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SYSTEM OF AUTOMATIC REGULATION OF THE RELATION BETWEEN TWO FLOWS

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ABSTRACT:
The system of automatic regulation proportion of the two flows is use when that particular process uses two substances whose quantities are exactly established, could be fluid or powder. In this case, the two flows are liquid (water). We have two transducer of debit, one of them is an electro-magnetic flow and the other is a stop-type. We use analogical regulators and execution elements are two regulating taps with one cap, who are handled with the help of two pneumatic servo-engines (closing spring).
KEYWORDS:
system, flows, regulator, report block, pump

1. INTRODUCTION

Amongst all industrial systems of automatic regulation, those who automatically regulates the flows are between 30-40%, and they vary according to the specific features of the installation. We refer to the chemical and petrochemical industry installations, because in their case, all liquid and gas products are transported through pipes and submitted to repeat processing.

The SRA proportion of the two flows we use when that particular process uses two substances whose quantities are exactly established, could be fluid or powder.

2. THE SRA OF THE PROPORTION OF TWO FLOWS

Figure 1 describes the structure of the system of automatic regulation of the relations between two flows.

The Q1 flow is independent, meanwhile Q2 is not. The report block ensures the dependency - Q2 [%] = KQ1 [%] –between the two flows.

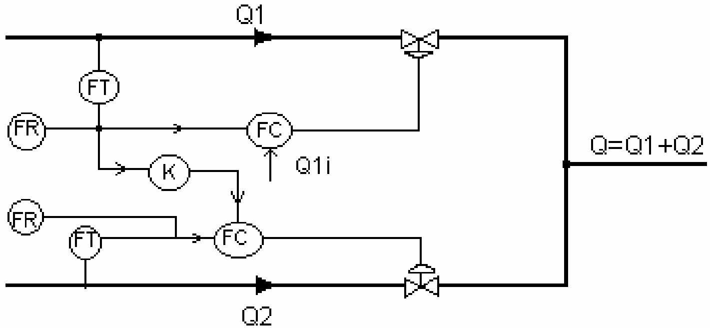

FIGURE 1. The structure of the system of automatic regulation of the relations between two flows

As you can see in Fig. No. 1, the exit of the flow translator FT associated to the Q1 flow is the entry-device for the FC associated regulator, who is associated to this path, as well as for the report block K. The exit of the report block K is prescribed for the Fc regulator associated to the Q2 flow. The already-existing SRA report block is situated between 0,2 and 2. As we can see in figure, the prescription of the FC1 regulator is available to the operator. The operator can change it as it needs, while the prescription of the FC2 regulator is "busy" as it is automatedly fixed by the report block K. If the operator changes the Q1i, for instance from 60% to 70%, then SRA-D associated to Q1 is going to produce it within almost 5 seconds Q1=Q1i=70%; then, the report block is going to change any delay of the FC2 regulator, according to that. If the system has K=1,1, then Q2i=1,1x70=77%, the SRA-D associated to Q2 is going to work within 6…8 seconds - Q2=77%.

The report block K has the exits of both the flow translator at each entry.

The current is generated by the radical extractor and it is proportional with the flow Q1 (i1= 2+ a1Q1), meanwhile current i2, generated by the adaptor of the electro-magnetic adaptor, is proportional with the adaptor of the electro-magnetic translator, who is proportional with the flow Q2 (i2=2+a2Q2).

3. SRA PHYSICAL SCHEME OF THE RELATION OF TWO FLOWS

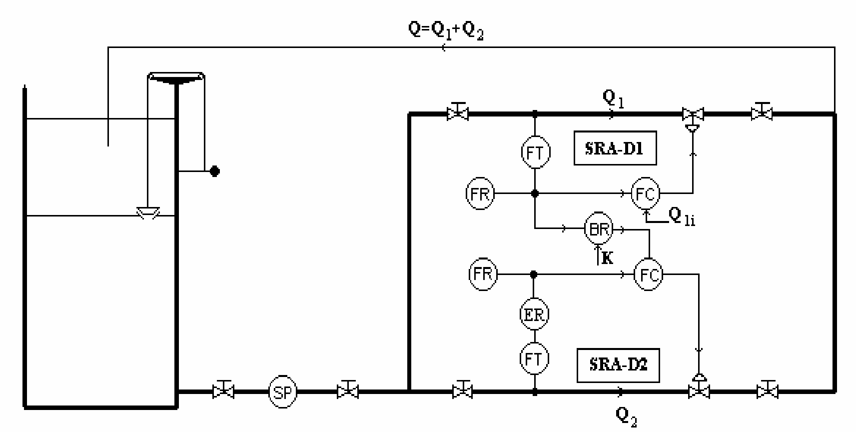

FIGURE 2. SRA Physical Scheme of the relation of two flows
SP – Pressure source ; ER- Radical extractor; FT – Flow translator ; FR – Flow register;
FC – Flow regulator ; BR – Report block ; Q,Q1,Q2 – flows;
SRA-D1, SRA-D2 – Automatic regulation flow system

Report block ELX 126

Figure 3 describes the main scheme of the report block

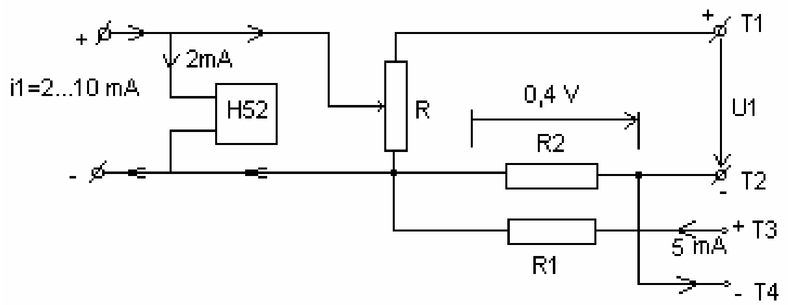

FIGURE 3. The main scheme of the report block

The values of the current of 2 mA are deducted from the Current i1= 2…10 mA entry, generated by the fixed source H52, so that there a current reaching i1= 2 mA is transmitted through the resistor R (=200Ω).

The exit tension U1 is obtained if there is a low tension in the resistance R, generated by current i1= 2 mA, added to tension of 0,4 V, produced by the resistance R2= 80Ω, by current of 5 mA, generated by the H51 source (comprised in the FC2 regulator).

The figure describes the value of the K coefficient, which is fixed with the help of the cursor of the variable resistance R.

The ELX126 device, combined with a continuous regulator, allows us to regulate any industrial process, where the values of two variable parameters must be strictly maintained to a certain proportion. The translators give entry signals 2-10 mA c.c., proportional to the measured size Q1,Q2m, and these signals are used to the entry I and II of the device.

The signal of the current with entry I is changed with the help of a group of resistances, provided with continuous tension 0.4—2 V, proportional with KQ1 product, and it becomes an exit signal used for the continuous regulator. The second entry signal 2—10m A c.c. (proportional with Q2) is measured with the help of the milliampermeter on the frontal panel of the device and used for the regulator terminal; the regulator is going to work on Q2 values, and it will infringe the difference between Q2 and KQ1. Thus, the Q2 size is regulated to a precise proportion K referring to size Q1.

There is a double milliampermeter on the frontal panel of the device; on one of the scales who is percentage gradual (0..100%). We can read the values of the exit signal 0.4–2V (proportional with KQ1).

On the second scale, gradual too, we can read the values of the signal used for exit II (proportional with Q2). The same scale contains the values of the first entry signal (proportional with Q1), if we push the " I entry"-button. The frontal panel also contains the gradual scale roll. The scale contains the values of the proportion.

4. CALCULATING DIMENSIONS AND CHOICE

In order to choose the size and to choose the most fitted tap we should follow some stages.

In order to set the size and to choose the tap, there are several stages. First of all, we should calculate any pressure loss in the pipeline DPc100, associated to the highest flow Q100 (completely open RR).

Figure 4 describes the P= f(Q) characteristics of the SP pump, C pipeline, and RR tap.

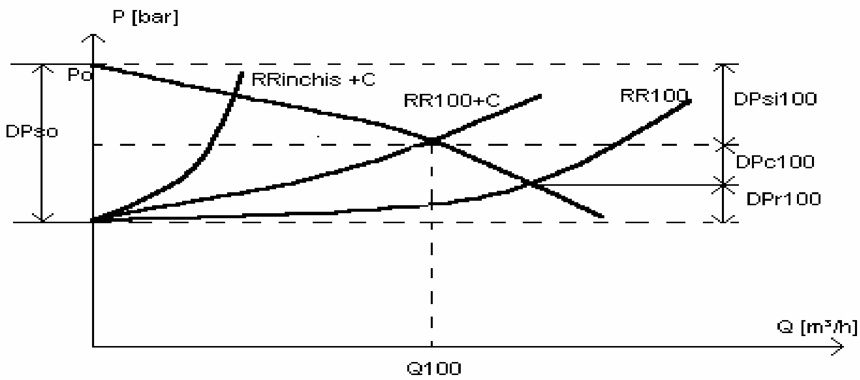

FIGURE 4. The P= f(Q) characteristics of the pump,pipeline and tap

The pipeline where the RR is going to be installed has the following sizes:

- length: 15 m;
- diameter: 0.05 m;
- section area/surface: 0.0019 m.

The highest value of the flow is:

$$Qmax = Vc \cdot A,$$

where Vc is the flow speed and A is the section area.

If we consider the flow is Vc = 2 m/s, then the highest flow reaches up to

Qmax = 11.26 m/h.

We want to find the static working characteristic who could compensate any change within any variation of the process. That is possible with the help of the static characteristic of the RR, for low values of the Ψ parameter.

We calculate: Dpso= DPr100 + DPc100 + Dpsi100,

where:

- DPr100 – is the low pressure for the RR, corresponding to Qmax;
- Dpsi100–is the internal low pressure of the source corresponding to Qmax;
- DPc100 – is the low pressure inside the pipeline corresponding to Qmax;

- Dpso – is the low pressure inside the hydraulic system.

In case of the highest flow, we measure the low pressure inside the RR with two pressure gauges, one situated upstream and another downstream, and we get:

p1= 1,2 bar - upstream pressure;

p2= 0,4 bar - downstream pressure;

DPr100= p1 – p2 =0,8 bar.

We calculate: $DPc= Po-DPr100 -\rho \cdot g \cdot H - Pv$

If we know: g=10 m/s; H=2 m; ρ=1000 Kg/m; Po=3,4 bar; Pv= 0, the result is: DPc= 2,4 bar.

We also know that Dpsi100= 0,5 bar, so that we can find the Ψ based on the relation:

$$\Psi = DPr100/DPso = 0,21.$$

According to the static working characteristic of the RR, with Kvs/Kvo=10/1, we see that we can choose a RR whose static characteristic is also logarithmic intrinsic. We calculate the Kvmax.

The dependency between Q and DPr100, on a hydraulic resistance, in case of varying flow, is given by the relation

$$Q = \varepsilon \cdot \alpha \cdot Ar \cdot \sqrt{(2 \cdot DPr_{100})/\rho} \tag{1}$$

where: DPr – residual low pressure;

ρ - fluid/liquid density;

Ar – lowest section area;

α - flow value.

To make it simpler, we use the relation: $Kv = \sqrt{2} \cdot \varepsilon \cdot \alpha \cdot A$

With the help of relation (1), we get:

$$\begin{gathered} Q = Kv / \sqrt{DPr/\rho} \\ Kv = Q / \sqrt{DPr/\rho} \end{gathered} \tag{2}$$

the result is Kv. We replace it numerically and we get: Kv=11,47

In order to get Kvmax, we multiply Kv with 1,2 and we get: Kvmax= Kv·1,2 =13,76.

If we look up for it in the annexe of the regulating taps, we choose a RR whose features are: Kvs=13; Ds=25 mm; Dn=25 mm; Pn=40; RR with one cap.

We look up for it in the catalogue and we choose the pneumatic servo-engine whose membrane is P200 and who has an air free-position.

When this position is fed with 0,2 bar, it produces a force of 62 daN that is able to handle a low pressure of 6 bars.

5. CONCLUSIONS

The SRA proportion of the two flows we use when that particular process uses two substances whose quantities are exactly established, could be fluid or powder. In our case, the two flows are liquid (water). We see that the two electro-magnetic flow translators do not have to be symillar, in case one of them is an electro-magnetic flow and the other is a stop-type. This type of SRA could use numerical regulators as well as analogical regulator. In our case, we use analogical regulators.

All process elements are two regulating taps with one cap, who are handled with the help of two pneumatic servo-engines (closing spring).

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