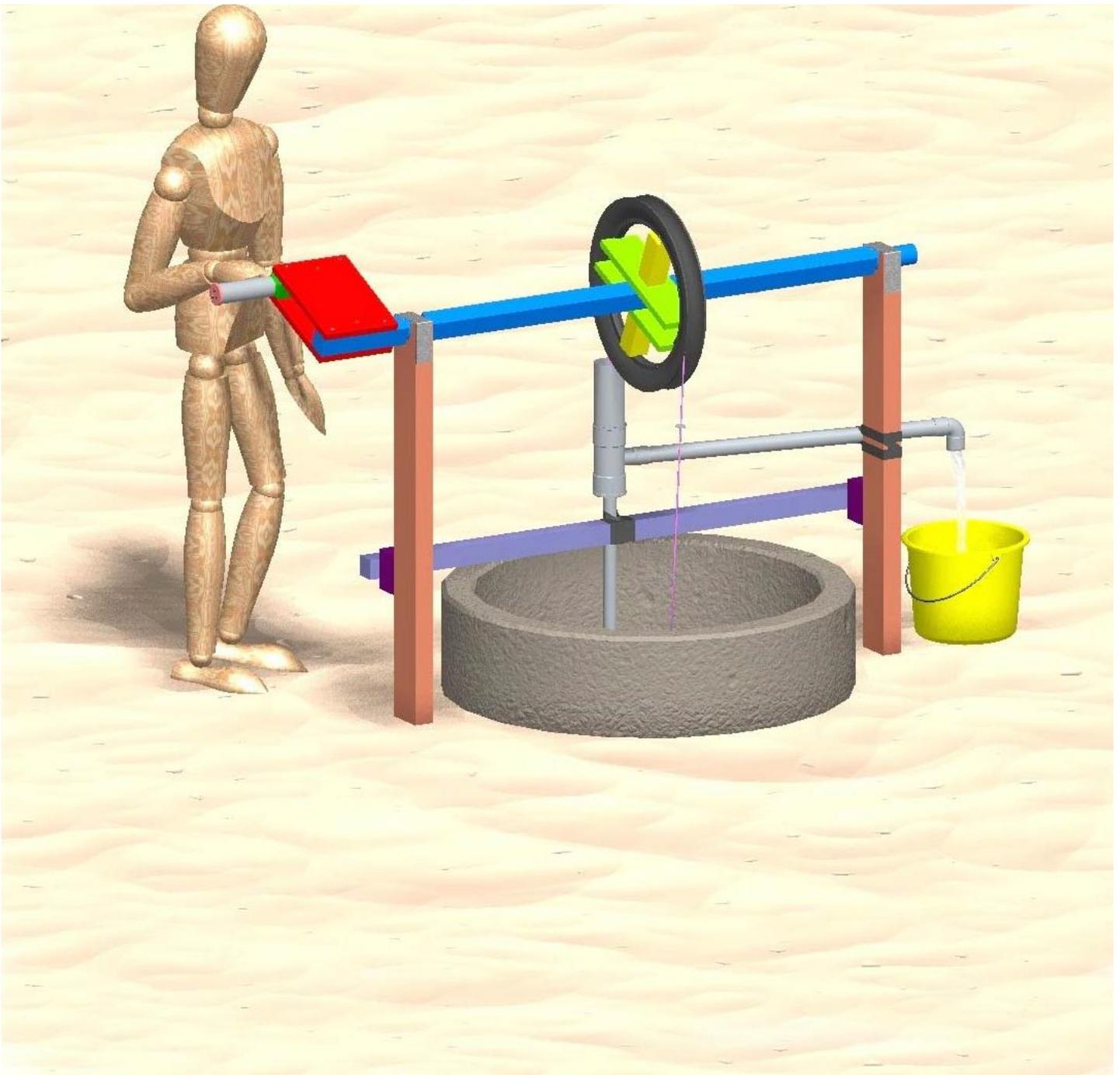


ROPE PUMP

CONSTRUCTION MANUAL

A translation of the Dutch manual composed by the WOT (see www.wot.utwente.nl)

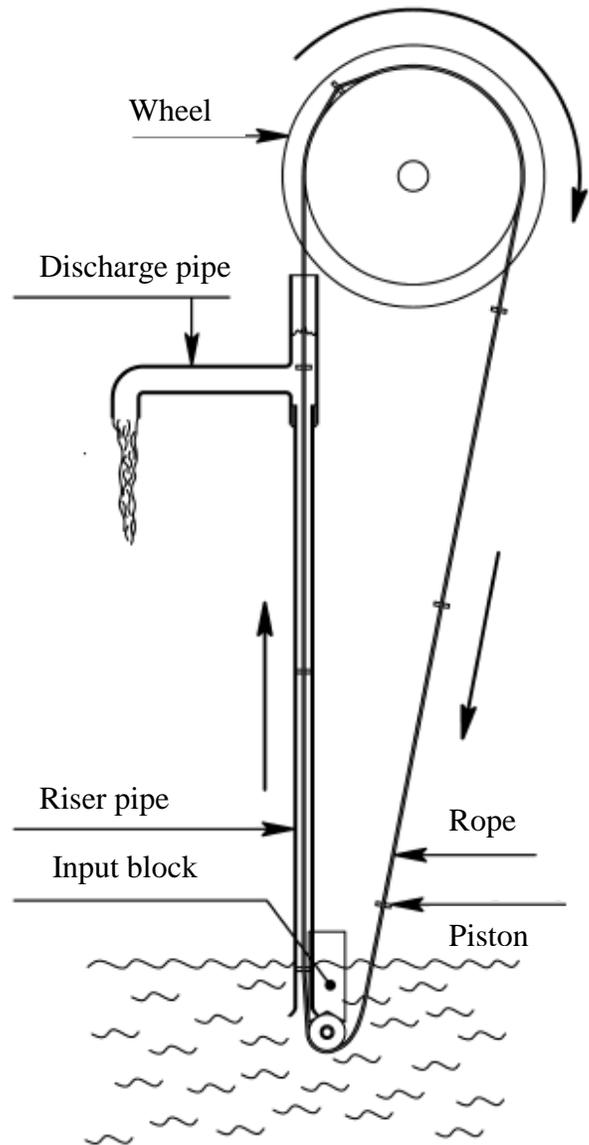


Rope Pump – a wooden model for hand dug wells and boreholes

Introduction

The rope pump is very simple and cheap to build and can be applied if a hand dug well or a borehole (width at least 8 cm) is available. Because of its simplicity it can be constructed and maintained by non-technicians, although some practical skills are required. In the figure alongside the principle of building a rope pump is shown.

The pump consists of a pipe which guides a rope at which pistons are attached. The riser pipe is placed in the ground water in the well and the top is at least one meter above the ground level. The pistons are attached to the rope and fit into the pipe by a small tolerance (between 0.5 and 1 mm). By pulling the rope through the riser pipe the pistons will more or less close the tube and the water will be taken upward. A water film between the piston and the wall of the pipe is acting as lubrication and also contributes to sealing of the opening between the pistons and the pipe. The rope is driven by a wheel that is mounted above the riser pipe. The input block on the end of the riser pipe ensures that the rope with the pistons is guided smoothly into the riser pipe. The rope pump can be applied, using simple materials, to a depth of approximately 40 meters. The deeper the water is located, the heavier it becomes to lift it. For that reason the diameter of the riser pipe becomes smaller for greater depths. Otherwise it would be too heavy to turn the wheel manually. Especially in case of small pipe diameters (large pumping depths), it is important that the pistons are made accurately. The advised pipe diameter for given pumping depths is shown in the following table.



Depth of the well (in meter)	0 ... 6	6 ... 10	10 ... 20	20 ... 35
Pipe diameter in inch	1½	1	¾	½
in mm	44	30	23	8
Water Production (liter per rotation of the wheel)	1.4	0.5	0.3	0.1

The construction of the wooden rope pump

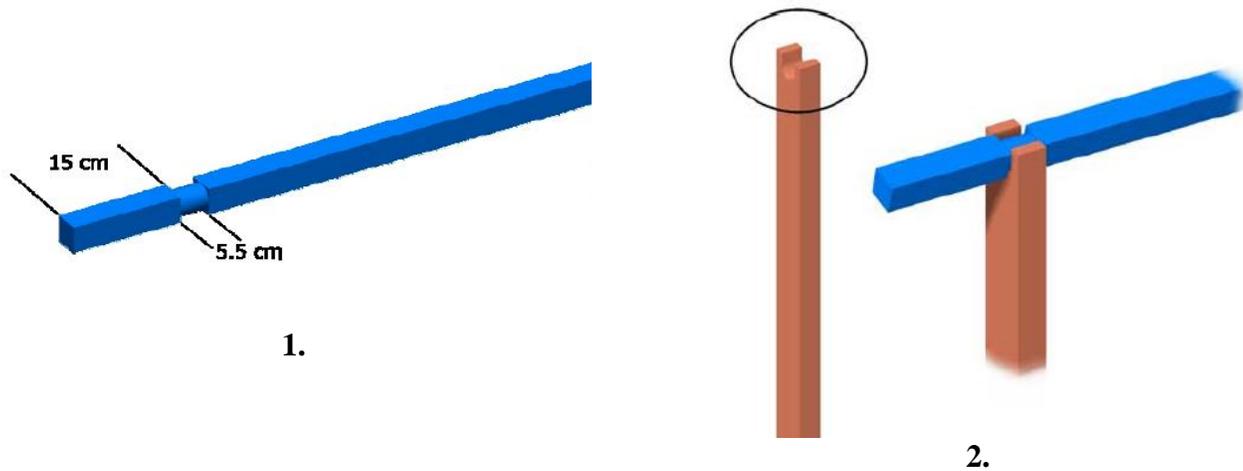
This is an example of how a wooden rope pump can be built. **Dimensions given in this description are only guidelines, and should be adjusted depending on the local circumstances and available materials.**

Required tools	
Wood saw	Wood rasp
Iron saw	Hole punch
File	Auger
Large knife (e.g. bread knife)	Sand paper
	Hammer
Scissors	

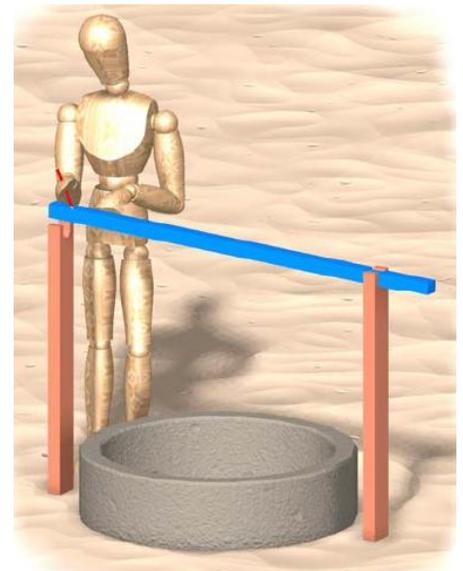
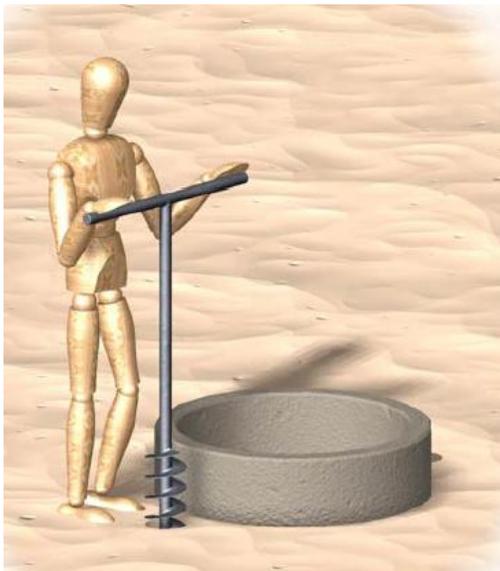
Required materials	
PVC pipes - 2 diameters	Galvanised plate
Coupling pieces	Stones
PVC glue	Rope
Inner tube (bicycle)	Nails / screws
Car tire	Bottle
Wooden poles and planks	Carbolineum and paint

The construction of a rope pump step by step:

1. The first rounding is grated with a wood grasp on one side of the axle. The length of this rounding must be a little larger than the width of the standards.

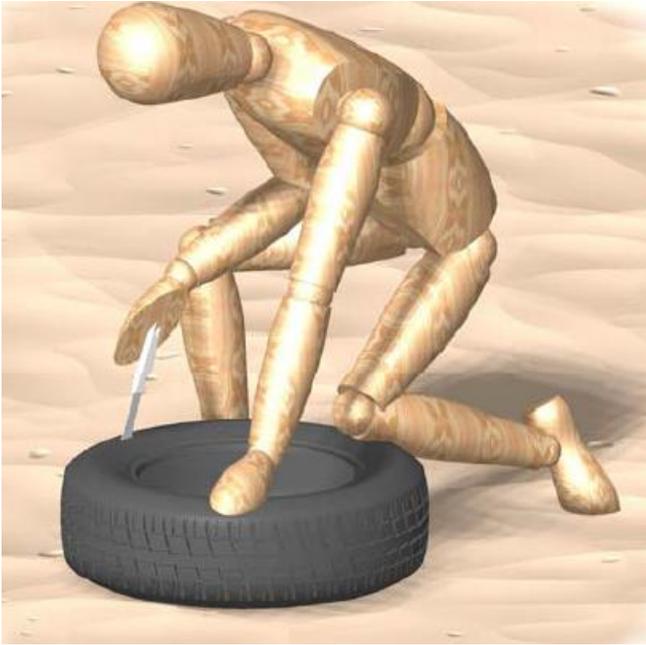


2. A notch is made at the top of the two standards in which the rounded part of the axle fits. Paint the poles entirely with carbolineum before they go in the ground. For the length of the standards, see point 3 and 4.
3. Drill with the auger on either side of the well a hole in the ground for the standards. The holes are approximately one meter deep.

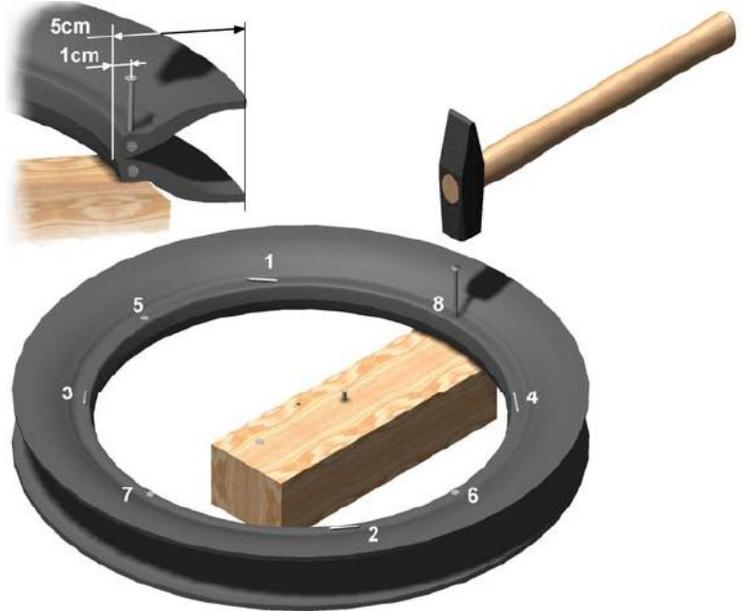


4. Place the standards in the holes. The grooves in the standards should approximately be at the height of the elbows.
5. Now that the standards are firmly in the ground, determine the location of the second rounding on the axle. Use the same dimensions for the rounding as before.

6. Cut off both sides of the tire at approximately 5 cm from the inside. You can simply use a bread knife for this job. Make the tire wet, this makes it easier to cut.
7. Nail the two half tires onto each other. Hit the nails at approximately 1 cm from the inside entirely through the two parts, and hammer the outstanding point on the backside against the tire. Use the order of nailing as indicated in the picture.

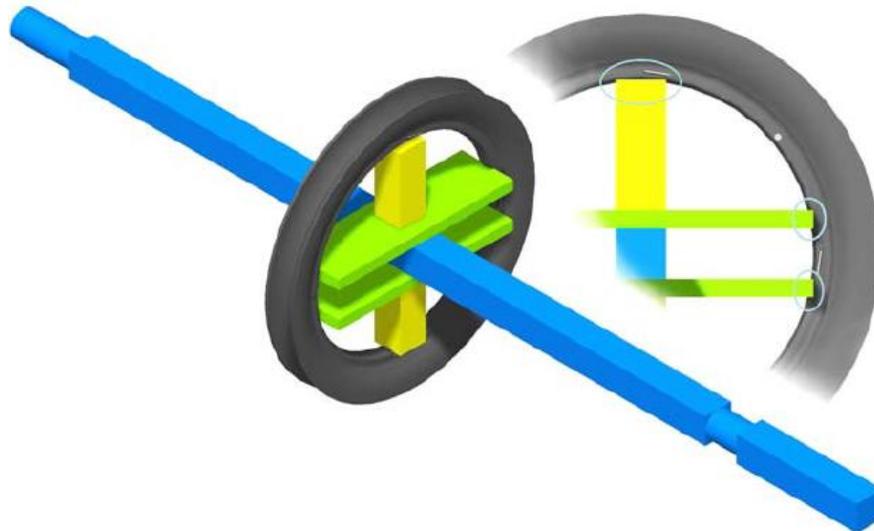


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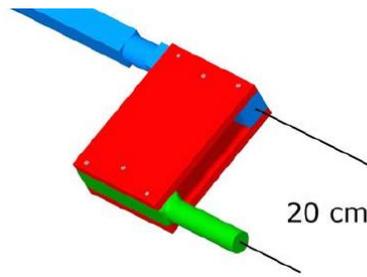
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8. Complete the wheel by assembling two planks and two short balks on the axle within the half tires. These planks and balks must be just slightly greater than the inside diameter of the tire (indicated by the circles). The tire then traps the components together on the axle. Nails or screws can be applied but are not necessary. The planks and balks should not be too large since the wheel will become square in that case.



8.

9. Attach the handle to the axle with two planks of wood. The optimal distance between the handle and the axis is approximately 20 cm. The end of the handle is rounded, so that a piece of the PVC pipe fits the handle and can move freely.

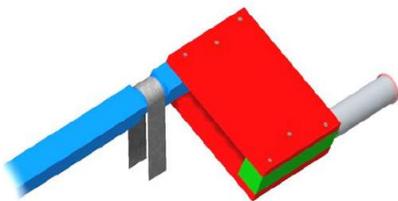


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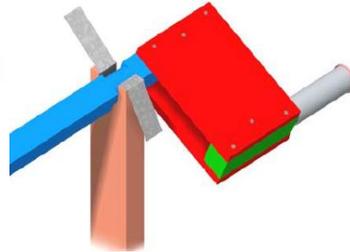


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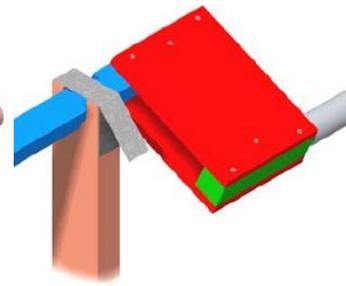
10. A jam pot cover is nailed to the end of the handle so that the PVC remains on its place.
 11. Now the bearings of the axle can be made. Take a strip of galvanised plate of approximately 38 cm long and fold this around the rounded part of the axle.
 12. Put the folded galvanised plate from the axle into the rounding of the standards and fold them back against the sides of the standards.



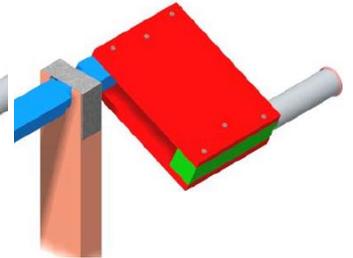
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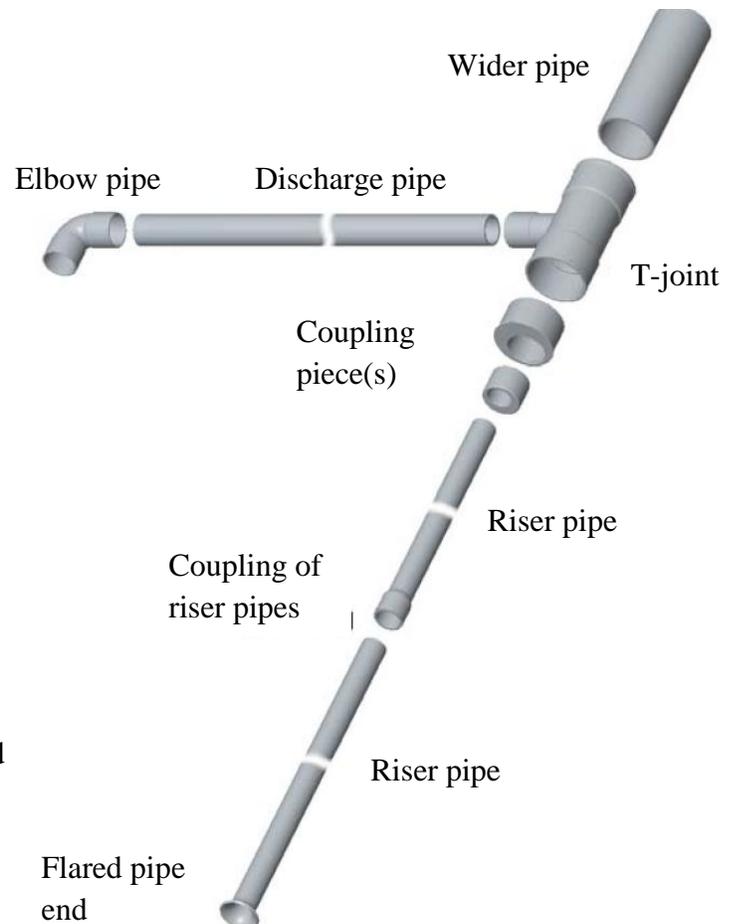


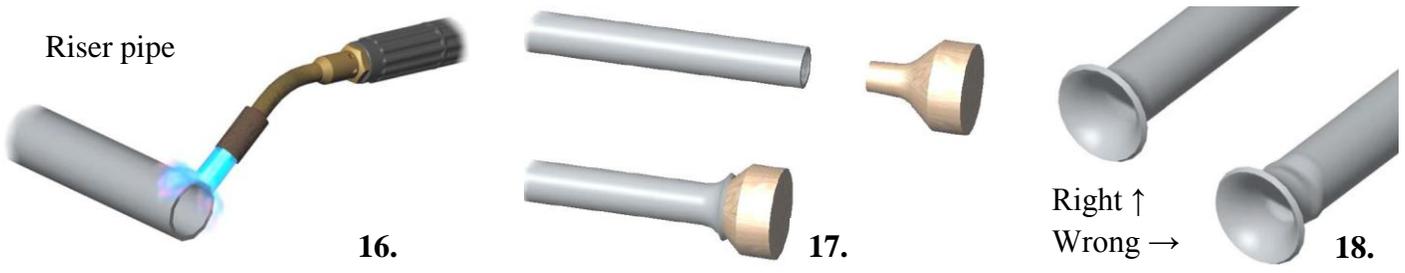
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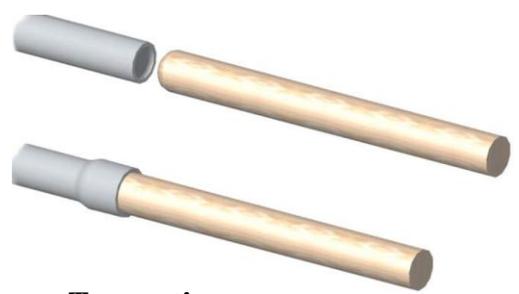
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13. Take a second strip of galvanised plate of approximately 30 cm and fold this on the top of the standards.
 14. Secure the two strips of galvanised plate to the standards with screws or nails.
 15. The pump is composed with a number of PVC components. The picture on the right shows an example how this is built. The inside diameter of the wider pipe on top must be at least twice as large as the inside diameter of the riser pipe. If the riser pipe is longer than available pipes in the store, more of them can be joined together. As the various components fit firmly in each other, it is not necessary to use PVC glue. However, the links between the several pieces of the riser pipe should be glued together. Note the direction of this coupling in the picture!
 16. The flared pipe end at the bottom of the riser pipe and the link between the various pieces of the riser pipe are easily made. The end of one pipe is heated above a fire until it becomes deformable. By rotating the end of the pipe in the fire it is evenly heated without burning.

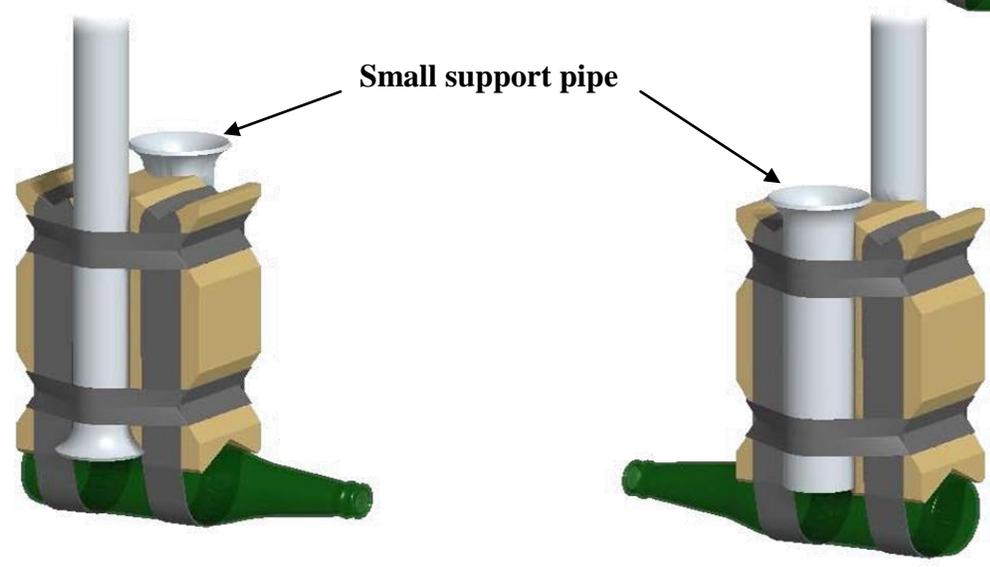
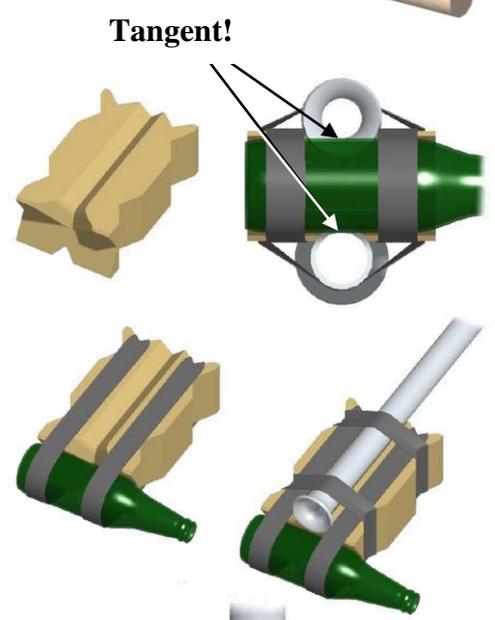




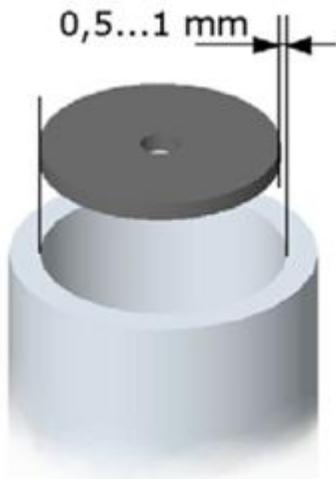
- 17. Press a bottle or a piece of rounded wood in the heated tip of the pipe and wait until the PVC is cooled down sufficiently so it does not deform anymore to its original shape.
- 18. Take care that the flared end does not have wrinkles. Wrinkles narrow the riser pipe so that the pistons on the rope can get stuck in the pipe.
- 19. Connections between the riser pipes are made by pushing a stick or another pipe of the same diameter in the heated end of a pipe.



- 20. The input block ensures that the pistons are running smoothly into the riser pipe. For this purpose, the riser pipe with flared end, a small support pipe and a bottle (or a piece of pipe) are tied together on a wooden block with strips of an inner bicycle tire. The small support pipe must be one size larger in diameter than the riser pipe. Note that the support pipe needs to be flared as well.
- Using a saw you can make slots in the wooden block to keep the various components in position. The pictures show how the input device can be constructed. In the pictures on the right you can see that the inside wall of the riser and support pipes must be tangent to the bottle diameter.



21. The pistons are fixed to the rope by knots on either side. They are produced from a rubber plate or from the remaining sides of the used car tire. The diameter of the pistons must be 0.5 to 1 mm smaller than the inside diameter of the riser pipe. If they are bigger, they get stuck in the riser pipe. If they are smaller, the pump becomes less efficient because water will leak through the gap between the pipe and pistons.
22. The pistons are attached to the rope at a distance of about 75 cm, using knots at either side of the piston.



21.



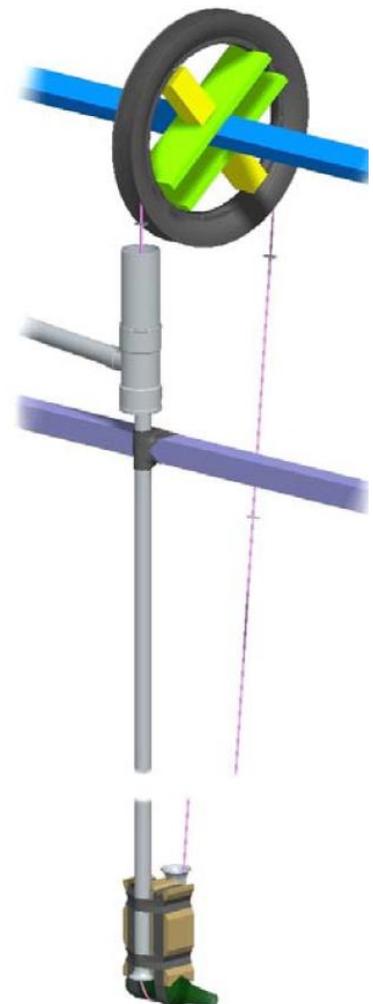
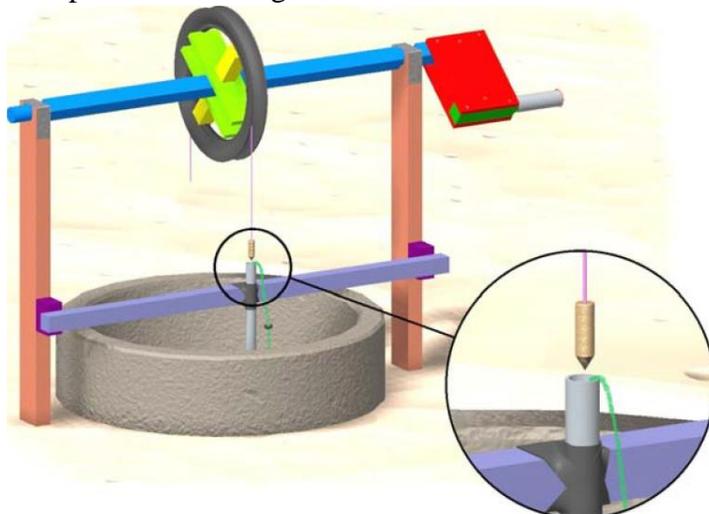
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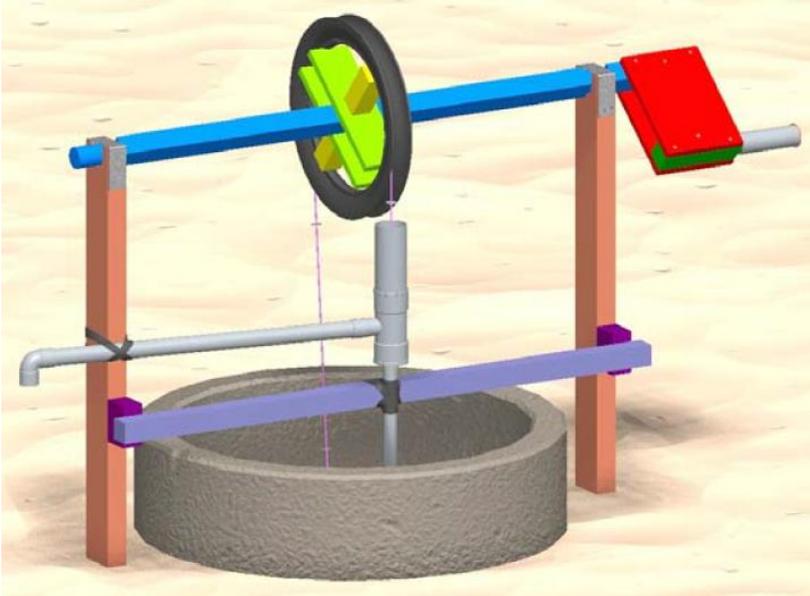
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23. Pull the rope with pistons through the riser pipe. This is done best by first dropping a thin rope with a weight through the pipe and connecting this rope with the rope with pistons. A ladder can be used to get the thin rope through the pipe, but you can also put the riser pipe in the well before you drop the thin rope with its weight through the pipe.

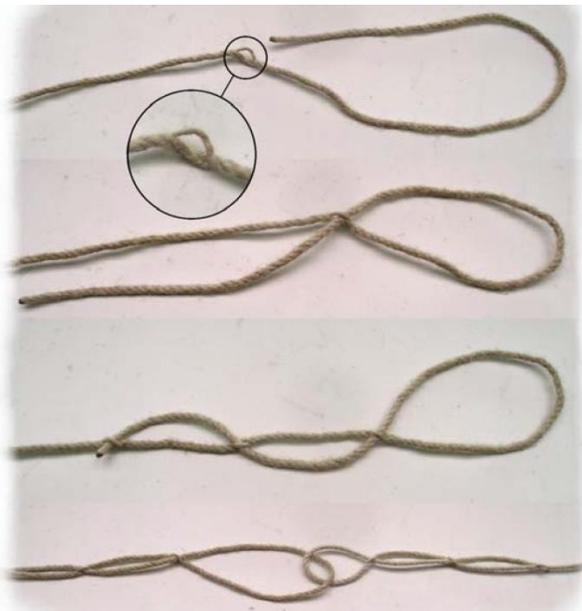
24. The riser pipe with the input block is placed in the well. Place the suspension balk in the right position, using some wooden blocks on the standards, so that the riser pipe is exactly positioned under the wheel. This can be checked with a piece of rope and a weight, as shown in the picture below. The riser pipe is tied to the beam with some strips of rubber. Ensure that the input block is positioned in the correct position under the wheel as shown in the picture on the right.



25. Assemble the PVC T-joint with the discharge pipe and the wider pipe as shown in the picture below.



26. The ends of the rope are now connected. An adjustable knot suits this purpose very well, since the tension of the rope can be adjusted, and the rope can be taken off for maintenance. Twist the rope a bit such that an opening is created and the end of the rope can be pulled through. Repeat this 2 or 3 times, so that it will not get loose anymore. Repeat this with the second end of the rope. Do not make the tension in the rope too high. This will wear out your pump too soon. When pulling the rope tight, add another 2-3 cm before tightening the knots.



Tips

- Cover the well with a lid, made of cement in two parts for example. Otherwise insects, animals and dirt can fall in the well and contaminate the water.
- Ensure that there is no water running back into the well: if dirty water is flowing back it may contaminate the clean water in the well.
- Install a gutter from the place where the discharge pipe ends to a place at a larger distance of the well, so that the environment of the pump remains clean. It is even better to provide a concrete floor in which the gutter is integrated.
- The input device of the pump should be sufficiently deep under the water to keep the pump working in times of drought.
- Pay attention if you stop pumping. Because there is column of water in the pipe, the rope can be pulled back into the well, turning the wheel with high speed.
- To tie the pipes onto the frame, you can use strips of rubber from an inner tire of a bicycle. Cut them approximately 2 cm wide. Do not use knots to fix it because they are difficult to release. The end of a rubber strip can simply be fixed under a tight loop.
- Instead of wood, iron can be used to make the wheel and its supporting construction. A welder should be available to produce it.
- If the standards are made of wood, use carboleum to paint them. This will protect them from from decaying by influence of the water in the ground. Other parts can be painted with normal paint.
- Maintenance of the pump is very important. Ensure that the pump (no matter what kind of construction, iron or wood, is used) is painted well and thereby protected from weather influences. Replace the worn-out parts in time so that the pump always continues to operate. This applies in particular for the rope and pistons.
- The use of a rope pump is not limited to a hole in which it is placed vertically. This type of pump can also be used on the slope of an embankment where water is pumped to the top.