DIVISIONS OR SUMMATIVE HYDRAULIC FLOW STANDARD

Victor BALASOIU[1], Ilarie BORDEASU[1]

[1] Universitatea Politehnica din Timisoara, balasoiu89@yahoo.com;
[1] Universitatea Politehnica din Timisoara, ilarica59@gmail.com;

Abstract

After a presentation of the concept of hydraulic flow divider that element to synchronize the movement of two motors hydraulic flow divider details the 1: 1. Based on an equivalent hydraulic scheme is acriu hydraulic balance equations for hydraulic divider 1:1 made in Timisoara Hydraulic Machinery Department. Based on the analysis of the static behavior of the flow divider are highlight factors that contribute to increased precision division. It shows that the error of division is the main parameter cararacterizeaza performance of a flow divider. .

Keywords: *flow divider,flow system, drawerdivider, errorofdivision, timing displacement, hydraulicproportionaldividers*

1.Introduction.

Flow dividers are hydraulic elements for division or summation of the working fluid flows predetermined proportions[1]. Flow dividers constant ratio of debt divided their use schemes are operated under different timing of construction equipment (loaders, excavators), presses, etc. Whatever the particular constructive split drawer partitions (fig.1, fig.2) is based on automatic insertion of an a dditional hydraulic resistance branchless loaded, which reduces the flowin this branch by increasing the flow of overloaded branch (F2>F1), ensuring the final displacement synchronized hydraulic motor (3) and (4) (fig.1, 2) [1].
On flow dividers have made clear that, in addition to control flow division1: 1, the device has the ability to maintain this relationship, regardless ofload variation on the two branches control. Flow divider resulted from bringing together two-wayflow, which caused loss of compression springs. Comparison(2) (drawer divider) is in equilibrium under the action of pressure p3 and p4 (fig.7.36). In this mode comparator and final position regulation disturbances are caused by the difference of the two branches-two hydraulic motors variation tasks. Droselele regulatoartelor flow components were replaced with fixed resistors R1 and R2 and adjustable resistors R3 and R4 are determined by slots droselizare mobile element (fig.3.b).
In fig. 3 are two variants of flow dividers: by dividing the aperturering (fig.3.a) and diaphragms embedded in the drawer divider (fig.3.b). Split flow with constant pressure, move the connector (1), by obruratoarele ring (6) and (7) (resistors R1 and R2- fig.3.a, b, fig.3.a) at droselele of adjustment (5) and (9) (resistors R3 andR4 - fig. 3.a, b) the drawer divider, for lines and leading to the two hydraulic motors. Rooms (15) and (16) are connected with pressure chambers(13) and (14), the compartment divider channels (10).
Equal loads on both hydraulic motors, pressure in the chambers(15) and (16) are equal and hence drawer divider (10) will be in the middle position. To differences in taskt wo branches (fig.3) due to pressure differences, drawer divider (10) moves until it compensates the difference in pressure, so in leads I and II will be the same flow division error is shall not exceed$\in = \frac{Q1-Q2}{Q0}$ =3%-4%.
Precision Hydraulics divisionis influenced by elasticity, compressibility fluid, displacement and deformation losses related pipelines. To decrease the influence of these factors is recommended that the divider to fit closer to the two hydraulic motors serviced.

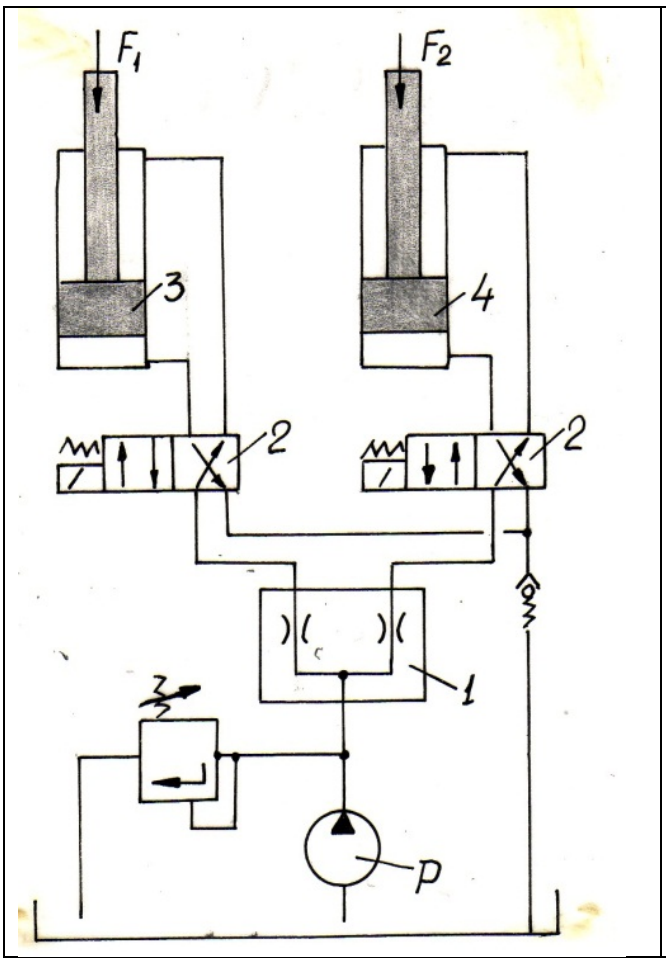


Fig.1

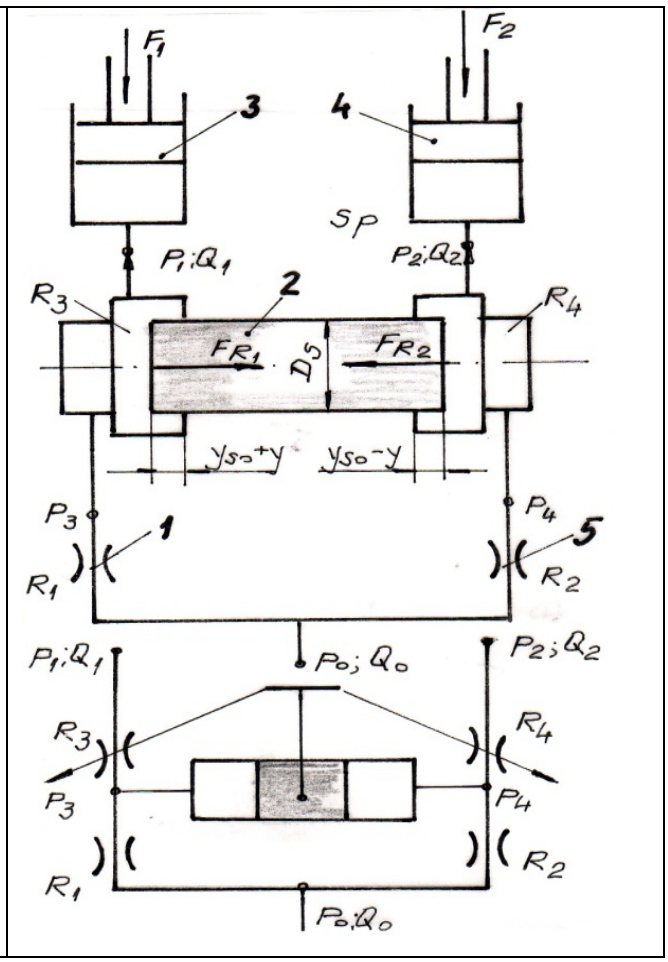
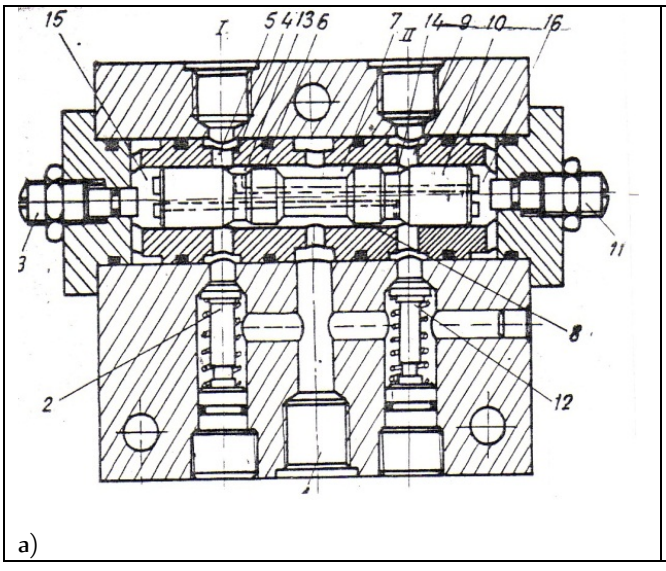


Fig.2



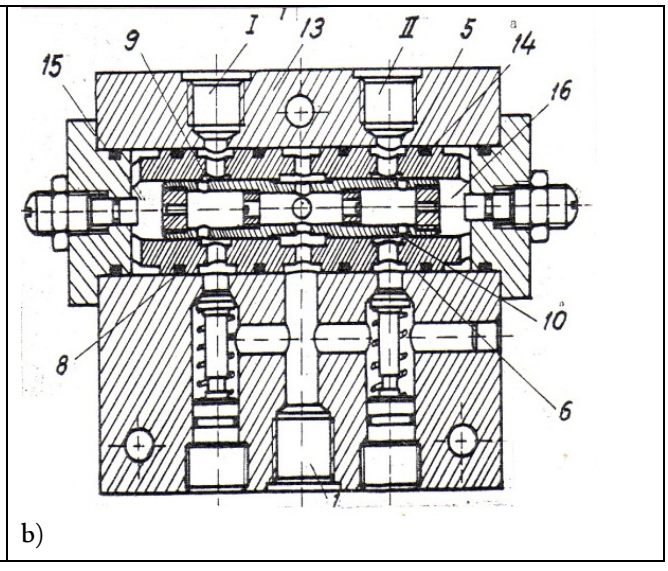


Fig.3. Flow divider 1:1.
a) resistance in the drawer edges, b) with drawer divider resistors

1. body divider, 2, 12. check valve, 3, 11.adjustment screw; 4, 5, 9. Input-Output section 6. sealing ring 7.section drawer divider 8.ring section 9.divider sleeve, 10.drawer divider;13, 14. Droselizare section; 15.16. control rooms drawer divider

Flow dividers are used in different combinations of synchronous and asynchronous operation of the two hydraulic motors for synchronous operation within a meaning and asynchronous operation in reverse.Way valves (2) and (12) (fig.3.a and b) mounted flow divider allows rapid recirculation of the fluid in the opposite direction with out resistance about. Screws (3) and (11) limits the maximum opening of variable resistance, and stroke.

2. Error of division, factors which divide error
Equal flow in both branches is determined by an equalization of pressure drop fixed resistors R1 and R2, and R3 and R4 adjustable, ie (fig, 1, 2):

respectively:

$$\Delta p_{34} = (p_0 - p_3) = (p_0 - p_4) \tag{1}$$

respectively:

$$\Delta p_{12} = (p_3 - p_1) = (p_4 - p_2) \tag{2}$$

Drawer divider is under the action of fluid pressure p_1 and p_2 control rooms F_{h1} and F_{h2} hydrodynamic forces the liquid flow passing through windows R_3 and R_4, and the friction forces between the gate and body F_{fr} divider. Axial component values of hydrodynamic forces ($F_{h1} = F_{h2}$) are proportional to fluid flow passing through sections droselizare.
Equations of continuity and steady flow stationary mobile element are:

$$\begin{cases} Q = Q_1 + Q_2 \\ Q_1 = C_{d1} f_1 \sqrt{\frac{2}{\rho}(p_0 - p_3)} = C_{d2} \pi D_S \left(Y_{S0} + Y_S\right) \sqrt{\frac{2}{\rho}(p_3 - p_1)} \\ Q_2 = C_{d1} f_2 \sqrt{\frac{2}{\rho}(p_0 - p_4)} = C_{d2} \pi D_S (Y_{S0} - Y_S) \sqrt{\frac{2}{\rho}(p_4 - p_2)} \\ \pi \frac{D_S^2}{4}(p_3 - p_4) = F_{h1} - F_{h2} \pm F_{fr} \end{cases} \tag{3}$$

Here were noted: C_{d1} and C_{d2}, flow coefficients corresponding hydraulic resistances R1 and R_2, R_3 and R_4 respectively; Y_{S0} - initial opening slots for droselizare symmetrical position in the body drawer divider, Y_S - drawer movement relative to the position initiation.

Hydrodynamic forces are calculated momentum relations:

$$\pi \frac{D_S^2}{4}(p_3 - p_4) = 2 C_{d2} \pi D_S (Y_{S0} + Y_S)(p_3 - p_1) - 2 C_{d2} \pi D_S (Y_{S0} - Y_S)(p_4 - p_2) + F_{fr} \tag{4}$$

under equilibrium conditions, $F_{h1} = F_{h2}$, we have:

$$p_3 - p_4 = \pm \frac{4 F_{fr}}{\pi D_S^2} \tag{5}$$

which shows that the error of dividing the flow depends on friction forces. For varying loads $F_1 \neq F_2$, resulting $p_1 \neq p_2$, and flow differences presence results in the appearance of axial components of hydrodynamic forces $F_{h1} - F_{h2} = F_h$ and get:

$$p3 - p4 = \frac{4F_h}{\pi D_S^{\,2}} \pm \frac{4F_{fr}}{\pi D_S^{\,2}} \quad (6)$$

and shows that the error of division of flow is determined by hydrodynamic forces and friction forces in the pair drawer - body divider.

Synchronization error between the two engines is defined as:

$$\varepsilon = \frac{Q_1 - Q_2}{Q_0} \quad (7)$$

or written as:

$$\Delta v = v_1 - v_2 = \frac{Q_1 - Q_2}{S_M} = \frac{\Delta Q_{12}}{S_M} \quad (8)$$

From the analysis of flow dividers, shows the following:
- Error of division is the main parameter characterizing the performance of a flow divider;
- Irrespective of the division, the annular diaphragm or diaphragms embedded in drawer partitions (fig.2, fig.3), reducing the error of division compensation is necessary pressure drop in system synchronization or reaction forces the drawer divider;
- Synchronization of two hydraulic motors with the same section utile S_M or the same displacement V_g useful MS, and under the same load conditions $F_1 = F_2$, involves using two equal resistors $R_1 = R_2 = R$ on the two branches of the circuit;
- Synchronization of two hydraulic motors different sizes and / or different loading conditions can be provided by using different resistors;
- Error of divisionis directly affected by the presence of axial components of hydrodynamic forces, the forces of friction and internal leakage of fluid;
- Reduction of the synchronization error is achieved by shorting the motor power sector through a properly sized resistors compensation;
- Reduction of the synchronization error can be made by reducing the area of application of the pressure response and / or useful surface S_M engines;
- Appropriate technology drawer assembly - body divisor, ie a proper choice of games and surface quality for parts in direct contact, leading ultimately to reduce the error of division within the value $\varepsilon = \pm (3 \div 5)$ % recommended of the literature specialized.

3. Conclusions

Following requests perturbations of differential synchronization is adjusted via flow dividers placed on the water both on entry and exit hydraulic motors. Engine speeds equality movement is approximate, depending on timing precision flow controllers integrated indicative of flow dividers and their working conditions. Flow dividers constant ratio of debt divided inb find their use of various schemes operated machines.
Regardless of particulaitatile constructive split drawer
partitions (Fig.3), is based on automatic introduction of additional hydraulic resistance less busy branch, which reduces flow resistance in this branch.
To increase the flow of overloaded branch (F2> F1), ultimately providing simultaneous displacement hydraulic motors MH3 and MH4 (fig.2).
Synchronization accuracy is influenced by the elasticity Hydraulics, fluid compressibility, volume loss and deformation of the connecting pipes.
To decrease the influence of these factors it is
recommended to mount divider closer to the two hydraulic motors serviced.

Given that require flow sharing between two users may not be in the ratio 1: 1, but different, sometimes varying phase of work required proportional flow dividers. IHP Bucharest, made the first hydraulic proportional dividers variants [1, 3].

REFERENCES

[1] Victor Balasoiu, Ion Cristian, IlareBordeasu, "Echipamentesisistemehidraulice de actionaresiautomatizare", Vol I, Aparaturahidraulica, EdituraOrizonturiUniversitare, Timisoara, 2008
[2] VictorBalasoiu, Echipamentehidraulice deactionare, fundamente, echipamentesisisteme, fiabilitate, EdituraEurostampa, Timisoara , 2001.
[3] Victor Balasoiu, Echipamentesisistemehidropneumatice de actionare, Vol II, partea I , II, LitografiaUniversitatiiTehnice, Timisoara, 1992
[4] I.Iu. Ciuprakov, Ghidroprivod I sredstvaghidroavtomatiki, Mosckva, Masinostroenia, 1979
[5] PetrinDrumea- Contributii la analiza si sintezaelementelor si instalatiilor de reglarweelectrohidraulice, Teza de doctorat, UniversitateaPolitehnicadin Bucuresti, 1998.
[6] V. A. Hohlov – Electroghidravliveskiislediasciesistemi, Masinostroenie ,Mosckva, 1971,
[7] *** The Procedings of the 6 th International Conference on Hydraulic Machinery and Hydrodinamics , Timisoara, oct 2000, Vol I, II, II.
[8] *** Conferinta de MasiniHidraulice si Hidrodinamica , Timisoara, 1990
[9] V. Javgureanu, Actionarihidraulice si pneumaticeînmasini si sisteme de productie". CursUniversitar, Editura UTM Chiúin□u, 2011.460 p.