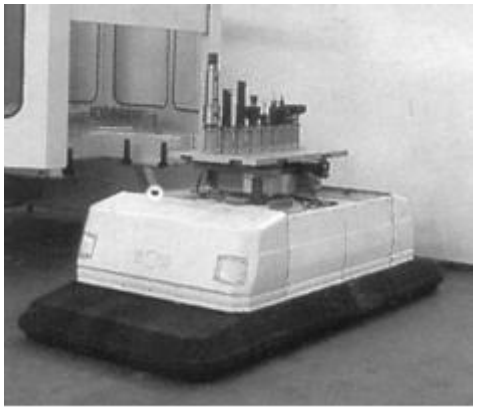
The other component of the transfer system is the T shape FlexLynk conveyor which transfers the tool from the permanent storage system to the machine tool.

Fig. 5 FlexLynk conveyor served by the two ABB robots.

The conveyor is a PLC controlled one. The controller is a Siemens Sinumerik controller. The power is generated by two 220V, 550W electric motors. The conveyor is T shaped, each branch having his own electric motor. The conveyor is an chain type conveyor. In order for the conveyor to be able to transfer an pallet has to be used so that the tool can be vertically positioned on the track.

In flexible manufacturing systems where de distances between the storage systems and the served machine tools in too big to be covered by conveyors or where conveyors would create problems for the other systems, automatic guided vehicles are used.

Fig. 6 AGV system (3) Fig.



7 AGV system with tool rack (2)

4. The ATC function.

An specialized component for the tool handeling which also contributes to the general flowof the tools in any CNC based manufacturing systems is the ATC.

ATC function implies the existence of the following parts on the machine tool:

- One or more tool storage systems (required).
- One or more tool changer devices attachrd.

In figure 8 is presented the tool magazine of the TMA 50 horizontal spindle machine tool. The TMA 550's tool magazine is served by a mechanized arm sown in figure nr. 9.

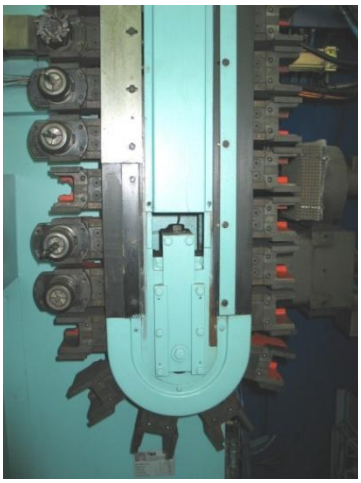


Fig. 8 TMA550 - tool magazine

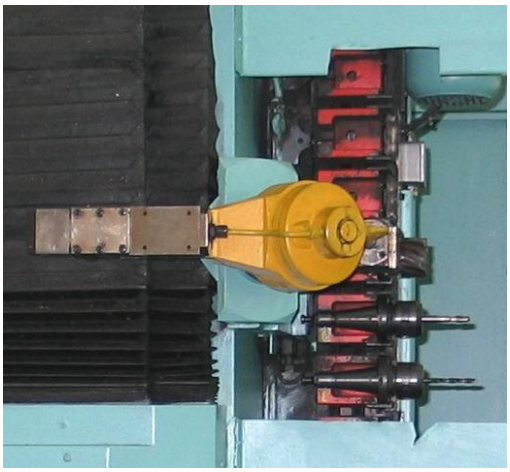


Fig. 9 Mechanized arm of the TMA 550 machine tool.

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