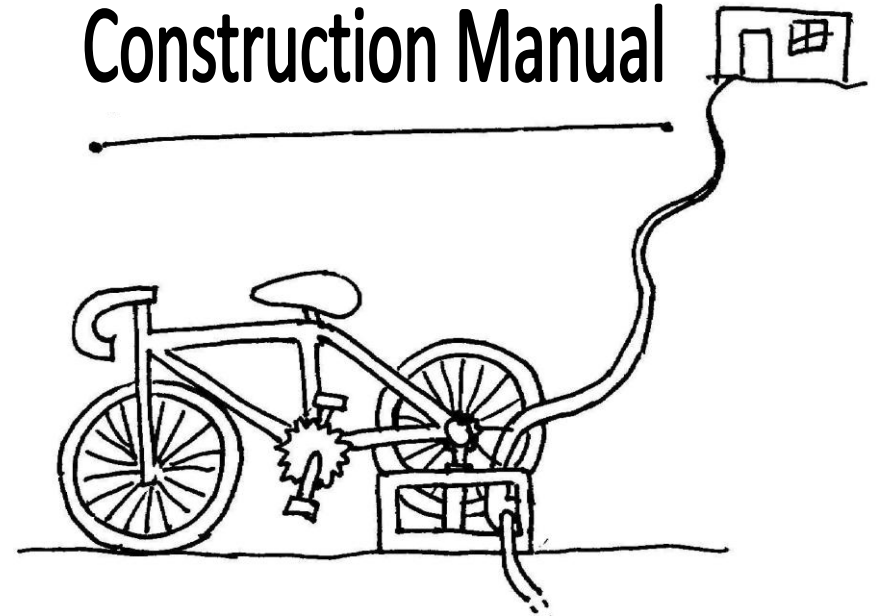


# Bicibomba Movil

**(Mobile Bicycle Powered Water Pump)**

**Construction Manual**



Designed for Maya Pedal by Jon Leary and Carlos Marroquin,  
in conjunction with The University of Sheffield (U.K.)

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# UNITS

Metric units (cm, m, W, etc.) have been used as the standard for this manual. However, a number of materials are commonly available in imperial stock sizes, e.g. 1" angle iron. Where this is the case, the Imperial stock size has been shown first, followed by the metric equivalent, e.g. 1"/2.5cm. These sizes are only a guide, so a different size is more readily available, feel free to use it where appropriate.

Imperial		Conversion factor	Metric	
Name	Symbol		Name	Symbol
----- length -----				
Inch	"	1" ≈ 2.5cm	Centimetre	cm
Foot	'	1' ≈ 0.3m	Metre	m
----- power -----				
Horse-power	hp	1hp ≈ 750W	Watt	W
----- flow-rate -----				
Gallons per minute	gpm	1gpm ≈ 4l/min	Litres per minute	ℓ/min

## *INTRODUCTION*

This manual aims to aid the construction of bicycle machines; in this case, a Bicibomba Movil (mobile bicycle powered water pump).

It's important to note that this manual should serve only as a simple guide, as it doesn't always contain exact methods. It will be necessary to use your imagination and creativity to experiment with the materials available for you to use, reuse, recycle or transform. The only limit is your own imagination.

This Bicibomba Movil works, like all the bicycle machines, with the force of your legs (which are 5 times stronger than your arms). It's a self-sufficient form of technology that doesn't require fuel or electricity.

We hope that, as far as possible, this will help clear up any doubts you may have and if not you are of course more than welcome to contact us using the information at the end of this manual.

## *SAFETY*

The construction of the Bicibomba Movil requires the use of power tools, such as an angle grinder or a welder. Power tools must be used with care as they can cause serious injury if used incorrectly.

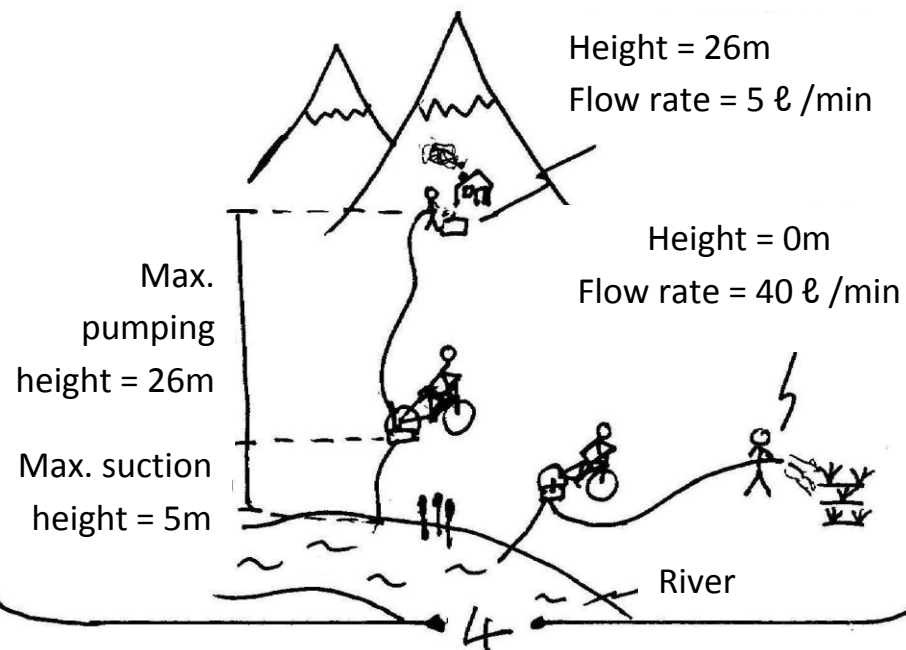
## PERFORMANCE SPEC.

The Bicibomba Movil has been designed to move water from one place to another. It's also possible to move the machine from place to place by carrying it on top of the back wheel of a bike like a pannier rack. Thus making it ideal for watering/irrigating crops, shifting river water up a hill, pumping to an elevated tank, etc. It works by pushing water and as a result, can only suck water up from up to 5m below the pump. Therefore, it's not great for lifting water out of wells. Maya Pedal have another machine for this task, the Bicibomba Para Pozo, aka the Bicibomba de Lazo, which can extract water from deep wells up to 30m.

An average person can only really sustain around 100-200W ( $\frac{1}{8}$ - $\frac{1}{4}$ hp) on a bicycle. Therefore, it's important to select a pump with a similar power rating.

It's better to go bigger than smaller, because overspeeding the pump can damage it. Around 200-400W ( $\frac{1}{4}$ - $\frac{1}{2}$ hp) should be about right.

On flat ground, with a good pump and peddler, it's possible to pump up to 40 litres/min of water. Pumping to a higher level requires more effort and therefore more time to pump the same quantity of water. The pump has been tested up to 26m (with a flow rate of 5 l/min).



## MATERIALS

- A bicycle of any shape or size, the only requirement is that it doesn't have a 'quick release' style rear wheel (although the design could easily be modified to take account of this if necessary).
- A 140cm length of strong angle iron ( $1\frac{1}{2}$ "/4cm width).
- Two 84cm and two 34cm lengths of lighter angle iron (1"/2.5cm width).
- Two bicycle chasses (only the seat tube is required, so the condition of the rest of the frame is not important).
- Two quick release levers for the seat tubes.
- 60cm of  $\frac{3}{8}$ "/1cm diameter construction rebar (steel bar).

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- Two seat posts that fit snugly into the seat tubes. If possible, chose seat tubes that are 25cm long or more, but if not, it's possible to weld tubes of identical diameter together.
- Two large 15cm sockets (i.e. from a socket set – they are actually tools, but they will be used as part of the machine) with  $\frac{1}{2}$ "/1.25cm drive, ideally with a small hole between both sides so that the body, but not the head, of a bolt can fit through. See p9/15-19 for details.
- Two 15cm lengths of 1.5cm diameter threaded bar with six nuts.
- Four 9cm strips of  $1 \times \frac{1}{8}$ "/2.5x0.3cm steel.
- Other nuts and bolts as required.

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- An electric centrifugal water pump of around ½hp/350W . The electric motor can be broken, as only the mechanical parts (axle, casing, bearings and impeller) are required.
- Pump adaptors for inlet/outlet tubes.
- Silicon sealant.
- Inlet/outlet tubes of the required length (inlet tube must be rigid because it has to suck up the water).
- Check valve (to keep the water inside the inlet tube).
- A 10-15cm strip of rubber from an old bicycle tyre to wrap around the pump axle.
- Wire to attach the rubber to the pump axle.

7

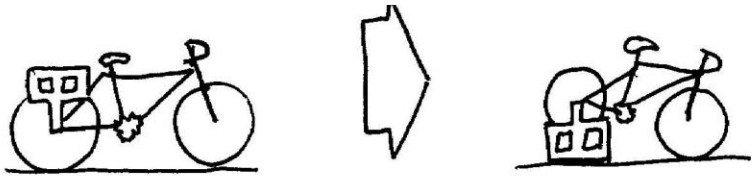
## TOOLS

- Welding equipment
- Grease/oil
- Screwdrivers
- Hammer
- Spanners
- Angle grinder
- Drill and drill bits
- Clamps and vice
- Spray paint
- Sandpaper
- Measuring tape
- Pliers

8

# DIAGRAM

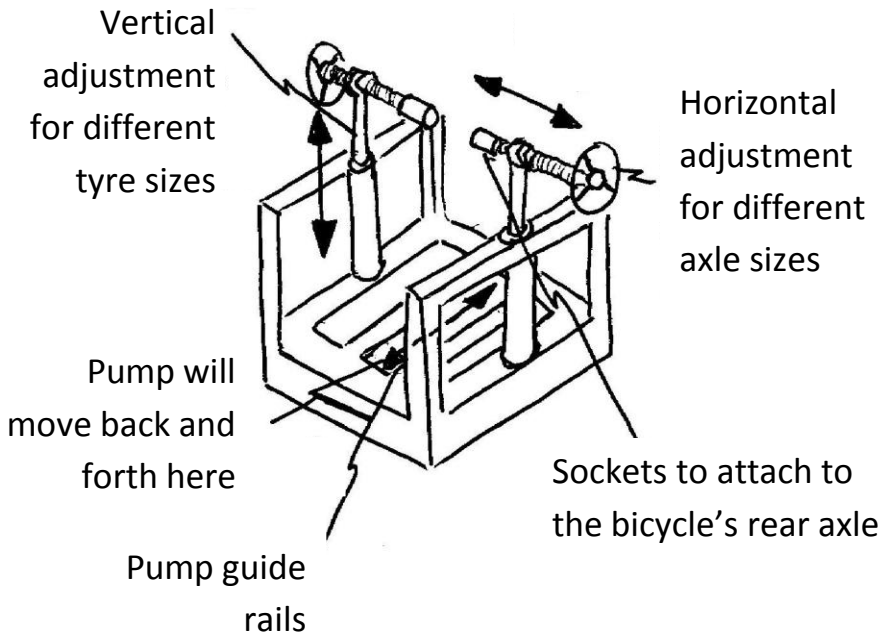
The finished product will (hopefully!) look like this:



TRANSPORTATION MODE

PUMPING MODE

It's possible to carry the frame and the pump on top of the bike, just like a pannier rack.



# CONSTRUCTION METHOD

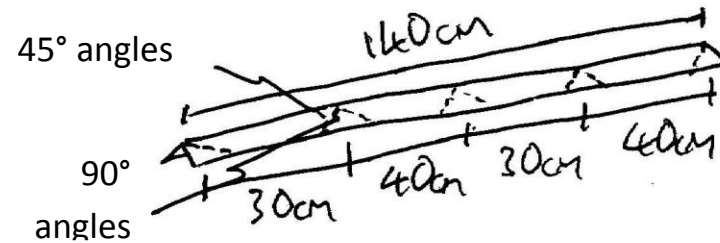
1

Where do we start?



- First, construct the base:

- Using the strong angle iron, measure and mark out the following:

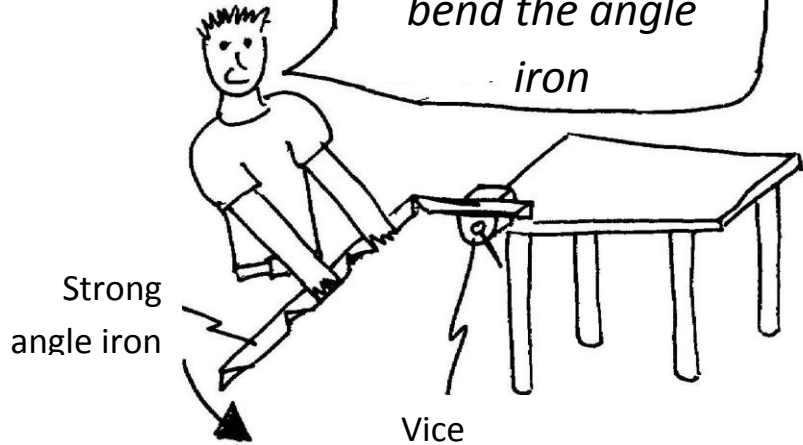


- Next, cut out and remove the 5 triangles shown above.

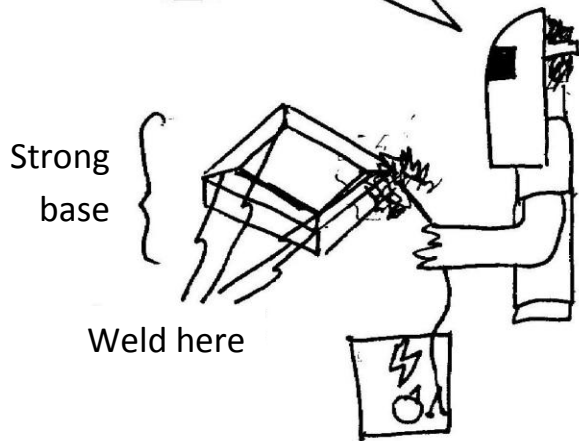
Now we need to form it into a rectangle



Use the vice to bend the angle iron



Weld in the corners to create the strong base



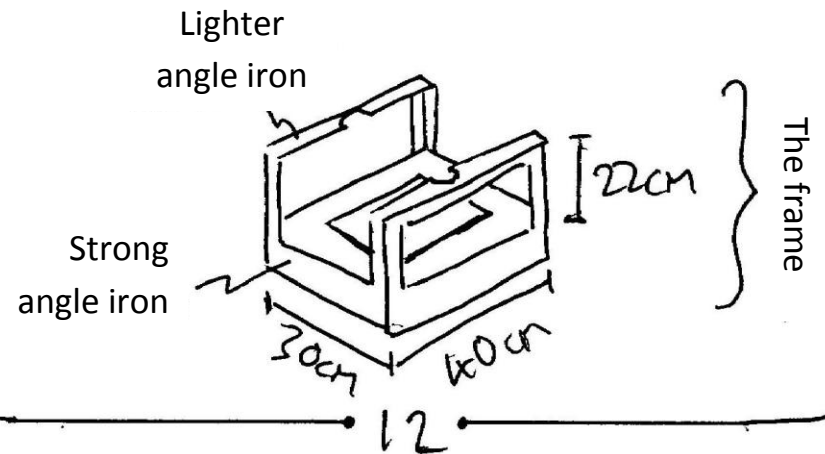
2

Then we measure & cut the rest of the frame from lighter angle iron



- 2 identical pieces:
    - 45° angles
    - 3-4cm diameter semi-circle
- 
- 90° angles
- 22cm 22cm 22cm 22cm
- 84cm

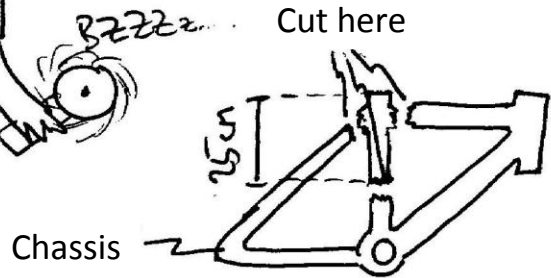
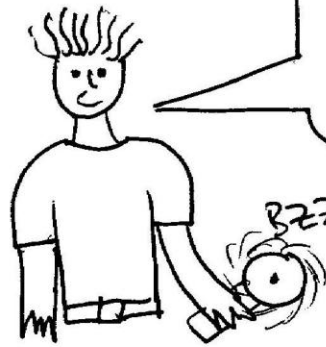
- Bend and weld the 2 identical pieces, as before, and then weld to the strong base to form the frame.





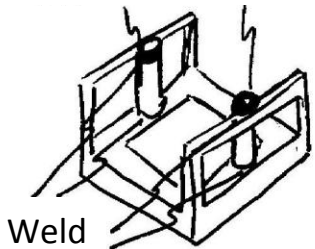
3

Now for the fun part!  
Remove 25cm of the  
seat tube using the  
angle grinder



- Smooth off the jagged edges of the piece of seat tube with the angle grinder.
- Repeat with another chassis.
- Weld the 2 tubes onto the frame:

Seat post clamps



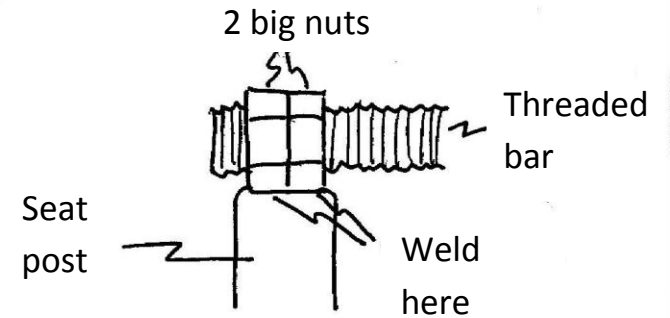
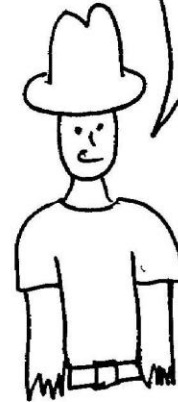
Weld here

- It's important to remember to put the seat post clamp at the top.

4

- The next step is to make the adjustable posts:

It's really simple – all we  
have to do is weld 2 big nuts  
on top of each seat post

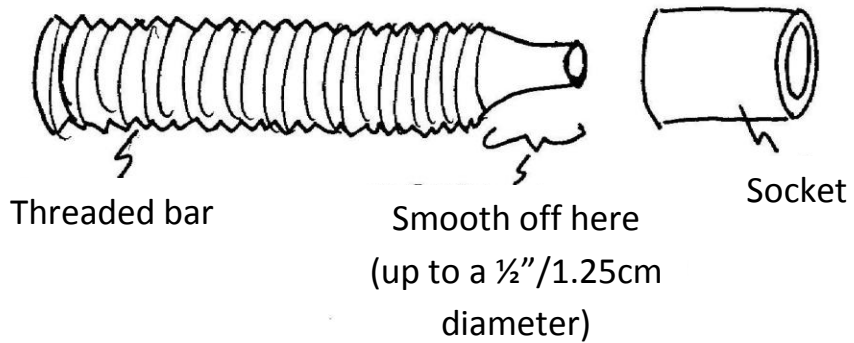


- It's essential that the 2 nuts are aligned correctly, so that the threaded bar can turn smoothly inside them. Therefore, it's necessary to weld the nuts in place with the threaded bar inside them.

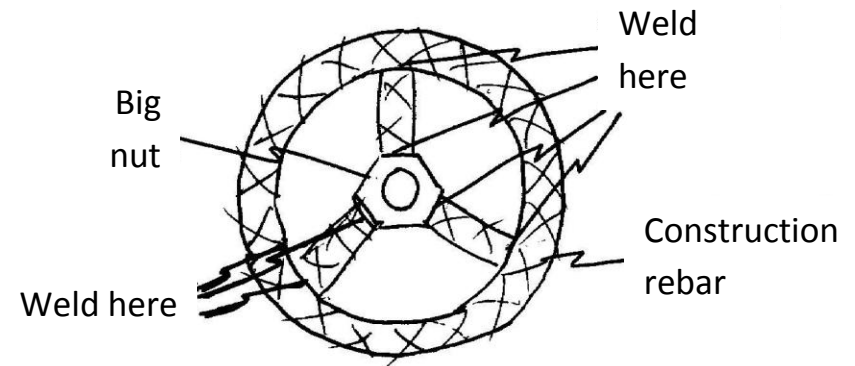
5

- Next, make the axle grips:
- First, smooth down one end of each of the 2 lengths of threaded bar with the angle grinder, so that it can turn freely inside the 1/2"/1.25cm drive end of the socket.

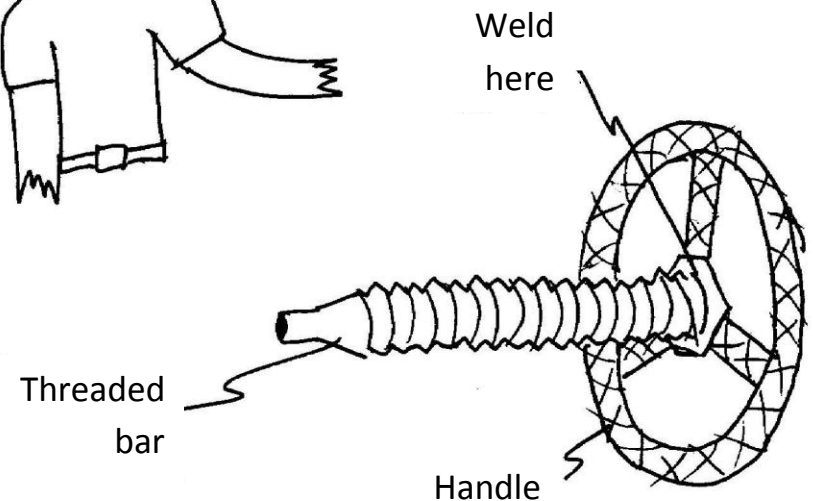
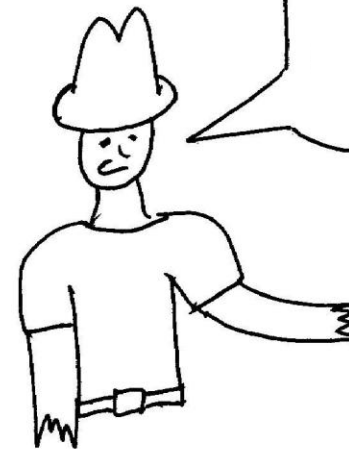
*The socket will attach to the bike axle, whilst the threaded bar will rotate inside it to tighten it on*



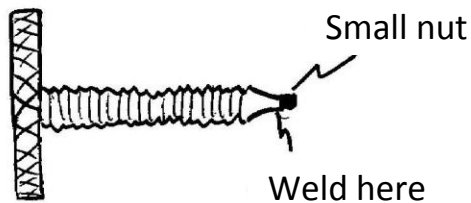
- Make the handles as shown below:



*Then we weld them onto the threaded bars like this:*



- Weld a small nut to the end of each piece of threaded bar as shown:



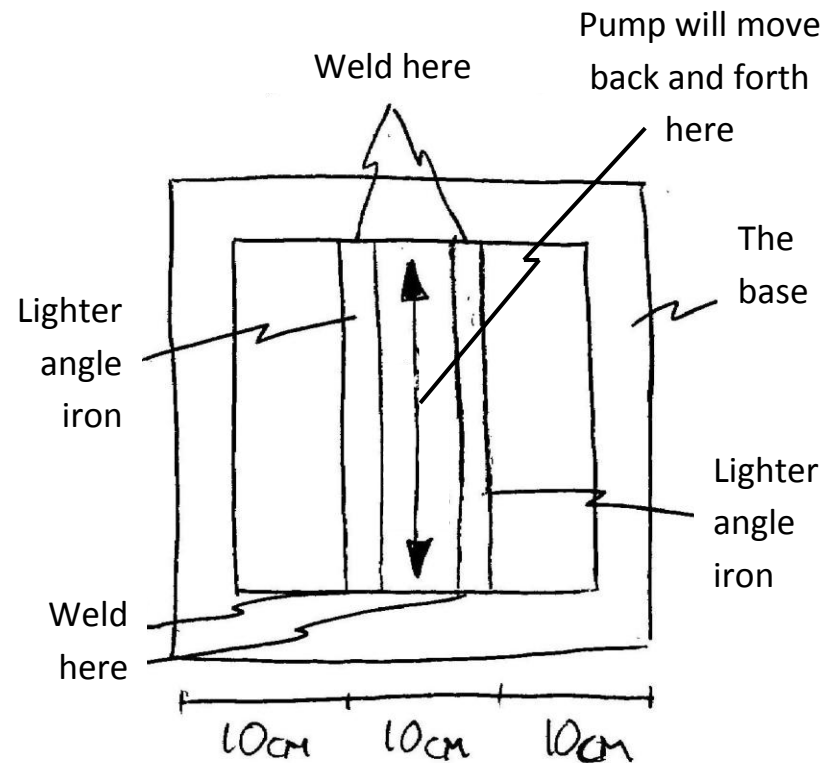
- Finally, place the sockets on the ends of the lengths of threaded bar and fasten them in place with a small bolt.

*We must take care not to tighten the screws too much, as the sockets must turn independently of the threaded bar*



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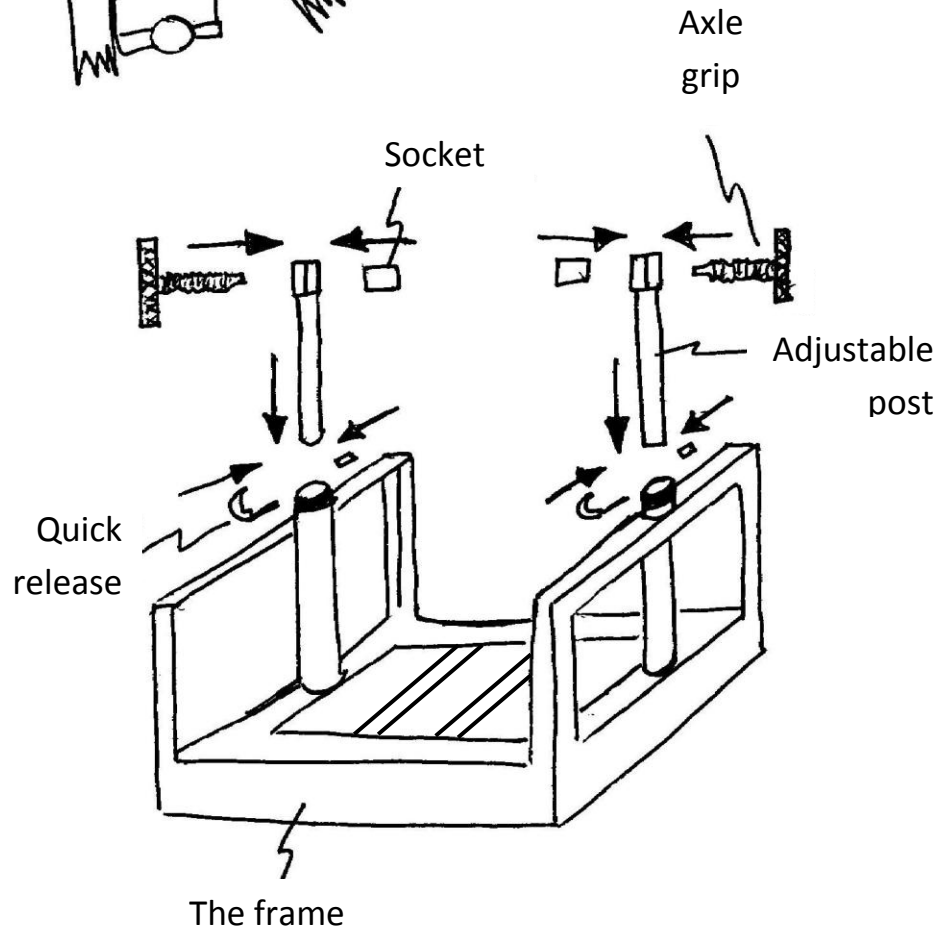
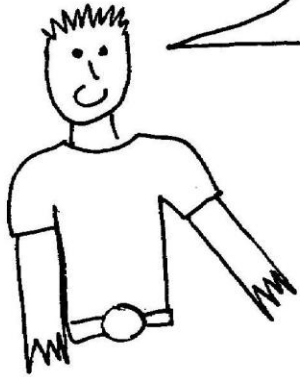
- The next stage is finishing off the frame by adding guide rails for the pump.
- Weld two 34cm lengths of lighter angle iron side by side as shown:



VIEWED FROM BELOW

7

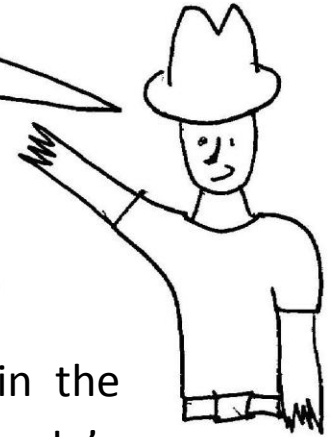
Now, we need to  
reassemble the parts



19

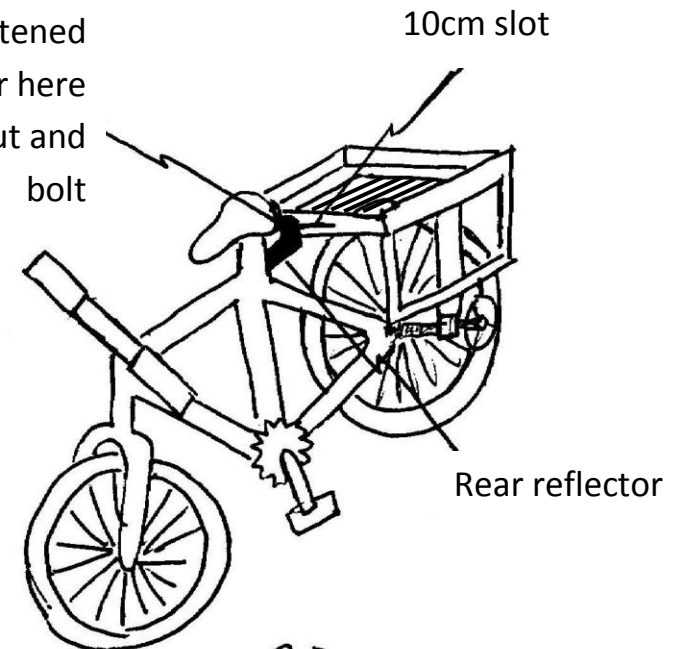
8

How does the frame  
attach to the bike  
when it's inverted in  
transportation  
mode?



- It's simple: cut a slot in the base and take off the bicycle's rear reflector, so that the two can be fastened together using a nut and bolt.

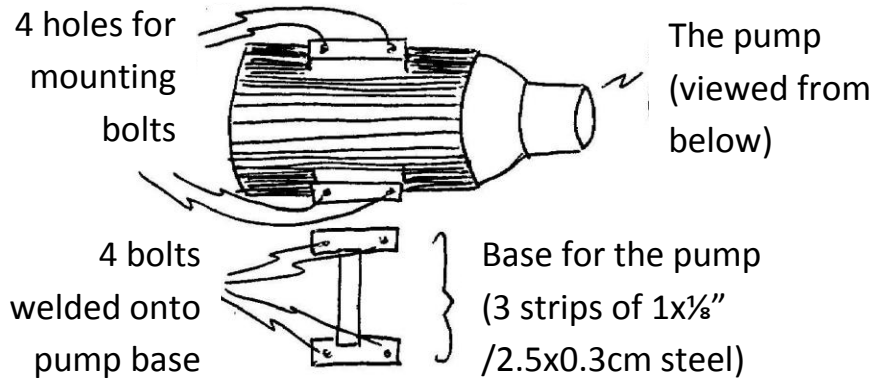
They're fastened  
together here  
using a nut and  
bolt



20

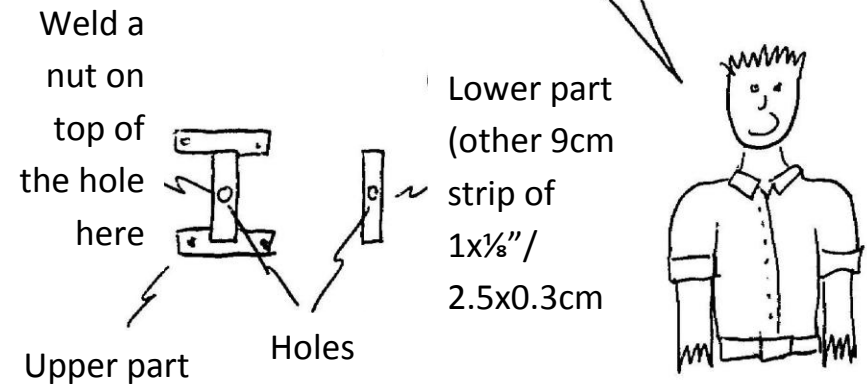
9

- Next, make a base for the pump.
- Use the pump itself as a guide for the size and positioning:

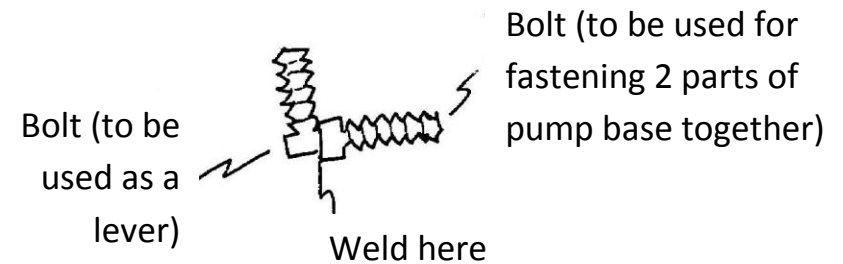


- The pump is held in place using 4 bolts welded onto the pump base and 4 nuts to keep it there.
- After this, drill a hole in the centre of the piece, as well as in the centre of the fourth 9cm strip of  $1 \times \frac{1}{8}$ " /  $2.5 \times 0.3$ cm steel that will become the lower part of the pump base.

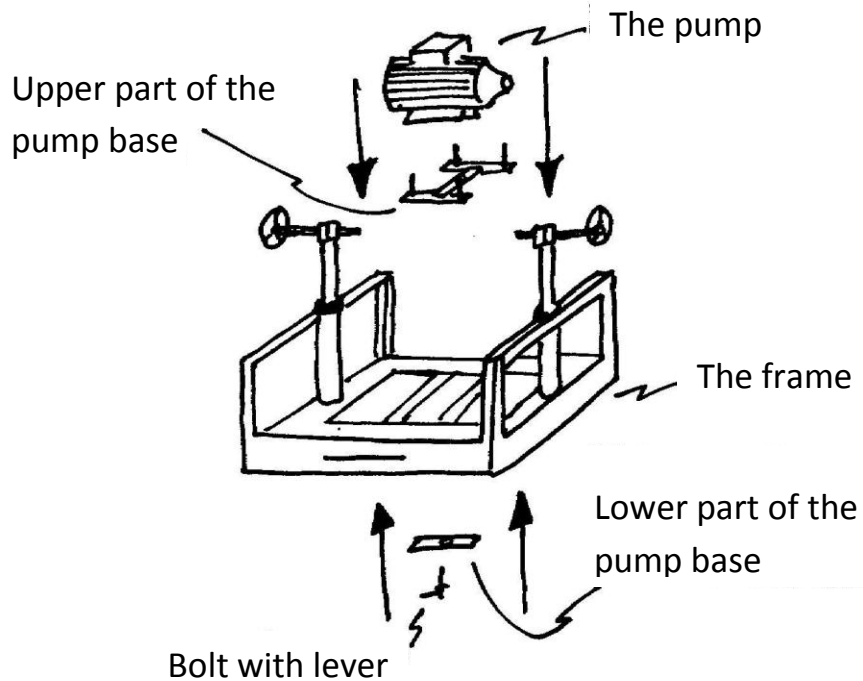
Drill the holes like this:



- Then weld a nut on top of the upper part of the pump base.
- The two pieces will be held together by a bolt. A lever is needed to help turn the bolt when the machine is assembled. Another bolt is ideal:



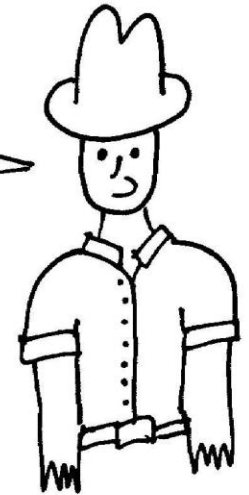
- Assemble the parts as shown below:



*Ah! Now we'll be able to move the pump to where we want it and fix it there using the levered bolt.*

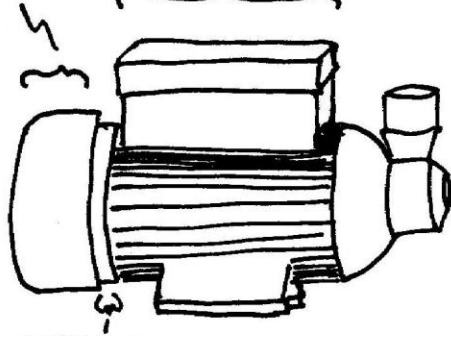
- 10
- The next stage is to get rid of the pump's electric motor:

*How do we get the pump apart?*



- Follow the steps below to dismantle the pump (see diagram on next page):
  - Take off and discard the fan and its case.
  - Carefully take off and set aside the back casing.
  - Remove the cylindrical casing containing the electric motor.

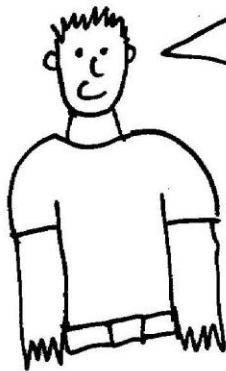
Fan casing



Cylindrical casing containing the electric motor

Back casing

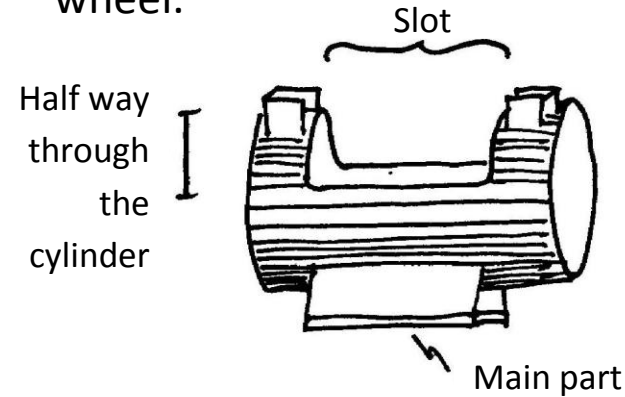
- Strip out all the electrical parts, including the cylindrical magnet inside.



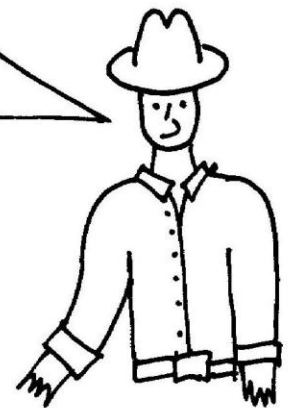
*Be really careful when removing the magnet, as the cylindrical casing is very fragile*

11

- Now the pump is ready to be converted to bicycle power.
- To do so, cut a wide slot into the cylindrical casing for the bicycle's rear wheel.

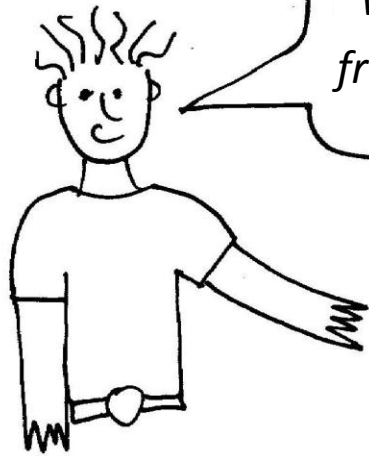


*Make sure the edges of the slot are smooth, or we might pop the bike's tyre later!*

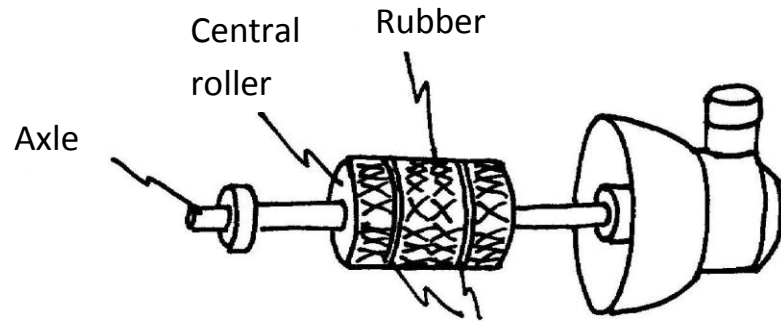


12

- To improve the traction between the pump axle and the tyre, wrap the central roller in rubber.



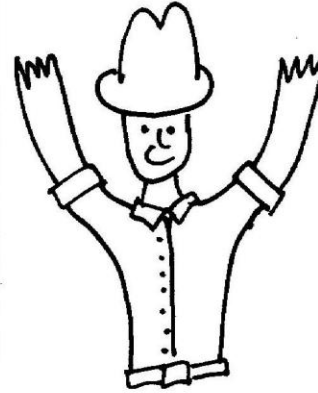
*Why not use rubber from an old bike tyre?*



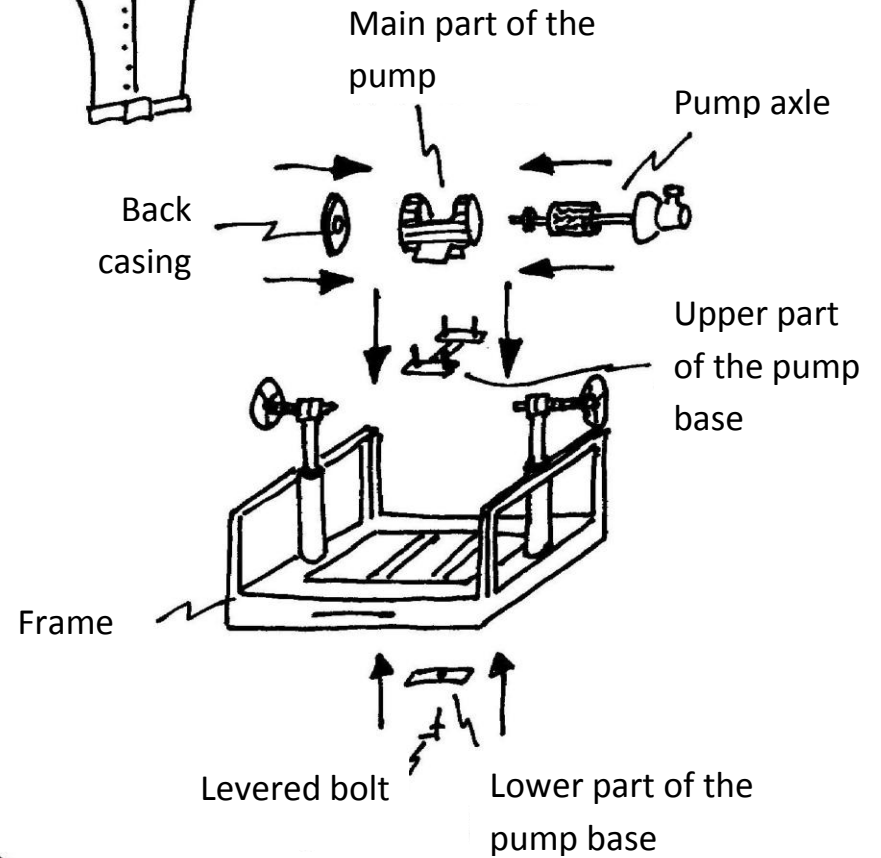
Fix the rubber in place with wire  
(take care to blunt off the ends, as it could cause a puncture later on)

13

- Next, put the parts of the pump back together and then back onto the frame using the pump base.



*We're almost done!*

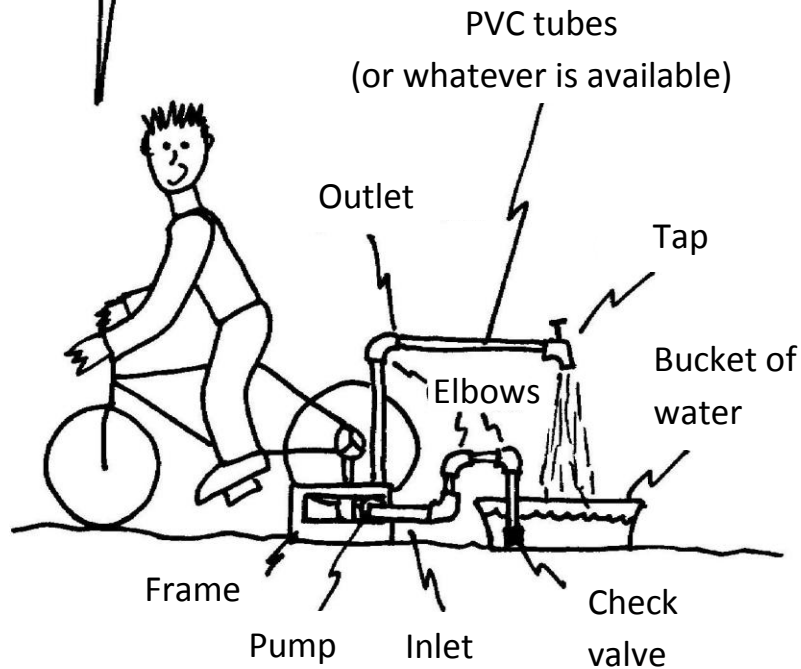




14

Let's put the machine to the test!

- Assemble the following system:



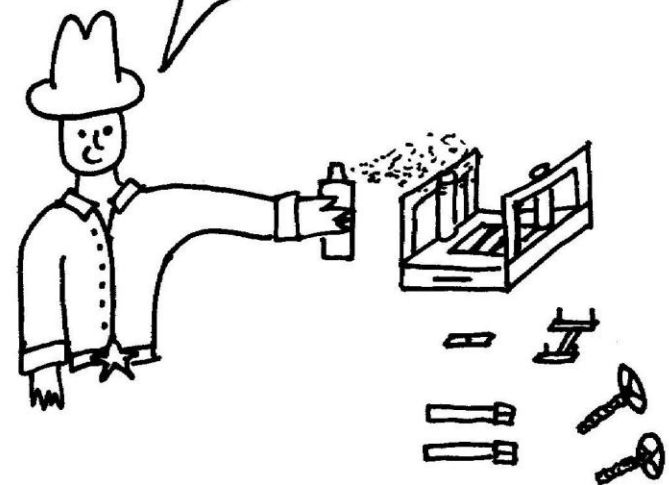
- The pump must be primed (filled with water) before using. Fill it from the top and the check valve will keep it in. Make sure the seals on inlet side are airtight (use silicon sealant where necessary).

29

15

- If everything works as planned, all that is left to do is disassemble the parts (where necessary) for painting to prevent rust.

How pretty!

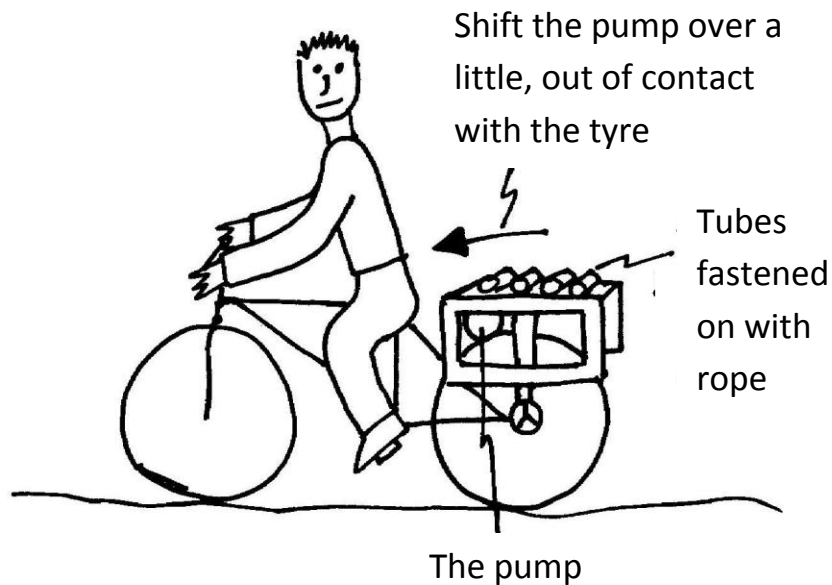


- Remember that some parts may not fit back together so smoothly after painting, so choose carefully which parts to paint and how.

30

## NOTES

- As previously shown, the frame can be inverted and used as a pannier rack to carry other things (such as the tubes).
- BUT... it's important to adjust the position of the pump using the pump base, so that it is no longer in contact with the tyre. If not, dirt, mud, stones, etc. could get caught between the tyre and the pump and break it.



## NOTES

From here, there are hundreds of uses for the machine: pumping to an elevated tank, supplying an irrigation system, a network of tanks and tubes to pump higher than 26m....



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By Jon Leary – jonnylsemail@gmail.com

For Maya Pedal – www.mayapedal.org

– San Andrés Itzapa,

Chimaltenango

Guatemala, C.A.