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PRESSURE MICROTRADUCTORS AS DYNAMIC LINEAR SYSTEMS

GENERAL INFORMATION

The sylphon is a revolution surface with thin walls, transversally curled on the lateral surface.

Fig. 1. Components with a sylphon, used in the construction of precision apparatus

The sylphon is literally a flexible element, bat because of the partial little deformation, it is considered as an elastical element.
If it works under a focused target or as consequence of an interval pressure, the characteristic of a sylphon becomes linear (geometrically a line) between certain limits.
The inferior limits “A” borders above the opening of the gophers, and the above limit “B” borders below the area where the changing of the shape of the gophers begins.

Between “A” and “B” the distortion of the sylphon is in figure 2.

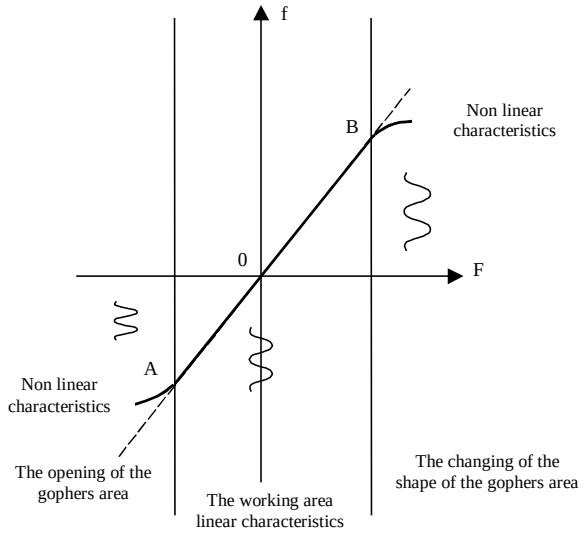

Fig. 2. The linear characteristics of the sylphon in the co-ordinate system Fof, the abscissa OF-the variation of the force, the ordinate Of-the variation of the movement (of the sag)

When the component with a sylphon is used a traductor, the main issue is the determination of the mechanical rigidity or the construction of the metrological characteristics in static and dynamic regime. The stresses in the section of the sylphon must be within certain limits, not only for the sake of resistance, but especially because of the elastical hystheresis, literally because of the coming back to “zero” in the discharging status of the traductor.

THE SYLPHON AS A DYNAMIC AND LINEAR SYSTEM

The sylphon may be considered as a dynamic system, which functionally controls the circuit of the fluid.
Intuitively, a dynamic system is conceived as a structure in which “a signal” can be introduced at a certain point and from which results-to the interior-“a signal” at another point, as in figure 3.
The concept of a system “Σ” includes a set “T” of associated torque of time.
In each torque $t \in T \subset \Sigma$, the system Σ receives an entrance signal u (t) and generated an exit sign y (t).
We suppose that the values of the variable u (t) belong to a set of experimentally determined values $U \subset u(t)$.

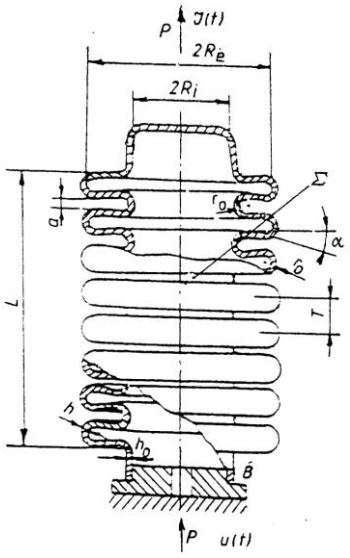

Fig. 3. The sylphon as a dynamic system

The function ω: $[t_1, t_2] \rightarrow U$, $\omega \in \Omega$ satisfies certain restrictions, the set Ω is chosen because of mathematical and physical matters.

Every value of the exit signal y (t) is considered to belong to a determined set $Y \subset y(t)$ and, generally, there are certain conditions that should be imposed, restrictions for exit functions $\gamma:[t_2,t_3] \rightarrow y$.

y(t) shoesn't depend only to u(t), but also to the past status of the system Σ.

By the status of the Σ system a certain internal capacity of ω: $[t_1,t_2] \rightarrow U$, $\omega \in \Omega$ (that is functional in the case of the traductor) is understood, at a certain point, that determines y(t) at the point and influences its future evolution. For instance: a minitraductor for the reduction or closure of the "too full" whole, a minitraductor to adjust the pressure of the air etc. In order to make the system a dynamic one it is necessary and enough that by knowing the status x (t_1) and the entrance function ω: $[t_1,t_2] \rightarrow U$, then the status $x(t_2) = \varphi(t_2, t_1, x(t_1)\ \omega)$ can be determined. From the experimentally point of view, the graphical characteristics "AOB" is linear.

From the mathematical point of view, it can be demonstrated that a dynamic Σ system is linear if:

— X, U, Ω, Y are vectorial spaces (over a given arbitrary body K) where: X – a status set; U – the set of entrance values; $\Omega = \{\omega/\omega: T \rightarrow U\}$ – a range of the entrance functions; Y – the set of the exit values; $\Gamma - \{\gamma \nearrow \gamma: T \rightarrow Y\}$ – a range of the exit functions; T – the time set.

— φ function: T x T x X x Ω → X is a transition function whose value is the x(t) = φ(t, τ, . . x, ω) status, the status of the system at the t torque which depends on the initial x(δ) status and the entrance variable ω. The function φ(t, δ, x, ω): X x Ω → X is K linear for any $t \in T$.

— The function η: T x X → y is the function, which determines the exit variable y (t) = η(t_1, x (t)). The function η: (t, .) : X → y is K linear for any $t \in T$.

After obtaining the solutions of the dynamic system and after choosing the physically coherent solution, it is necessary the approaching and, if possible, the solving of some objectives/goals as:

1. maximizing of the linear answering area, of the sylphon (the working area) under the action of an interval pressure (on concentrated force).
2. studying of the chosen stability solution, which consists of decisions upon the way in which disturbances from the entrance conditions of the sylphon reflects in the disturbances of the exit solution.
3. studying the extend in which the dynamic system considered is controllable and, therefore, adjustable.

For this experimental searching of the optimal entrance is pursued, which determines a certain status of the system or ensures a certain behavior of the exit, named in the work "the standard status" in order to compare with the working status.

EXPERIMENTAL REZULTS

In order to accomplish the exposed conditions, theoretical studies have been made with practical finalizing like these:

1. The most indicated material was considered the bronze-beryllium alloy (Bz Be 2) which shows a steady linear characteristics up to p = 1,5 daN/mm^2 and t=150°C; little loss on the hystheresis (0,2-0,5%). At high pressures and cyclic stress bronze-beryllium and ads of titanium are used.
2. The sylphons used as very sensible elements can be combined with elicoidal arcs like in figure 4.

The advantage of those solutions lies in the reduction of the elastic hystheresis effect and the sensible growth of the working zone of linear characteristics.

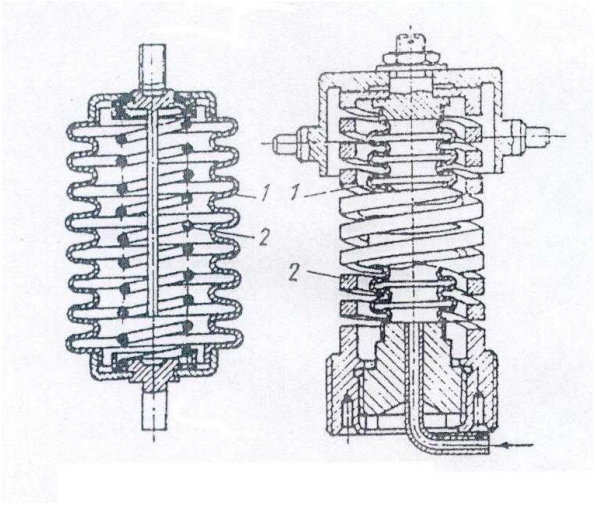

Fig.4. Sylphons combined with elicoidal arcs in the interior and exterior
1 – corrugated tube; 2 – exterior and interior elicoidal arcs

CONCLUSIONS

— From the theoretical study and from the experimental results obtained results that the most indicated sylphon from the point of view of the performances of the metrological characteristics for the goal is the one achieved from the alloy bronze-beryllium (Bz Be 2);
— The growth of the sensitivity of the traductor achieved based on this elastic element, and also of the working area can be obtained by introducing the component sylphon-arc;
— The solution proposed has as an effect also reduction of the hystheresis of the traductor.

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