The Breurram

Ferdinand Kroon, 2003

This document is put together by Ferdinand Kroon, based on the WOT-website, the WOT publication “the WOT-field” and own experiences. The WOT is a knowledge centre in the field of small-scale applications of renewable energy and handpumps and provides a free question and answering service for projects in developing countries. For more information see www.wot.utwente.nl

Introduction

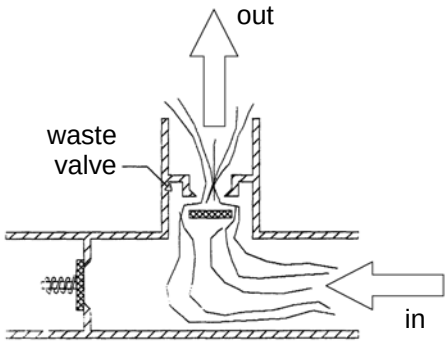
The Breurram is a kind of hydraulic ram. The hydraulic ram is a pump, that uses water power to pump water. The energy of a large mass of water with a limited height difference is able to pump about 10% of this water to greater heights. A hydraulic ram can for instance be used in a river with a small decline in height to pump water to greater heights for domestic purposes.

There are many designs of hydraulic rams available. On commercial basis cast iron hydraulic rams are available for a long time. Cast iron hydraulic rams are quite expensive and usually only useful for bigger purposes. Also, considerable knowledge is needed to install and repair the hydraulic ram. To make the hydraulic ram more useful for smaller purposes, several organisations have successfully designed 'self-built' hydraulic rams. In other words, it should be constructed with easily available materials. In 1996 the WOT has designed its own hydraulic ram: the Breurram. This ram is specially designed for very small-scale applications. The Breurram can be constructed with easily available materials. The costs for a Breurram are in the Netherlands around 50 Euro. Costs for the necessary civil engineering structure, not included.

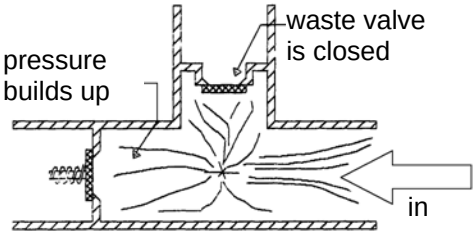
Working principle

The basic principle of the hydraulic ram is simple. In the figures the main part of the ram is shown schematically. On the right side the water flows into the hydraulic ram. Water flows into this opening continuously. This water is delivered through a plastic pressure pipe, which comes from at least 1 metre above the ram. The necessary height difference can be created by making a small dam or by digging a small extra canal next to the river.

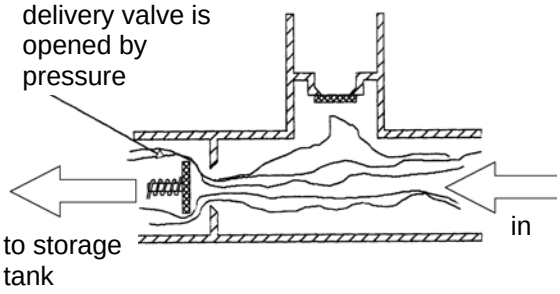
First the water flows out of the ram through the top part (see top figure). This water flows back to the river. The water gains more speed, until at a certain point the water pushes the waste valve in a closed position. The water closes off its own way out.



But the water in the pressure pipe is still flowing, this causes an excess pressure (see middle figure). This pressure-rise also happens when you suddenly close the tap at home. Then the exit is “suddenly’ closed, but the water is still flowing. A loud “toink” can be heard in the water pipe. This effect is know as a “water ram”, and has named the ram pump.



In the hydraulic ram, this water ram is used to pump water: The excess-pressure opens the delivery valve on the left side (see bottom figure), and the water flows through it. This side of the pump leads to the delivery pipe. After a short period of time the excess-pressure disappears, this closes the delivery valve. At this moment the water is almost at a standstill. Gravity makes the waste valve fall into an opened position.



Now the cycle restarts. This whole process happens about 2-3 times each second. Every time a little bit of water is pumped into the delivery pipe, and is pumped up.

An important advantage of the ram pump is that it works completely on its own, as long as the water is flowing into the pump. In many cases water rams have worked, non-stop for years without malfunctioning. Hardly any ware is found in the hydraulic ram. The ram doesn’t cost anything while it is being used.

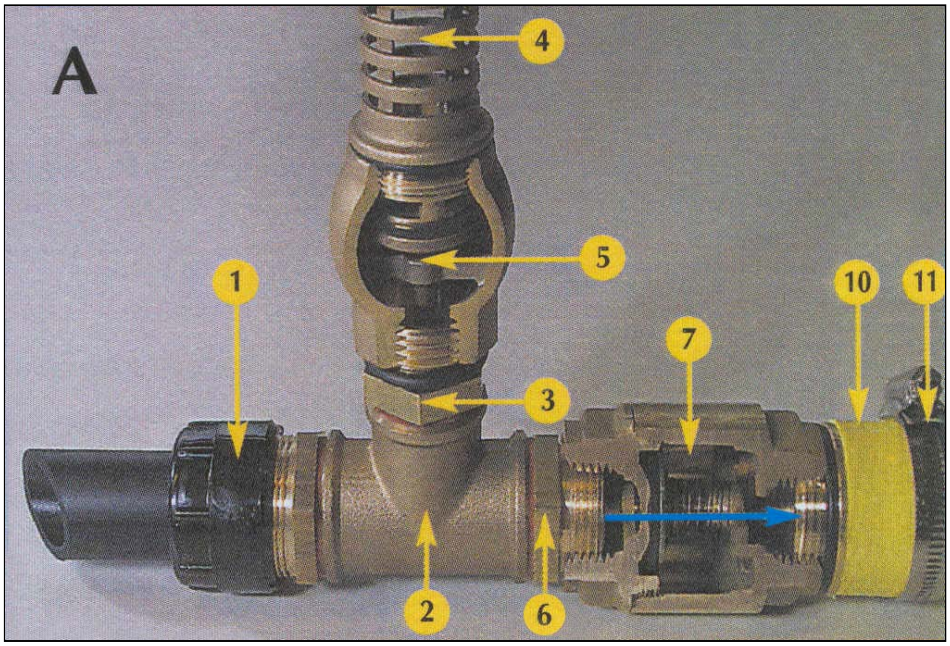
Construction

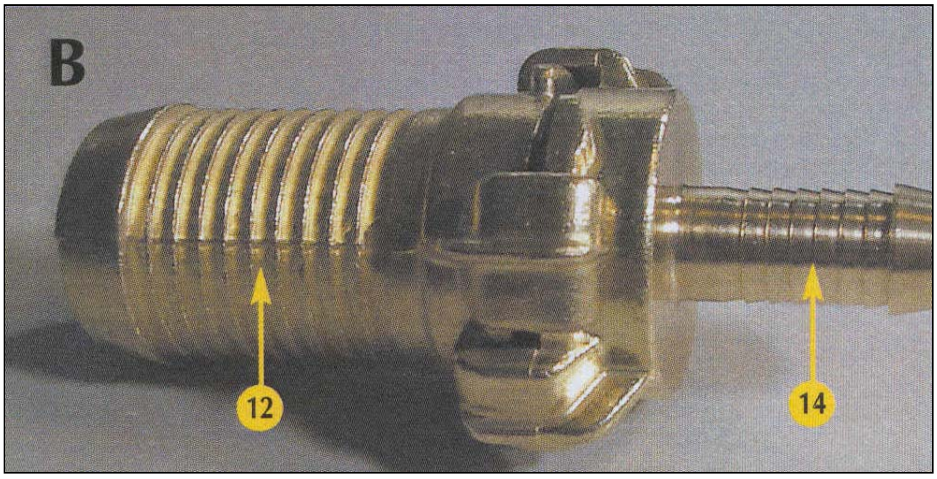
For the assembly of the Breurram the following parts are needed. The numbers refer to the pictures on the following page.

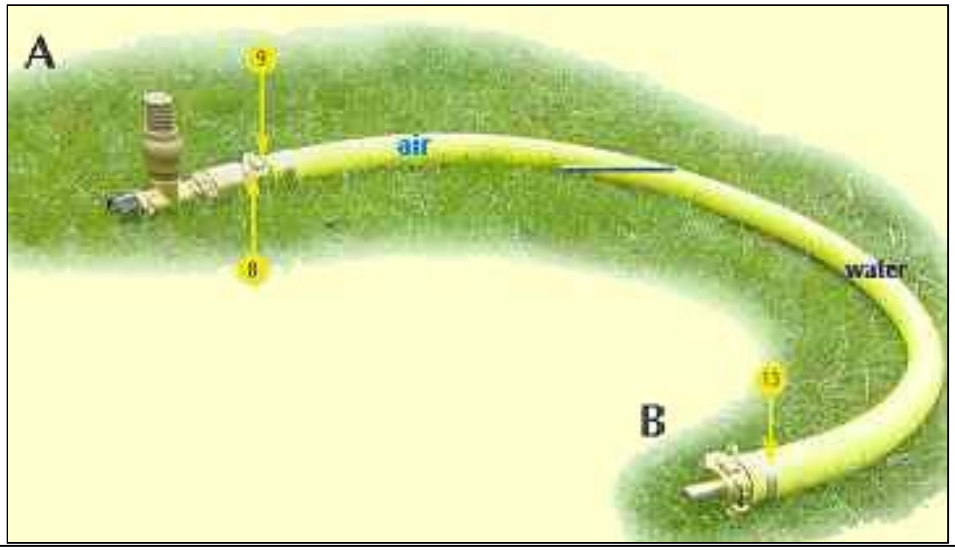
Nr	Part	Amount
1	Sleeve coupling (clamp-connection) 25 x 3/4" male thread	1
2	T-joint, brass, 3/4" female thread	1
3,6	Reducing coupling, brass, 1" x 3/4" male thread	2
4	Foot valve, brass, 1" female thread (ball shape and used in reverse direction)	1
5	O-ring nitrill rubber 6.0 mm x 1.5 mm (to regulate pump frequency)	5
7	Spring-loaded check valve, brass, 1" female thread	1
8	Standpipe coupling, 1" x 32 mm	1
9,12	Quick connect hose coupling, brass, 1 1/4"	2
10	Pressure tube TRICOFLEX (compressed air vessel) 1 1/4" x 150 cm (more than 10 bar/psi)	1
11,13	Hose (tube) clamp, stainless steel, RVS JUBILEE 30-40 mm	2
14	Quick connect hose coupling, brass, 1/2"	1
	Enflontape 12 m x 12 mm x 0,1 mm Afdichting fiber WÜRTH 26 mm x 32 mm x 2 mm	

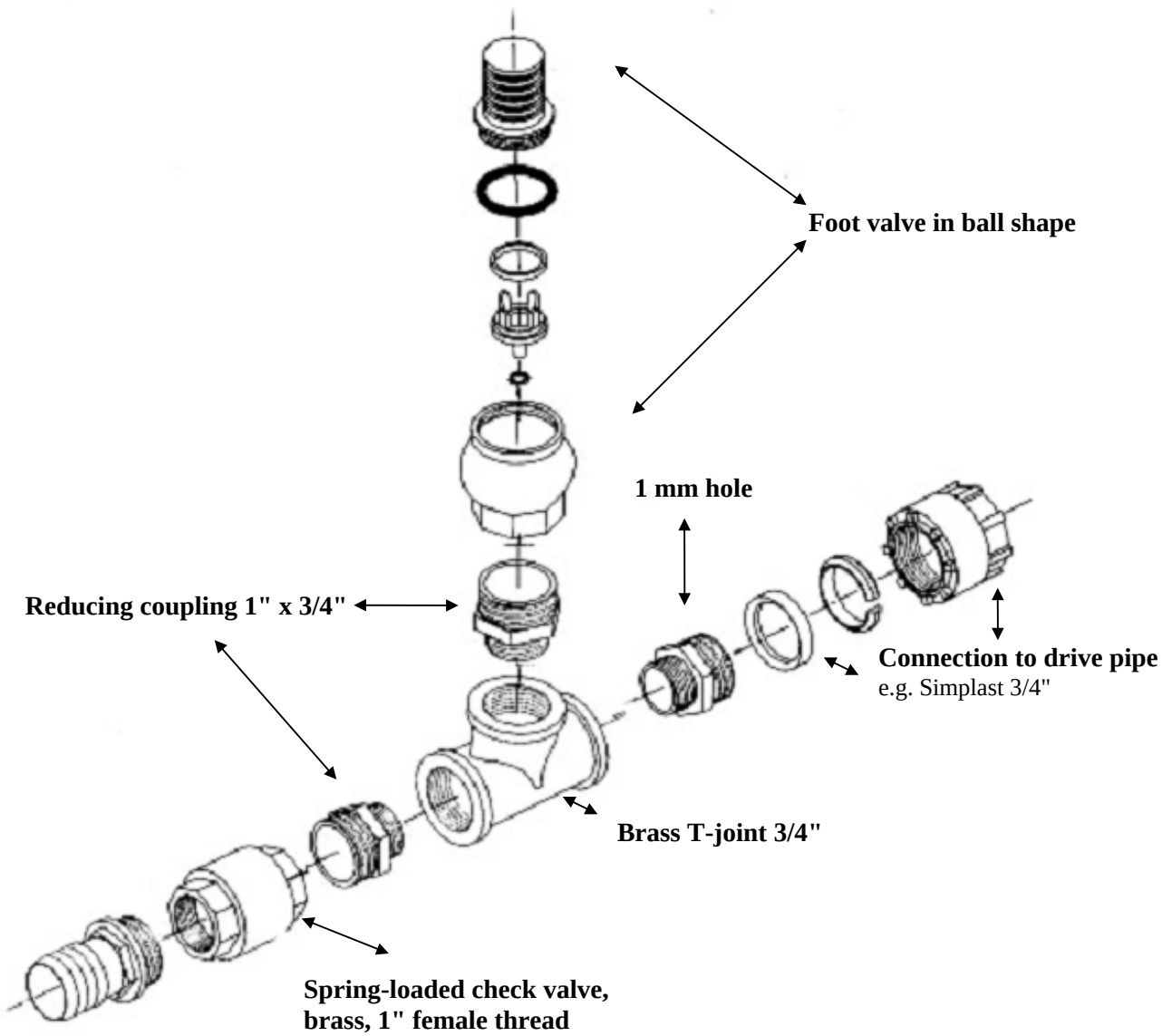
The drive-pipe is not specified, this is either a rigid (metal!) pipe or (easier and therefore preferred) tylene tube, also used in drinking water installations. The diameter must be at least as much as the ram, so 3/4 inch. The length is expected to be several meters, from water-supply to ram. It should be 4 to 6 times the supply head. All parts should be taped airtight.

In the following pictures it is shown how the Breurram is assembled.



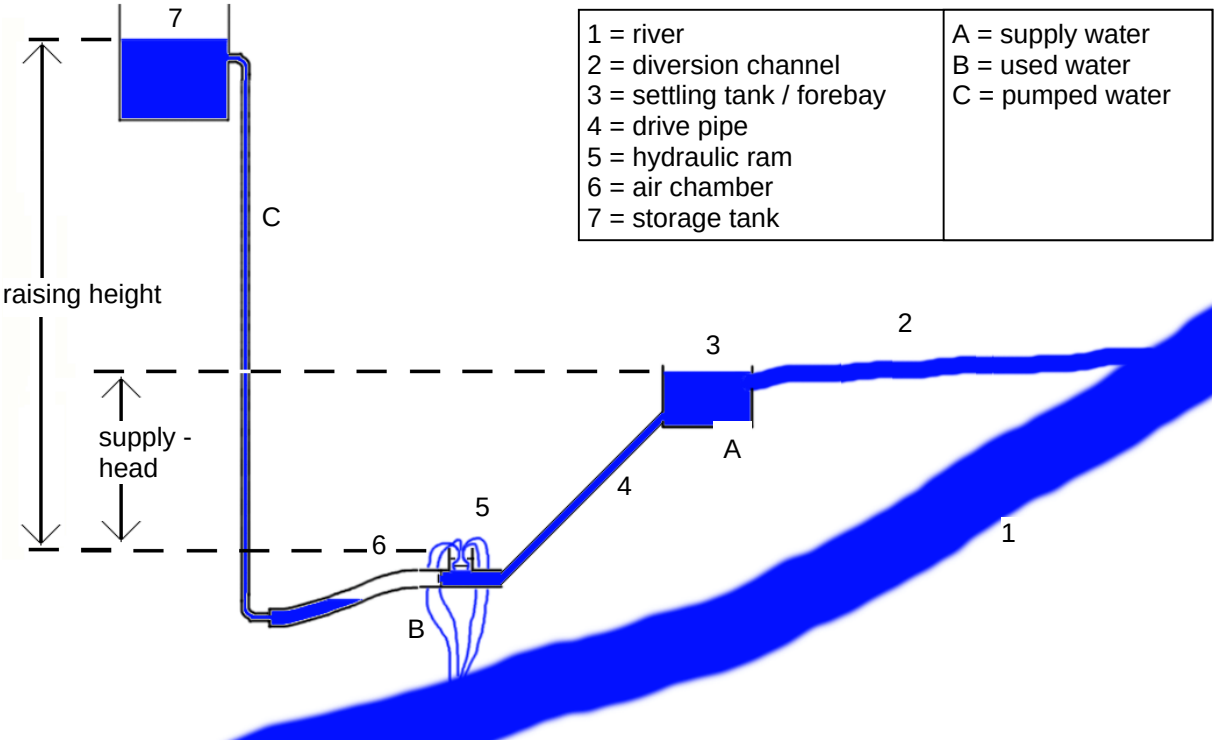





Foot valve in ball shape
1 mm hole
Reducing coupling 1" x 3/4"
Connection to drive pipe
e.g. Simplast 3/4"
Brass T-joint 3/4"
Spring-loaded check valve,
brass, 1" female thread

Installation example

In the picture below it is shown how the ram can be installed by a river. If there is no natural height difference which can be used, this can be created by constructing a dam or a diversion channel which flows more gradually downhill than the river. The river or channel has to have a minimum supply of 3 litres per minute. In case such a situation exists, a hydraulic ram is suitable. A small civil engineering system has to be constructed to collect the inflowing water. The water can be filtered from sediment and other things which the water carries (3). This can be done by constructing a settling tank. A settling tank is a widening of the inlet channel. The widening causes the water to flow slower, giving the sediment in the water the opportunity to sink to the bottom. Next, a drive pipe (for example a poly ethylene tube) is needed to conduct the water into the ram (4).



The biggest share of the water flows back into the original river (B). Part of the water will be pumped up into the storage tank, higher than the original supply water. The percentage of pumped water in relation to the total amount of used water is dependent of the supply head.
(low supply head → much water ; high supply head→ little water). With reasonable raising heights a capacity of over half a litre to a full litre per minute can be achieved. It should be noted that one litre per minute is equal to about 100 buckets of water per day per ram, because the ram can operate continuously without much wear or cost.
In case the amount of pumped water is insufficient, several rams can be installed in parallel. The rams must each have a separate drive pipe, but can share the raising pipe. The same diversion channel and settling tank can be used. If less water is available, one or more rams can be disconnected while the whole system is still functioning. Another advantage of parallel rams is that the system is less vulnerable to disturbances. If maintenance needs to be done or one of the rams is not functioning, the system is still functional.

Practical hints

Starting the ram

The ram can be started by quickly opening the inlet tap. In case the ram doesn't work immediately, the tap has to be opened and closed several times.

The air chamber

The air chamber is located just after the ram and is meant to receive the force of the ram. This force is then used to pump the water gradually. The end of the air chamber should be located lower. This ensures that no water can escape through the raising tube.
While using the ram, the air in the air chamber might still get out. The ram doesn't function very will in this case. This problem can be prevented by making a small hole (+/- 1 mm) just before the delivery valve. During every cycle a little amount of new air is sucked in. Another solution is to put a full cycle-tyre into the air chamber, which is a thicker tube. The compressed air inside the cycle tyre will than perform the function of air chamber.

The drive pipe

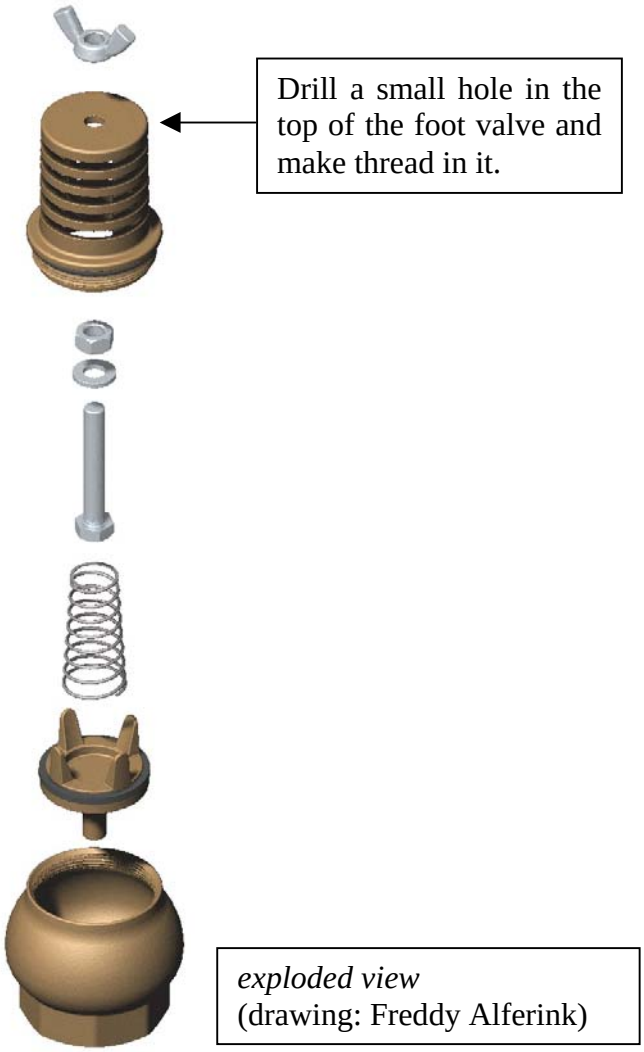
If you install a bigger size hydraulic ram like the 2 and the 3 inch, you need rigid piping for the drive pipe (iron), otherwise you will loose too much energy (kinetic energy).

What to do if the ram doesn't function?

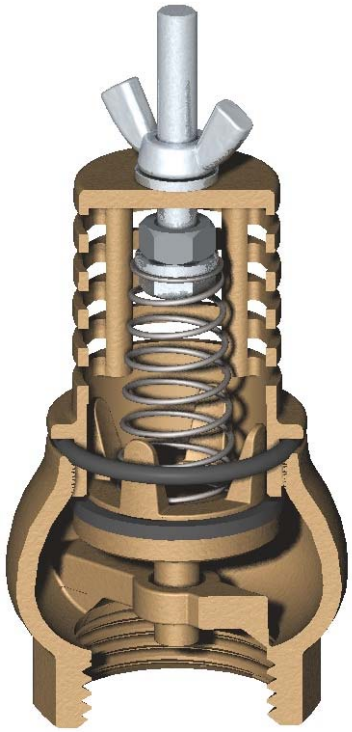
- Check the valves and the working of the valves. It is advisable to put a strainer/filter before the inflow opening of the drive pipe in order to prevent dirt coming in between the valves.
- Check if the connections are airtight.
- Check if there is air in the drive pipe (causing malfunction). That is why the inflow opening of the drive pipe should lay approximately 50 cm below the waterlevel in order to prevent sucking in air.
- Check if there is enough air present in the air chamber and if the air chamber at the end is laid down sufficiently.
- Check if the delivery pipe can provide enough counter-pressure (squeeze the delivery pipe, start up the ram, if it is starting now, then the choice of the delivery head was to small). The delivery head should be more than 3 times the supply head!!!!!
- The impulse valve works, but no water is being pumped up. Probable cause: the delivery valve is defect.
- The impulse valve stays closed. Cause: the supply head is too high.
- The impulse valve will not close/stays open. Cause: the supply head is too small or the delivery head is too high.

Adjustment
The output of the ram can be optimised by adjusting the ram properly.
If a lot of supply water is available, the cycle time of the ram should be longer. Enlarge the lift of the waste valve to accomplish this. If little amount of supply water is available, the cycle time has to be decreased. Reduce the lift of the waste valve to accomplish this.

Adjustment of the impulse valve
The impulse valve can be made adjustable. The output of the ram can be optimised this way, based on the specific site conditions.
To do this, proceed as follows; (the accompanying drawings should make it clear)
1. Drill a small hole in the top of the foot valve and make thread in it.
2. Tighten a ring on a bolt with a nut.
3. Turn the bolt in the just drilled hole.
4. Tighten the bolt with a nut.
5. You can now place a spring in the foot valve using the ring. The ring can be adjusted to vary the pressure of the spring.



exploded view
(drawing: Freddy Alferink)



View of the inside after assembly
(drawing: Freddy Alferink)