Proceedings of the International Conference on Manufacturing Systems – ICMaS
Vol. 4, 2009, ISSN 1842-3183
University POLITEHNICA of Bucharest, Machine and Manufacturing Systems Department
Bucharest, Romania

# AUTOMATIC TRANSFER SYSTEM FOR CHARGING/EVACUATING OF THE WORKINGPOST USED TO ASSEMBLY/TEST THE SUBSYSTEM-CARCASS

**Dorin TELEA, Ştefan BARBU, Ilie POPP**

***Abstract**: This paper presents the main CAD – computer aided design – elements of an automatic transfer system, air-driven, destined for some charging/disposal operation of some work posts for the assembly/testing of the subsystem-carcass, in agreement with Compa SA Sibiu. The carcass, the manipulated subsystem, is part of the turbo-compressor assembly (compressor + turbine) – of a testing equipment. The analyzed manipulator for the handling of 7 work posts, with direct application to the charging with disc type subsystems from subsystem palletainers, can be generalized to the serving, to the purpose of testing, of many such posts in a automatised assembly line and carcass checking.*

***Key words:** automatised transfer system, charging/evacuating system.*

## 1. GENERAL CONSIDERATIONS

The automatic transfer system, meant for the charging/evacuating system of the assembly/testing workstations of the subsystem-carcass, from which the air-driven manipulator (Fig. 1) is part, has to respect the demands of the market economy and the beneficiary's requests:

- to be easy to maintain;
- to be a flexible system, so that the crossing from one type of part to another is done easily;
- to be capable to identify itself with the parts from the production line;
- to be able to guarantee that the part passed every work station.

The imposed conditions are:

- operation checking;
- to recognize the part using the Poka Yoke system.

The transfer of the part from one post to another has been settled to be automatically done, using transfer manipulators and the automatic elimination of dissenter parts through the deposit on the elimination chute.

The general characteristics of the manipulation line are:

- automatised line with 7 work posts;
- the transfer of the parts with identical manipulation systems,
- automatic dissenter part disposal system;
- automatic control for every work station.

The automatic assembly and checking line "Assembly/testing carcass" with 7 distinct working posts have the following sequence (Fig. 1):

- thread checking post;
- pressure checking global post;
- hading drain pressure testing post;
- spiroloux ring assembly post;
- bush and pin assembly and testing post;
- welding post;
- final checking and marking post.

Figure 1 presents the manipulation system used for assembly/testing in 7 different posts.

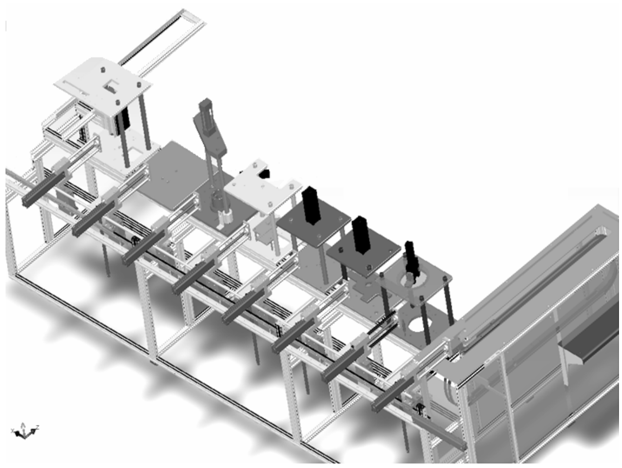

**Fig. 1.** Modular system.

## 2. THE STRUCTURE OF THE FLEXIBLE TESTING MODE

According to the established kinematics, following a criterial analysis regarding the transfer conditions, as the flexible module focuses the diverse processes in time and space (being able to charge/evacuate small and medium revolution parts, with a maximum of Ø 410 mm ), that is the way the components of the automatic line have been established.

The presented system accomplishes the manipulation – charging/evacuating – function of the parts in the automatic drive. The human operator has to charge the transport pallets with carcasses (Fig. 2).

The manipulator has the ability to pick up the workpieces from the transporters pallets, to transport them to the work stations and to evacuate them through the evacuation post (Fig. 3); the movement cycle being: lift/lower and push/pull.

The automatic system projected to manipulate parts (Fig. 1) has a frame structure on which the bracket is moving horizontally. The frame has two side arms in order to assume the torque which resulted from the

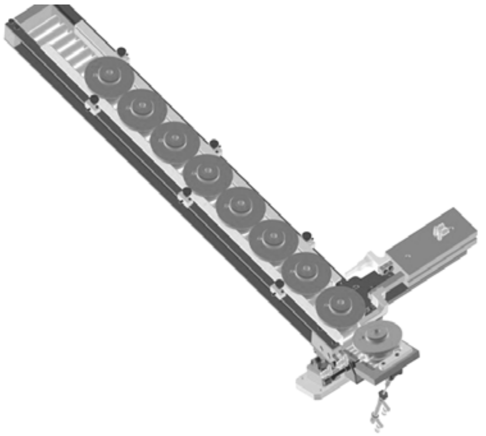

**Fig. 2.** The alimentation post.

**Fig. 3.** The evacuation post.

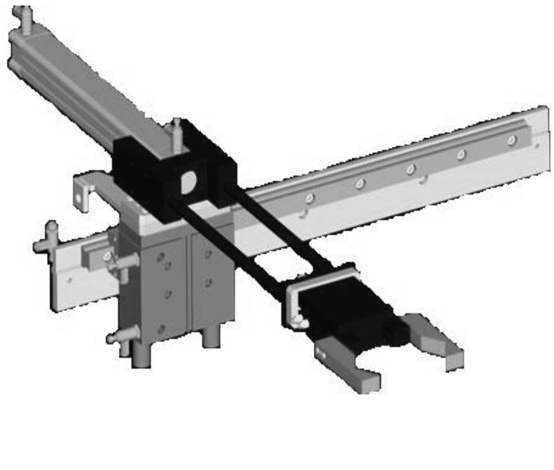

**Fig. 4.** The manipulation system.

weight of the subassembly and the manipulated mass. Bar slides are assembled on the upper part, on which the bracket will move powered by an air-driven motor assembled on the same joist. A linear motion system is assembled on the bracket, which realizes the push/pull motion with the help of some linear air-driven motors (Fig. 4). On the lower side of the horizontal translation module a shield is found which contains two linear

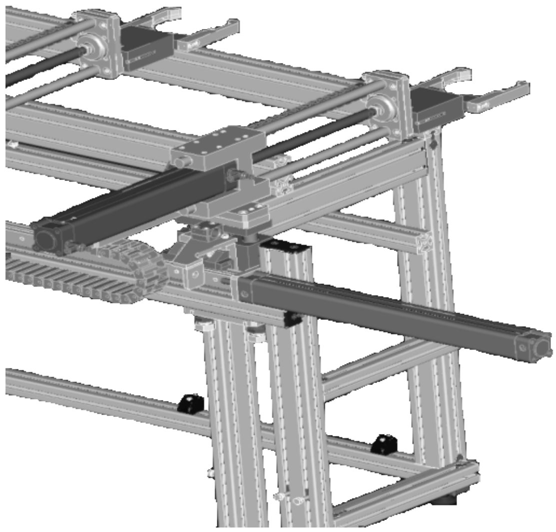

**Fig. 5.** The modular system structure.

air-driven motors, lift/lower, one that drives the extraction of the part and one that drives the prehension device. The system is entirely air-driven.

The manipulator, used as an automatic transfer system, presents a simple kinematics, modular architecture and a combination of dependent/independent moves, achieved directly under the drive of some linear air-driven motors, which eliminate the position and functional error generating intermediary transmissions.

The component:

- a bracket, which slides along a horizontal joist;
- an air-driven MPO motor which moves the cart along the joist;
- two cart boards on which the air-driven motor is being assembled, motor which commands the whole assembly, and a connector box that is assembled on another board, through which the electrical connections are being made;
- a horizontal translation module which is built out of a block, through which a tubular casing slides , guided by two ball brasses;
- handling pieces, on horizontal level , is being made by air-driven motors MPO1...MPO8 and prehension devices belong on each;
- the control of the movements along the two directions is being made with the work sequence execution approval by the proximity translators, after a pre-ordered schedule stored in the programmable logic controller memory.

Replacing the inductive proximity sensors with linear position translators, as well as a programmable logic controller or another appropriate command system, the system becomes a flexible/robot manipulator, which works in Cartesian coordinates.

The manipulation cycle phases and the working cycle are presented in the Fig. 6. In this way, the component parts of the manipulation system are presented; the charging with semi fabricates system; the part disposal system, the component parts of the manipulation system. After the forwarding of the motors MPO, the gripper device of the manipulator is in a well determined position, to be able to catch the subsystem-carcass. From this initial position, at the same time with the start button, the gripper

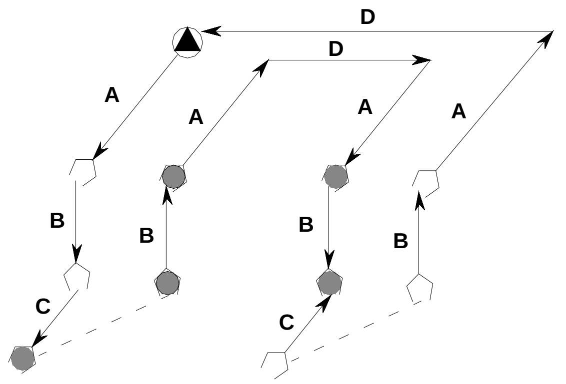


**Fig. 6.** The working cycle.

is being lowered at first with a higher speed, until it reaches it's capable position for the part grabbing. In this moment, the motor that drives the mechanical hand goes into action. Then the extraction command is given. The MPO are back in action making a fast retrieval. Next, the stirrup driven motor MPL accomplishes the horizontal translation, moving the workpieces in the direction of the testing equipment from the container. In this moment, a new MPO cycle begins, following the charging /disposal and then the fast retrieval of them. When the stroke is being accomplished, the MPL command is given, which returns to its initial position, waiting for the command of a new cycle.

The working module is driven through linear air-driven motors: 8MPO – forward/withdrawal (320 mm); MPL moving/withdrawal stand (1000 mm); 8MPR lift/descent stirrup (70 mm); 8MPS clasp/free semi fabricate/part (50 mm). Speed in the work time: MPO (5 m/min), MPL (6 m/min), MPR (3 m/min), MPS (1/1.6 m/min).

The air-driven manipulation scheme (we picked the compressed air source charge), is elaborated regarding: movement kinematics, the duration and configuration of the work cycle, special conditions imposed by the cycle, the special conditions regarding the insurance of some succession relations or interblocking phases. The protection from overcharge, speed adjustment and stabilisation will be regarded.

For the adjustment and settlement of the speed we use a speed stabilizator, with two ways, mounted on return, with detour valve. In the scheme, for the control of the system, exist, maximal adjustable valves, which adjust the necessary pressure in the system, pressure measured by a manometer, unspecified in the scheme.

The retaining valve has the role to prevent the emptying of the evacuation circuit at the stop faze and to create a contra pressure during the working fazes.

## 3. THE PERFORMANCE OF THE MANIPULATION SYSTEM

The structure consists of a stand, which slides along a horizontal resistance sole. An air-driven motor MPO displaces the stand along the sole; the air-driven equipment is placed on a board, with controls the whole assembly, and on another board the connector box, is placed, though which the electric connections are made.

The horizontal translation module is consisted of a body though which a tubular column, guided through two bushes with balls. The manipulation of parts on the horizontal is done through air-driven motors MPO1 and MPO2 and the device grippers (Figs. 4 and 5).

The control of the movements on the two directions is done with the confirmation of performance of the work sequence done by the proximity translators, after a preset program stored in the memory of the programmable logic controller presetable. Replacing the proximity inductive sensors with linear positioning translators, and also with a suitable command system, the system becomes a flexible manipulator, witch works in Cartesian coordinates.

The designed system accomplishes the manipulation function – charging/disposal – of the parts in a automatic way. The frame has two side arms in order to take over the torsion moment resulted from the weight of the sub-assemblies and of the manipulated table. The guide way is rigged up on the upper side, on which the stand will move driven by the linear air-driven motor, mounted on the same sole (Fig. 7). The horizontal translation modules are mounted on the stand, which fulfils the horizontal back/forth movement with the help of some linear air-driven motors. In the lower part of the horizontal module we can find two linear air-driven motors, lift/descent, one that realizes the extraction of the part from the clasp device of the MSF, and the other that drives the gripper. The driving of the whole system is air-driven.

The moment in which the sensor confirms the withdraw of all the linear air-driven motor MPL of the charging/prehension modules MPO/MPS in the initial waiting, the manipulation system starts the work cycle through the "start" command of the manipulation cycle. This command can be inserted by the human operator, or in an automatic way.

The pneumatic diagram (Fig. 8) is elaborated keeping in mind: configuration and duration of the working cycle, the special conditions imposed by the cycle, the special conditions regarding the assurance of some success-

**Fig. 7.** The manipulation system.

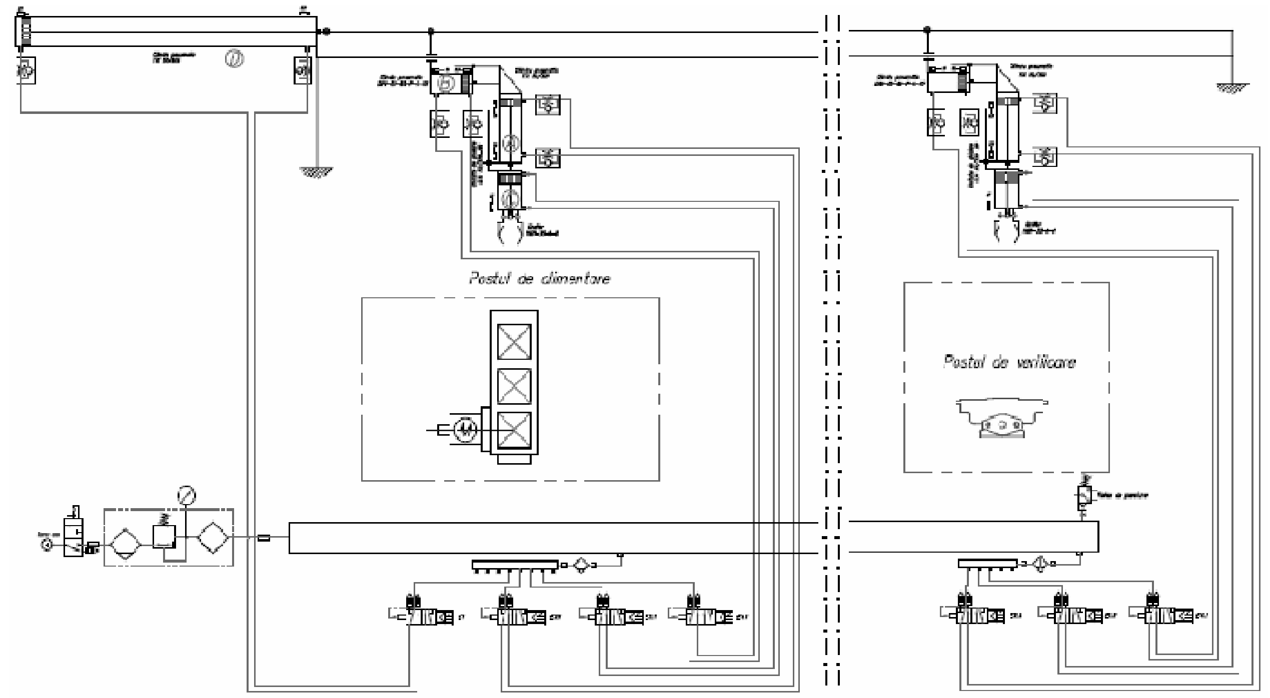


**Fig. 8.** Pneumatic diagram.

sion or deadlock between phases. The protection against overload will also be kept in mind, and also the adjustment and settlement of the speed, etc.

## 4. CONCLUSIONS

This paper presents parts of the computer aided design CAD of a manipulator, air-driven, destined for some charging/disposal operations of work posts from the automatic assembly line for the checking/assembly of the subsystem-carcass.

The analysed manipulator for the charging of seven working post, with direct application to the charging with disc type workpieces taken from the workpiece pallets of the charging system, on a disposal system, can be generalized at the serving, in order to check/test many such posts, in the automatic assembly checking line.

Following the current tendencies in design, the flexible module concentrates in time and space various processes, being capable to charge/transfer/dispose the automatic assembly/testing line with medium and small revolution parts, with the maximum diameter of Ø 410 mm.

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## Autors:

PhD, Eng, Dorin TELEA, Professor, "Lucian Blaga" University of Sibiu, Faculty of Engineering "Hermann Oberth", Department of Machines and Equipments,
E-mail: telea.dorin@ ulbsibiu.ro
PhD, Eng, Ştefan BARBU, Professor, "Lucian Blaga" University of Sibiu, Faculty of Engineering "Hermann Oberth", Department of Machines and Equipments,
E-mail: stefan.barbu@ulbsibiu.ro
PhD, Eng, Ilie POPP, Assoc. Professor, "Lucian Blaga" University of Sibiu, Faculty of Engineering "Hermann Oberth", Department of Machines and Equipments,
E-mail: ilie.popp@ulbsibiu.ro