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COORDINATE MULTI-VALVE

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***Abstract**: The paper describes a new coordinate multi-valve targeted at the individual management of a large number of actuators with the ability to use different levels of pressure for each actuator. The solution, that is shown, has about 200 outputs which activate the executive elements with the working principle as single acting actuators. Bringing the distribution elements on each selected output optional, is achieved with two stepping motors which are controlled by personal computer through an appropriate electronic interface*
***Key words**: pneumatic, multi-valve, program control*

1. INTRODUCTION

The common technical solutions control of pneumatic elements with one device or together integrated unit involves controlling that is carried out in repetitive cycles. There are known devices such as the Bi-selector of the former company Martonair (Everding & Borth, 1969), selector – multi-positional valve of Valco Company (***, 2011) or several device of Festo company such as Quick stepper (***, 1998), the earlier decision Sequenz module 4 (Nikolic, 1977) or integrated combination of stepper modules (TAA, TAB, TAC) (Nikolic, 2007). Also, earlier are used, for this purpose, programming devices with ridges or strips (Festo) (Nikolic, 2007). Characteristic is defined by an executive order of the elements of movement (by connecting the input and output signals to the actuators) remains the same and the cycle repeats.

In practice, cases occur where a large number of actuators must be activated at the current situation, desire or selected program, which means that there are not repeatable runs. There is a need to bring (optional selected) the correct output or actuator in order to perform a specific job. This can be solved with a single valve type, depending on the actuator type and working mode. The work describes the specially designed new device, which based on selected or the default address on the control device associated the output with power (respectively venting).

2. CONSTRUCTIVE SOLUTIONS

The designed coordinate multi-valve (Nikolic et al., 2009) leads compressed air to the desired output (or vented) based on the number of pulses that were brought to two stepper motors, Figure 1.

The number of output depends on the length of the coordinate multi-valve body and can range up to 300 outputs. Each output has a check valve (2/2 valve), which is mechanical activated, i.e. that deactivate its function of air transmitting. Then the output is connected to compressed air supply in order to power the actuator or its venting. The stepping motor with a screw-shift transmission allows the piston movement in the horizontal direction, and second stepping motor with a worm gear shift transmission per round.

In case of only the horizontal displacement along with a control piston, a stepping motor with worm gear transmission travels. For that can be used recyclable ball guides.

In order not to include the output when piston moves to the new position of the output, his move to the next place of inclusion, is achieved by way of opening the check valves (2/2 valve). Stepper motors control via an electronic interface is done with a personal computer.

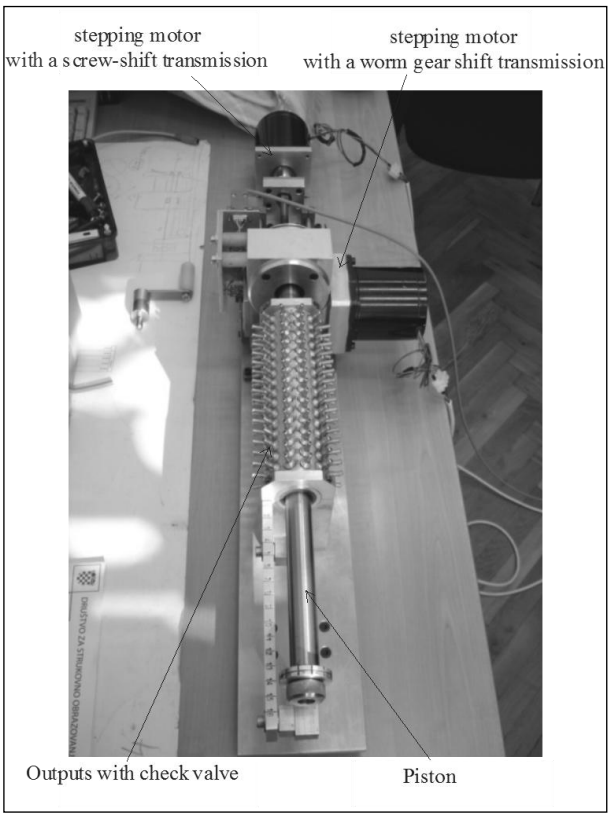

Fig. 1. Coordinate multi-valve

The time spent on each output is determined by program, and it is dependent of pressure to be achieved in the actuator, which is determined by air pressure power and size of air flow damping through the device and air lines.

The maximum time of passing through all output ports is 30 sec with the 3 round per seconds on stepper motor. A stepper motor power is + /-24V. The maximum time for one rotation turn is 10 sec.

Positioning accuracy is extremely high because the stepper motor engine has 1.8° and mechanically transfer the rotational axis 1/36 is 0.05°. In the longitudinal displacement (the rise of the screw 1.5 mm) accuracy is 1.5/200 = 0.0075 mm. Figure 2 shows the electronic circuit for a stepper motor control (Krajnovic, 2011). Due to the implementation of complex systems, controlling is performed by calculation and programs

based on algorithms work. In the case to be managed manually, a control unit is using which provides the coordinates of the desired output, Figure 3.

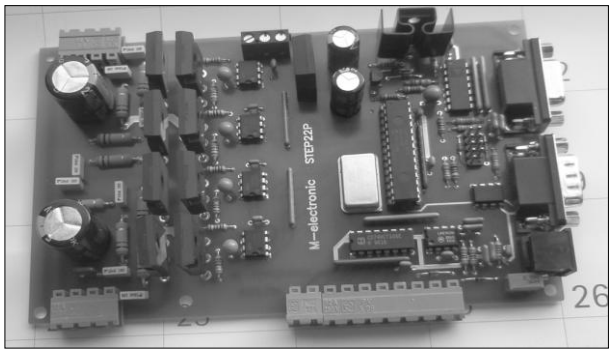

Fig. 2. The electronic circuit for a stepper motor control STEP22P

Pressure sensor checks the size of a given air pressure in the actuator and inform the computer for its correction with a given size.

Fig. 3. Control unit

Applying a coordinate multi-valve at device that required individually activate more than 250 actuators, was recorded by programming algorithm based on behaviour or by direct operator intervention, and showed its application efficiently and reliably. Due to large amounts of output (Figure 4) coordinate system of lines is addressed and is determined by a matrix connection.

Depending on the actuators, their purpose and size, thus defining the amount of air that needs to flow through to or from actuators, the movement of the piston can be stopped and activate the check valve at will for as long as the necessity of this process.

One of the biggest problems was a sealing of a large number of connected check valves, as well as ensuring a sufficient amount of air flow, due to the relatively small strokes of their activation.

3. APPLICATION IN PRACTICE

The system is commercially viable compared to using individually activated 2/2 electromagnetic valve when is operated with a minimum of 150 actuators. The process control can be complicated if you are looking for specifically regulating the air pressure in each actuator, which is with coordinate multi-valve easily solved. It is designed specifically for this purpose for a large number of executive elements (single acting activated), which is powered by any other appropriate level of air pressure and in the practical application has proved to be effective and meet all the requirements.

The system manages to combine all the individual actuators at versions of 192 exits with the retention of 1 sec at each outlet within 3,2 min. This is the case when all they want to activate the actuators. In the case of practices that are used by coordinate multi-valves it was sometimes necessary, and in the normal process does not work.

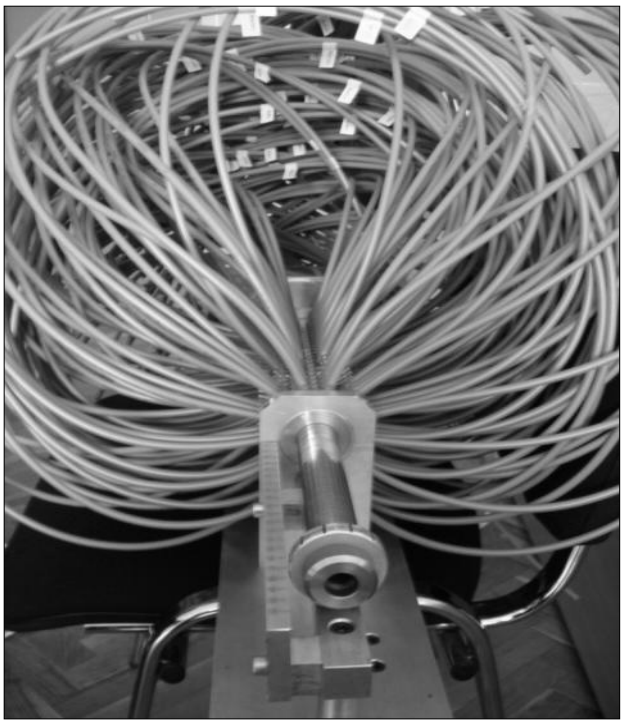

Fig. 4. The connecting the output with the actuators at coordinate multi-valve

Higher speed of passage is not necessary because of the necessity of stopping at the point where the output power for compressed air and ventilation is require.

An example of successful application of the coordinate multi-valve realized in practice is its use as part of the control system to activate the air cushion on the no bedsore bed. It is potential applications of the lymphatic drainage system in the therapeutic treatment.

4. CONCLUSION

Coordinate multi-valve solution is formed with the resolution of the case in practice when applying for a large number of actuators one-way activation, because the other solution would be considerably more expensive. As the solution, it is interesting because of possible applications in other similar cases in the specific practice. Also, this solution complements the already mentioned electro-pneumatic or pneumatic devices that have emerged as the need for executive control of pneumatic elements in automation equipment or lines. The difference between these devices and multi-valve is the possibility of arriving at any exit at will, or a computer controlled program.

5. LITERATURE

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