1- FLATS PROFILES

As hydraulic engineers know the volume of a surge tank increases as the geometric head decreases (for the same length and discharge). This is due to the fact that we are dealing with energy : potential gravity energy does not exist in flat profiles where the flow never stops, and elastic energy is smaller in the vessel when the gas is less compressed.

When it is possible a good solution is to use external atmospheric energy and feed the system with atmospheric air, using limitless amounts of free energy. This job is perfectly achieved by the A.R.A.A. vessel and this, without any air bubbles being introduced into the pipework.

As these flat profiles are frequent in sewage systems, the design of the device is adapted to raw water and effluents. They have been successfully used for over ten years from 50 litres up to 50000 litres.

2 - CONCEPTION OF THE A.R.A.A. VESSEL

This device, is a vertical vessel, connected to the pipework by a large connection pipe at the bottom, the top of this vessel has a compression chamber limited by the dipping tube or ventilation tube with a shut off float valve.

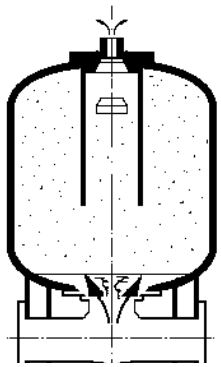
This special Charlatte patented vessel has three different operations :

1 - compressed air vessel as the compression chamber traps air.
2 - chimney when the float is open in the dipping tube.
3 - air valve if all the water volume has been delivered to the pipework.

As there is no bladder in the vessel, the connection pipe is completely open and there is absolutely no risk of obstruction if used in a sewage system.

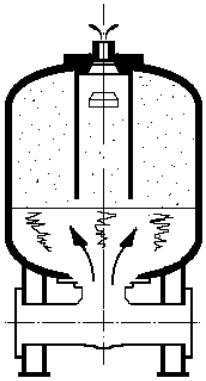
With this surge vessel there is absolutely control of the amount of air as it is renewed at any pump stop, and if some dissolution occurs, the other operations will give sufficient security to the system.Obviously it is preferable to stop the pumps once a day in order to refresh the air and compensate the dissolution by performing one cycle.

3 -OPERATION pump start :



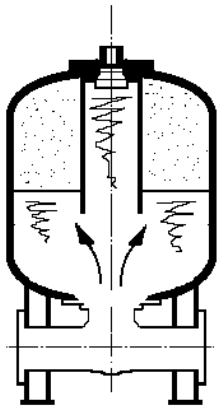
3-1 Air release valve

As the system is commisionned the rising main fills and begins to discharge into the surge vessel, first air is expelled as the float is open.



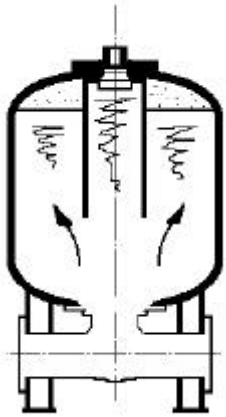
3-2 Atmospheric free surface chimney

The rising main is still filling and water is still entering the vessel, expelling air as the float is still open. The liquid level increases (under pump operation) until reaches the bottom of the dipping tube.



3-3 Float closure

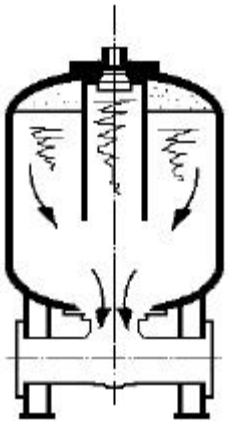
The air volume situated above the water level in the compression chamber is then trapped. The liquid level increases up the central dipping tube as the upper float is still open the atmosphere. However the air trapped inside the shell of the vessel is compresseed. The liquid pushes the float to the upper limit of the central dipping tube, closing the shut off valve.



3-4 Air compression

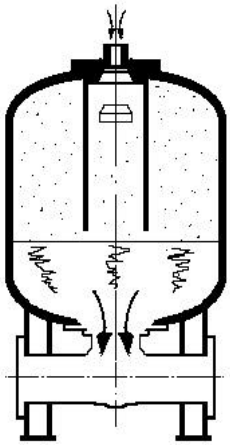
As the system pressure increases the trapped air is compressed more and more until the system is balanced. There is no movement at the outlet.

4 - Operation pump stopped :



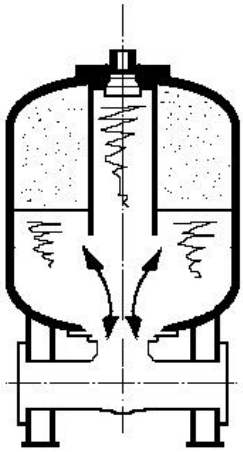
4-1 Surge vessel

Immediately after the pumps are stopped, the pressure in the pipe ligne starts to decrease and the elastic energy of the gas dicharges the liquid of the vessel, and this limits the pressure drop as the pipework is energised. When all the water stored above the bottom of the dipping tube has been delivered, the dipping tube starts to empty and the float opens.



4-2 Chimney

The vessel is now open the atmosphere and the water is delivered to the pipework with a constant atmospheric pressure. The level continues to fall until low level is obtained as the reverse flow through the pipework from the downstream outlet reaches the ARAA vessel.



4-3 Oscillations

The process oscillates and repeats itself with a decrease in amplitude due to friction losses in the pipes. After several cycles the static level is obtained obave the bottom of the dipping tube, or not, depending on the geometric head of the project and on the installation level of the vessel.

4.4 Next start of pumps

The air cushion in the vessel will be compressed during the next start of pump and will oscillate before the obtention of next steady state conditions. The stored elastic energy is now ready to manage an eventual general power failure.