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DEVICES FOR MAINTAINING BETWEEN TWO PREDETERMINED VALUES THE PRESSURE IN HYDRAULIC CIRCUITS

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Fig-1

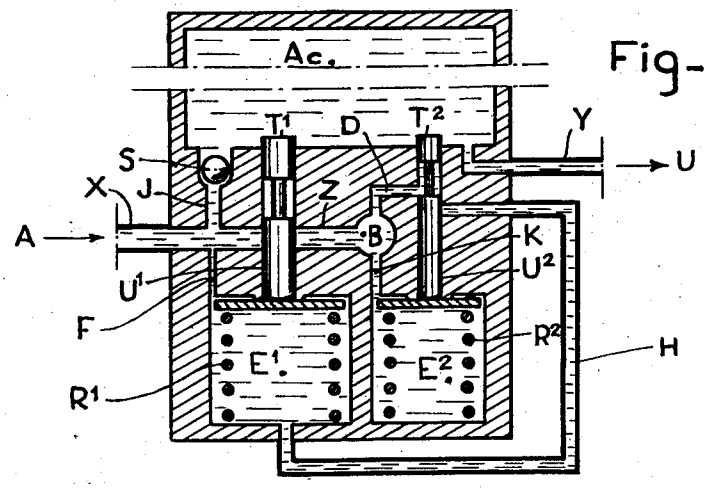


Fig-2

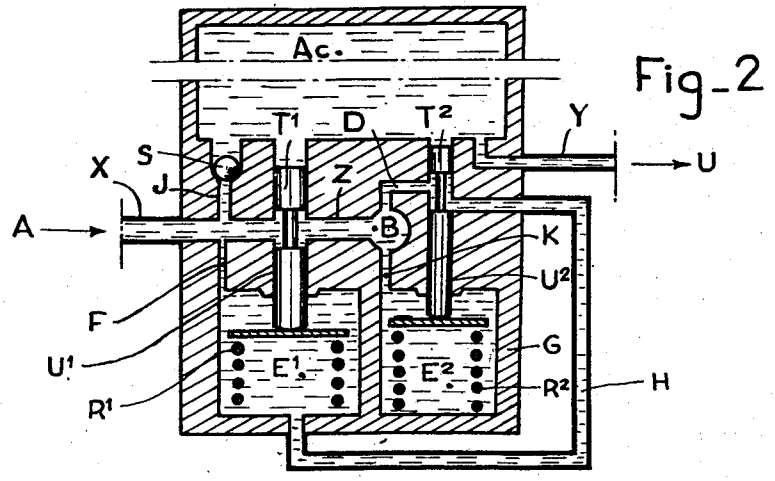
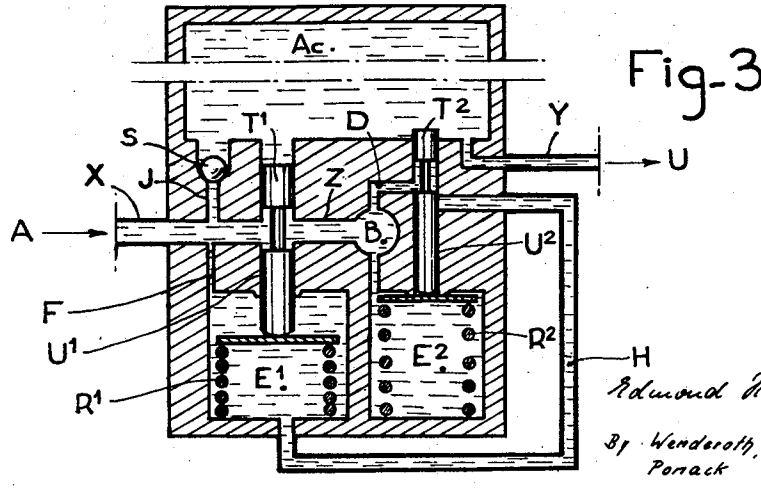


Fig-3



Edmond Henry-Biabaud
INVENTOR

By Wenderoth, Lind & Ponack

ATTORNEYS

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DEVICES FOR MAINTAINING BETWEEN TWO PREDETERMINED VALUES THE PRESSURE IN HYDRAULIC CIRCUITS

Edmond Henry-Biabaud, Paris, France, assignor to Societe Anonyme Andre Citroen, Paris, France, a French corporation

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6 Claims. (Cl. 137—108)

In certain hydraulic circuits comprising notably a pump, a pressure accumulator, a reservoir and a variable number of hydraulic devices utilizing the energy from the fluid delivered by the pump, it is advantageous to keep the fluid pressure between two predetermined limit values.

It is the essential object of this invention to provide a hydraulic device inserted between the pump and the reservoir and adapted to feed the load devices with a fluid under a pressure constantly maintained between two predetermined values.

An apparatus of this type may advantageously be contained in a body secured on the lower portion of the pressure accumulator and consist essentially of a pair of slide valves mounted in cylinders opening into the accumulator, the movements of the first slide valve directing the fluid from said pump either to the accumulator or to the discharge, these movements themselves being controlled by those of the other slide valve responsive in turn to the pressure prevailing in the accumulator.

However, this invention will be better understood from the following description of a typical embodiment thereof, which is given by way of example with reference to the accompanying drawing, in which:

FIGURE 1 is a diagrammatic vertical section showing a device constructed according to the principles of this invention, the component elements thereof being shown in the positions corresponding to the phase during which the pump output is delivered to the accumulator;

FIGURE 2 is a similar view showing the position of the same elements when the pressure in the accumulator attains its upper limit, and

FIGURE 3 is a similar view showing the relative position of the movable elements of the apparatus when the pressure in the accumulator drops from its upper limit to its lower limit.

An apparatus according to this invention (see FIG. 1) consists of a body G attached to the lower portion of an accumulator Ac connected through a pipe line X to the feed pump A and another pipe line Y to the load U.

In this body a pair of vertical cylinders U_1, U_2 have a cross sectional area S_1, S_2, respectively. These cylinders U_1, U_2 open at their lower end into chambers E_1, E_2 respectively in which compression springs R_1, R_2 apply to the slide valves T_1, T_2 slidably fitted in cylinders U_1, U_2 respectively an upward force of value F_1, F_2 respectively in the uppermost position of the slide valves.

These springs R_1, R_2 are so calibrated that if Pc and Pd designate the lower and upper limit values between which the pressure is to be kept in the accumulator the aforesaid values F_1 and F_2 are given by the following formulae:

$$F_1=Pc\times S_1 \text{ and } F_2=Pd\times S_2$$

The slide valve T_1 is interposed in the duct Z interconnecting the fluid inlet X and the discharge chamber B and acts in duct Z as a valve which is closed in the upper position and open in the lower position.

Between T_1 and X the fluid delivered from the pump may feed on the one hand the accumulator Ac through a branch duct J of relatively large cross-sectional area

which opens into Ac through a non-return ball valve S, and on the other hand the chamber E_1 through a branch duct is of relatively small cross-sectional area.

Chamber E_1 is further connected to the discharge chamber B through ducts H and D isolated by the other slide valve T_2 in its upper position of this slide valve. E_2 is directly connected to the discharge chamber B through passage K.

This apparatus operates as follows:

When the pressure rises (see FIG. 1) both slide valves T_1 and T_2 are urged upwards by their corresponding compression springs R_1, R_2.

The fluid fed from the pump through pipe line A cannot flow to chamber B through T_1, now closed, and therefore this fluid rises through valve S into the accumulator Ac in which the pressure P increases gradually. At the same time the fluid fills up the chamber E_1 under the same pressure P through the small-sectioned duct F, but it cannot flow into B through H and D since the other slide valve T_2 is closed.

As long as the pressure P in Ac and E_1 remains lower than Pd, both slide valves T_1 and T_2 remain closed, that is in the position in which they are shown in FIG. 1.

This is clearly apparent in the case of valve T_2, since P/Pd leads to $P\times S_2/Pd\times S_2$, which means that the pressure force $P\times S_2$ exerted by the fluid contained in Ac on the upper face of T_2 is inferior to the antagonistic effort $F_2=Pd\times S_2$ exerted by the spring R_2 on the lower face of T_2 (considering that S_2 is constantly connected to the discharge through duct K).

But the slide valve T_1 also remains in the upper position since it receives on its upper face the pressure force $P\times S_1$ of the fluid contained in Ac and on its lower face the same force $P\times S_1$ (chamber E_1 being filled with fluid under a pressure P) plus the force F_1 of spring R_1.

When the pressure P in Ac attains and exceeds slightly the upper limit value Pd, the slide valve T_2 is depressed or lowered (since the downward pressure $Pd\times S_2$ counterbalances the effort $F_2=Pd\times S_2$ of the calibrated spring R_2), and chamber E_1 is thus immediately connected to the discharge through ducts H and D.

Since the pressure force $Pd\times S_1$ acting on the upper face of T_1 is greater than the force $F_1=Pc\times S_1$ exerted by the spring R_1 on the lower face of T_1 (in fact, the relation Pd/Pc involves $Pd\times S_1/Pc\times S_1$), the slide valve T_1 is also lowered (see FIG. 2) and the feed line A is discharged directly through duct Z.

Valve S is thus closed and the pressure in Ac decreases immediately as a consequence of the flow of fluid toward the load U.

The slide valve T_2 will thus rise immediately but the other slide valve T_1 remains depressed (FIG. 3) for the pressure in chamber E_1 previously connected to the discharge B rises only very slowly through the narrow passage F, whereby, during a certain time period, the forces acting upon the slide valve T_1 consists simply of the pressure force $P\times S_1$ of the fluid in the accumulator Ac, which is transmitted to the upper face of valve T_1, on the one hand, and of the force of spring $F_1=Pc\times S_1$ which is applied to the lower face of this valve, on the other hand.

As long as $P>Pc$, it is evident that $P\times S_1>Pc\times S_1$ and the resultant of the forces acting upon T_1 is directed downwardly.

As soon as P attains the lower limit Pc, the slide valve T_1 rises, the accumulator Ac is again connected to the feed line A and the apparatus resumes the condition illustrated in FIG. 1, and the above-described cycle is resumed.

It will be noted that if the pressure drop in Ac, from value Pd to value Pc, is very slow, it is obvious that T_1 will rise when pressure $P'c>Pc$ as a consequence of the pressure increment in E_1 through F.

Of course, to produce the above-described cycle it is necessary that the pump output exceeds the total output necessary for operating all the load apparatus connected to the outlet of U.

The arrangements characterizing the above example have been chosen with a view to facilitate the description and the understanding of the invention, but it will be readily understood by anybody conversant with the art that it would not constitute a departure from this invention to provide any other embodiment based on the same principles and functional realtionships between the parts involved. Thus, external pipe lines such as H may be avoided by connecting E_1 to U_2 through a passage formed inside the block G.

I claim:

A device for maintaining between two limit values the pressure at the inlet end of hydraulic load circuits, operating in conjunction with a delivery of fluid under pressure from a source of supply comprising a pressure accumulator having an outlet to said load circuits, a body on said accumulator, a pair of cylinders in said body, a sliding valve movable in each cylinder, a first and second chamber in said body for said cylinders, each of said cylinders having an opening at one end into said accumulator and at the opposite end into its associated chamber, a calibrated spring in each of said chambers to provide a resilient resistance counteracting the movement of its associated slide valve into the corresponding chamber under the influence of the pressure force exerted by the fluid compressed in said accumulator, a discharge well in said body, a first passage connecting said fluid supply to said discharge well controlled by one of said slide valves, a second passage controlled by said other slide

valve connecting said first chamber associated with said first mentioned slide valve to said discharge well, a third passage of relatively small diameter connecting said first chamber to said fluid supply, a fourth passage of normal diameter connecting said second chamber to said discharge well, a fifth passage of normal diameter connecting said fluid supply to said pressure accumulator and a non-return valve in said fifth passage.

2. A device according to claim 1 wherein each slide valve closes the passage controlled thereby when its associated calibrated spring attains its maximum permissible elongation.

3. A device according to claim 1 wherein said spring acting upon said first slide valve is calibrated to exert a pressure counterbalancing a pressure force exerted on the opposite face of the same slide valve by the lower limit of pressure in said accumulator.

4. A device according to claim 1 wherein said spring acting upon said second slide valve is calibrated to exert a pressure counterbalancing a pressure force exerted on the opposite face of the same slide valve by the upper limit of pressure in said accumulator.

5. A device according to claim 1 wherein said body is located at the lower portion of said accumulator.

6. A device according to claim 1 wherein said slide valves have their axes disposed vertically.

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