

## **PNEUMOMECHATRONIC UNIVERSAL EDUCATIONAL STAND**

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**Abstract:** Within this paperwork the authors conceived and realized a universal educational stand, pneumatic. Starting from the analytic program of the Hydraulic and Pneumatic Auctioning they conceived some laboratory paperwork's, applications for the students from the specializations which follow this teaching line. The stand was conceived and realized using pneumatic equipment's from the FESTO Company. With the help of this stand there can be realize studies regarding the study of various logical functions with pneumatic equipment's, functioning schemes with a normal or automatic behavior. The stand can be connected to a computer to conduct and simulate the desirable functions within the applications. By introducing the "informatics" component, the stand can be considered a mechatronic product.

### **1. INTRODUCTION**

We can say that the XX<sup>th</sup> century is an era of the huge scientific and technological progress. It can be characterized by the growing complexity of the machines and installations, accuracy and working speed, by the precision and design. These high technologies gave the most flexible systems with a high degree of intelligence and autonomy. Still today, there is aspiration for the mechatronic design of our day's product.

### **2. WHAT IS MECHATRONIC?**

In 1960, a engineer from the Japan Company Yasakawa Electric Co. is mentioned to be the first person who used the "mechatronic" expression, regarding the computerized control of an electric engine.

In the 70's, mechatronic was used more frequently in the servo technology, used in products like, auto focalizing devices, ventilation installations, automatic closing-opening installations of the doors, advanced methods of control a.s.n.

In the 80's the microprocessors were introduced in the mechanically or electromechanically systems, as a international technology to improve the product performances. The numeric control of the engines and the robots became more compact, while the application in vehicles, like the electric control of the engine and the anti-blocking system (A.B.S) became more popular. The connection in huge network gives the possibility of the functions, like the remote operations of the robots, or the manipulators.

The microelectronic systems, micro-electro-pneumatic, like the miniaturized silicon accelerometers, which release the vehicles airbags, are recently used examples.

Mechatronic was introduced in some other countries under some other names. The term "mechatronic" is used in commonly beginning with 1985. The majority of the definitions given to mechatronics can be found after a combination of keywords: mechanics, electronics, technology, intelligence and flexibility.

The mechatronic term can be defined as a scientific field which takes account of the synergetic interaction of the mechanics (weight circulation), electronics/electric (electron circulation) and informatics (information circulation). The mechatronic designation is design, construction, production and operating the systems.

Our days there can be found many fields of application of the mechatronics like:

- Robotized systems;
- Vehicles with intelligent control of some systems
- Flight control systems
- Engines with numerical commands

- Biomechatronic ( products for rehabilitation, prosthesis, orsthesis a.s.n.

It is visualized the development of mechatronics by creating new specializations of mechatronics like:

- Micro-mechatronics;
- Bio-mechatronics
- Opto and piezo-mechatronics
- Liquid-mechatronics (pneumo - hidromechatronics) a.s.n.

### **3. MECHATRONICS AND PNEUMATICS**

Pneumatics can be considered a established sub-domain of the mechanics in general. So we can say that the pneumatic auctioning systems combined with electronics and informatics (pneumo-automatics) is mechatronic products. The pneumatic-mechatronic systems have integrated electric components not only in the field of equipment auctioning but in the command field too. In the last period the liquid auctioning systems, beyond having the function of power, or speed have taken the function of positioning too. In this way new electric components have been upgraded like the couple engine, proportional electromagnet.

The liquid auctioning systems becoming a automatic regulation system, which can be closed by one or more reaction circuits, brought the entrance of the electronics and informatics in fluidity (hydraulics and pneumatics).

Because the compressed air is more complex controlled, the liquid environment of work of the pneumatics, made pneumatics to record, only under the aspect of the regulation function a arrearage, with the hope that the intensity of actual preoccupations will annihilate this gap.

In unity with the definition of mechatronics, at the level of pneumatics, pneumo - mechatronics of pneumo – mechanics can be defined, as being a synergetic integration of electronics and informatics in pneumatic equipments and systems.

In the future the pneumo-mechatronics takes the role of making the pneumatic auctioning systems feasible in terms of the precision and positioning criteria. From those presented results the multidisciplinary character of pneumo - mechatronics, which asserts like a request in preparing the future specialist.

For the study of the pneumatic auctioning systems and for the study of some logical functions realized with pneumatic equipments and the initiation of students for pneumatic universal stand has been conceived and realized, connected to a computer, becoming so a mechatronic system.

### **4. STAND DESCRIPTION**

The conceived and realized stand is composed from two pneumatic engines ( $M_{p1}$  and  $M_{p2}$ ), eight distributors auctioned electro-pneumatic ( $D_1.....D_8$ ), eleven taps ( $R_1.....R_{11}$ ), a electric time relay (RT), two selection clacks of circuit ( $S_1$  and  $S_2$ ) and two throttles for way ( $DC_1$  and  $DC_2$ ).

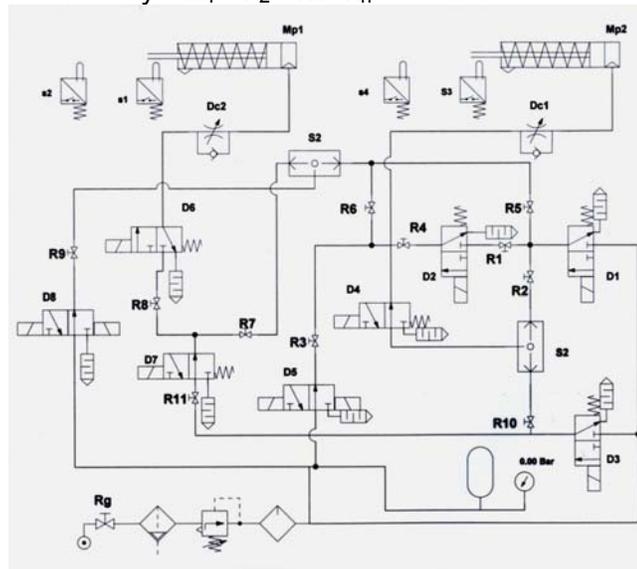
The realization of different schemes of engine auctioning is made by activating of some parts from the entire scheme and the isolation of the rest of the scheme with the help of the taps.

**How it works.** To realize the logical functions all the taps are closed in the way shown below.

**The “AND” function** (Conjunction) is a function of safety utilized in the auctioning systems. She protects the human operator or the peripheral equipments of the installation against some possible accidents or collisions.

The mathematic equation of this function is:

$$y = x_1 * x_2 * \dots * x_n \tag{1}$$



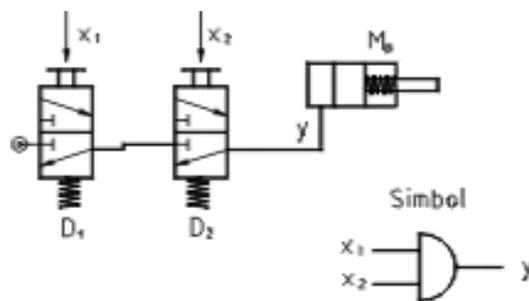
**Figure 1 Pneumomechatronic universal educational stand**

and the table of truth is:

To obtain these functions a stand is conceived and the procedure is the following one:  
 All the taps are closed with the exception of R<sub>1</sub> and R<sub>4</sub>. The engine MP<sub>2</sub> will function if we will auction at the same time the distributors D<sub>1</sub> and D<sub>2</sub>.

**Table 1**

X <sub>1</sub>	X <sub>2</sub>	X <sub>n</sub>	Y
0	0	...0	0
1	0	...0	0
1	1	...0	0
...	...	...	...
...	...	...	...
...	...	...	...
1	1	...1	1



**Figure 2 Logical function "AND"**

**The "OR" function** (Disjunction), assures the possibility of starting or stopping of an installation from more positions, being a safety and productivity function.

The mathematic equation of this function is:

$$y = x_1 + x_2 \tag{2}$$

and the table of truth is:

Table 2

$X_1$	$X_2$	$Y$
0	0	0
1	0	1
0	1	0
1	1	1

The taps  $R_2$  and  $R_{10}$  are left opened. The engine  $MP_2$  will run by commanding the distributor  $D_1$  or  $D_3$ .

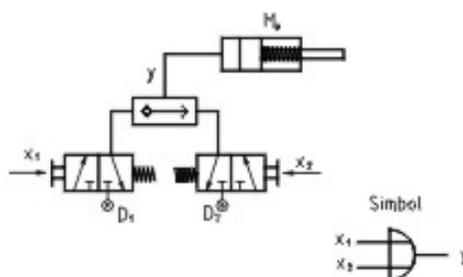


Figure 3 Logical function "OR"

The "NO" function (Inversion) is utilized to command some stops at bench marks of the engines, having the mathematic equation:

$$y = \bar{x} \quad (3)$$

and the table of truth is:

Table 3

$X$	$Y$
0	1
1	0

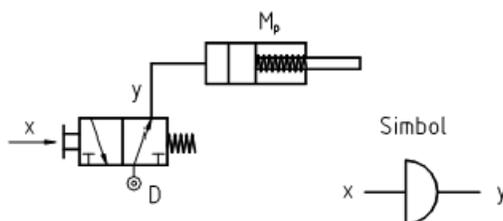


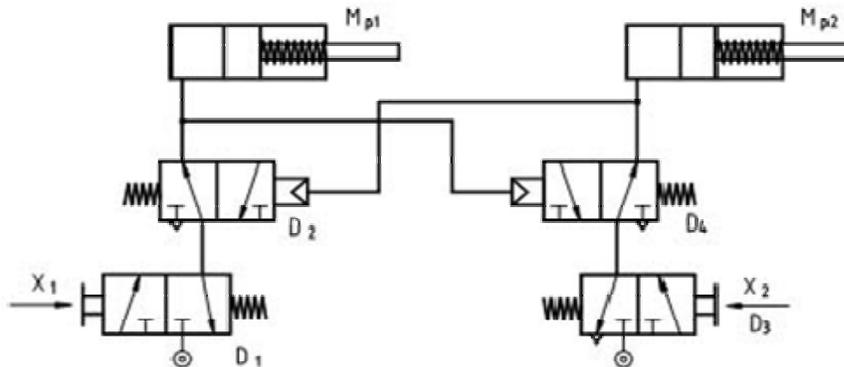
Figure 4 Logical function "NO"

The tap  $R_{10}$  is opened and the  $D_3$  is connected to it. The engine  $MP_2$  will go on only if it is not commanded by the distributor  $D_4$ .

**The "NAND" function** The taps  $R_{10}$  and  $R_2$  are connected with  $D_1$  and  $D_3$  distributors. From this moment the function AND-NO is realized, and this means that the engine will go one so long that there are not given simultaneous commands to  $D_1$  and  $D_3$ .

**The “NOR” function** The taps  $R_1$  and  $R_4$  are connected with distributors  $D_1$  and  $D_2$ . From this moment the function OR-NO is realized, and this means that the engine will run only while there will be no action on the  $D_1$  and  $D_2$  distributors simultaneous or in turn.

**The “TEMPORIZING” function** The tap  $R_{10}$  is opened and the distributor  $D_3$  is connected. The time relay is adjusted and is connected with  $D_4$  distributor. The engine  $M_{p1}$  will run till the end of the adjusted time has ended.



**Figure 5. Logical function "interlocking COMMANDS"**

**The “INTERBLOCKING COMMANDS” function.** This function is very important in the successive function of some engines. This function doesn't allow the functioning of some engines, so long as another engine is running. To realize this function with the conceived stand the next procedure will be followed: The taps  $R_2$ ,  $R_8$  and  $R_{11}$  are opened. Simultaneous the distributor  $D_1$ , which will fuel the engine  $MP_2$ , and the distributor  $D_7$ , which will block fueling the  $MP_1$  engine, are opened.

In the laboratory tutorials, the students can realize logical functions and can realize their simulation using computers. To simulate the functions they can use specialized simulating programs.

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