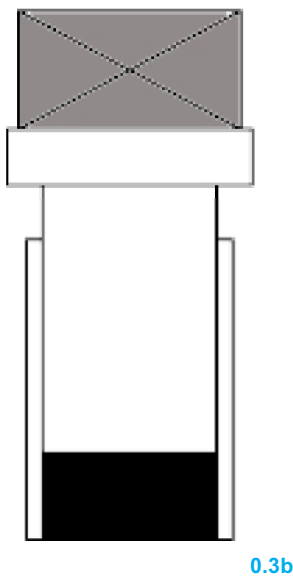
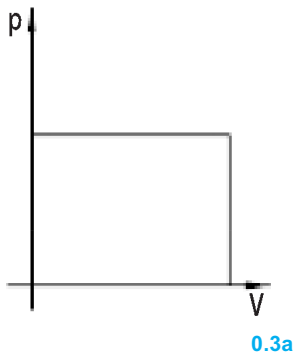


0.3.1 ACCUMULATOR HISTORY

At the beginning of the industrial period, accumulator made his first appearance on the water systems. It was, in fact, used in presses, usually added between the pump and cylinder with the function of a Flywheel. During the pressing phase, through a system of valves, the accumulator and the pump worked in parallel and powered the cylinder of the press.

During the discharge phase, those valves supplied the startup of the pump and consequently the functioning of the accumulator.

The use of accumulator, leading to the better functioning of installed power, lower cycle times and more power presses from a single pumping station. The accumulators commonly used at that time were the "raised weight Accumulator" and the "free hair Accumulator".



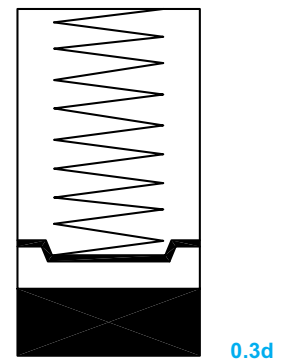
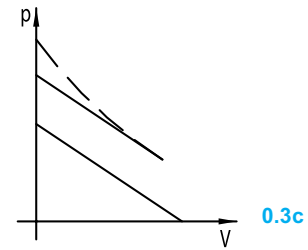
The raised weight Accumulator essentially consists in a vertical steel cylinder inside of which flowed a metal piston on which is placed a weight. The water is pumped into the cylinder so as to raise the piston and the weight; a check valve furthermore prevents the water flowing into the pump. So there is a reservoir of hydraulic energy equal to the product of the cylinder stroke by the weight above.

The weight accumulator is the only accumulator that can return a quantity of liquid at constant pressure.

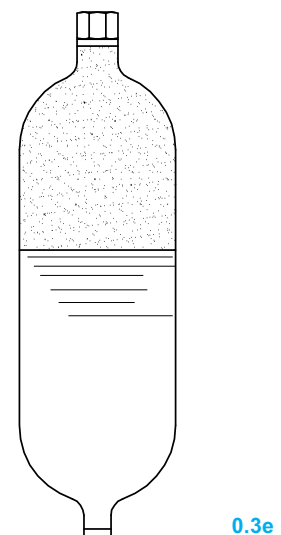
An evolution of the raised weight accumulator is the spring-loaded accumulator.

The spring accumulator consists of a cylinder whose piston is charged by one or more springs. For constructional reasons could be built only in small dimensions. Moreover, this accumulator returned the fluid

under pressure so inconstant and variable in time depending to the fatigue resistance of the spring.



Another type of accumulators used in the past is called "free hair". These accumulators were made of mainly of a steel shell filled with water and air. There were also a safety valve set at the working pressure (P_{max}) and a valve of minimum pressure (P_{min}). The first provide to discharge the water when the pressure exceeds the maximum working pressure, the second will allow the flow when the pressure was below the minimum value.



On these systems the minimum pressure of work was generally very close to maximum pressure.

$$P_{max} - P_{min} = 5\% \times P_{max}$$

The shells were filled with liquid to approximately 50%.

It should be noted, however, that a third of the capacity of the shells was not used anyway, because the vortex that was formed during the

discharge swept away also the air.

So the shells were used for only about 20% of their total capacity.

The hydro-pneumatic accumulator had a delivery much greater than the raised weight accumulator and also, thanks to the use of air with water, or nitrogen with oil, allowed a variation of pressure contained.

This type of accumulator is still used today (though not in its original configuration) in plastic moldings, metal die casting and so on.

In 1936 a French engineer, Jean Mercier, was commissioned by a company of aircraft manufacturer to design a retractable landing gear.

Thus was born the hydropneumatic bladder accumulator. Its function on this aircraft were mainly two:

- provide hydropower to lower/raise the landing gear during takeoff and landing.
- ensure the hydro-pneumatic suspension of the aircraft during takeoff and landing on the track.

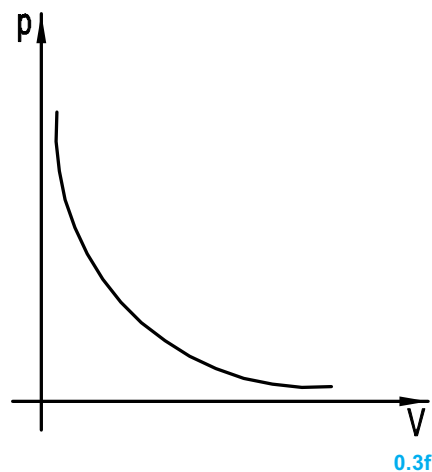
These systems built for Dewoitine (French fighter entered into the Armée de l'Air shortly before World War II) were later adopted by Moran, Caproni, Fokker and other aviation pioneers.

The originality, simplicity and innovative performance has subsequently opened the doors to several markets, such as car manufacturing, machine tools, aviation, marine, aerospace, nuclear, petrochemical, food in all applications where the pressure of a liquid should be controlled or where are required high instantaneous flows.

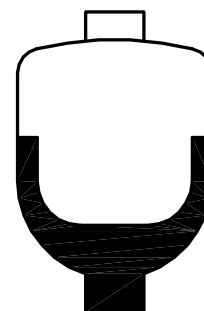
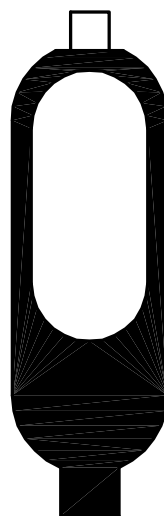
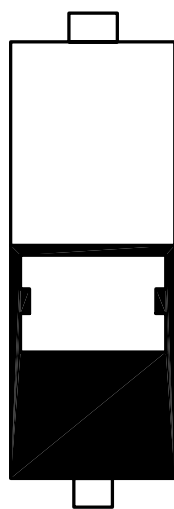
In most of the existing hydraulic systems are increasingly used those gas accumulators with a separation between gas and liquid.

Depending on the type of item separation, the accumulators are distinguished:

- bladder accumulators
- piston accumulators
- diaphragm accumulators



0.3f



0.3g

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