



INTERNATIONAL JOURNAL FOR ENGINEERING APPLICATIONS AND TECHNOLOGY

Bhramari Ventilator.

A Low cost, low resource alternative to mechanical ventilator.

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Introduction.

In the light of the ongoing COVID-19 pandemic, we propose a low cost, low resource, easy to make alternative to a mechanical ventilator i.e. easy to make CPAP. The proposed device, named as *Bhramari Ventilator*, is not intended to replace a mechanical ventilator, but act more like a first aid or help to a respiratory distressed patient.

The device is based on the technique known as Continuous Positive Airway Pressure (CPAP). CPAP is a commonly used technique for patients experiencing respiratory distress. In brief, what CPAP helps achieve is by applying continuous positive pressure to a patient's airway, the alveoli (air sacs) in the patient's lungs are prevented from complete collapse and helps in proper diffusion of air inside the lungs. This technique is already known to help reduce mortality rates. (Milliner,*et.al.*, 2019).

In developed countries, CPAP is generally applied using costly mechanical ventilators, which also regulate a patient's respiratory cycle. While mechanical ventilators are no doubt the best weapon in this war, one can arrive at a plausible scenario where we have a shortage of ventilators. Note that as mechanical ventilators are highly complicated equipment, manufacturing them on a massive scale in a very short period of time is not possible. Mechanical ventilators also requires very high skill person. In such a scenario, we propose the following - use *Bhramari Ventilator* for less serious patients based on bubble CPAP & use mechanical ventilators for more serious & critical patients. *Bhramari Ventilator* could be used as a first line of defence in this war against COVID- 19. Fig- 1, 2 & 3.

Benefits

1. Low cost, low resource device.
2. Zero energy device.
3. No special skills required for operating this device.
4. Can be used in remote areas.
5. Easily manufactured at home.
6. High portability.

Proposed device design & working

Bhramari Ventilator consists of the following components-

1. Face mask
2. Pipe for air flow
3. Water bottle

A schematic diagram of the same:

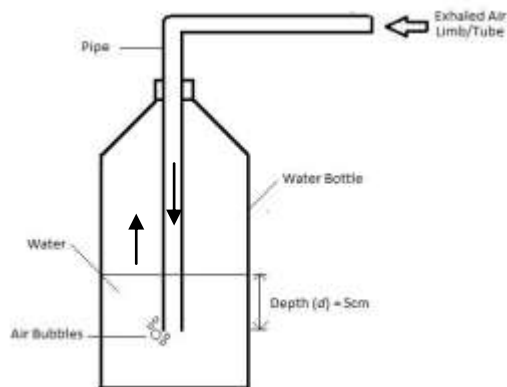


Fig 1. Schematic diagram

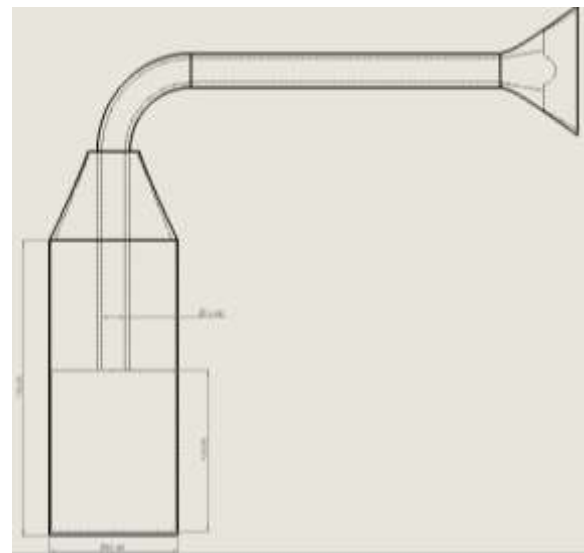


Fig 2. Engineering drawing

Using simple fluid mechanics, one can evaluate the constant pressure that the patient will feel while exhaling. Let ' d ' denote the depth of pipe below the water surface. Then the additional pressure ' P ' experienced by the patient while exhaling air is equal to -

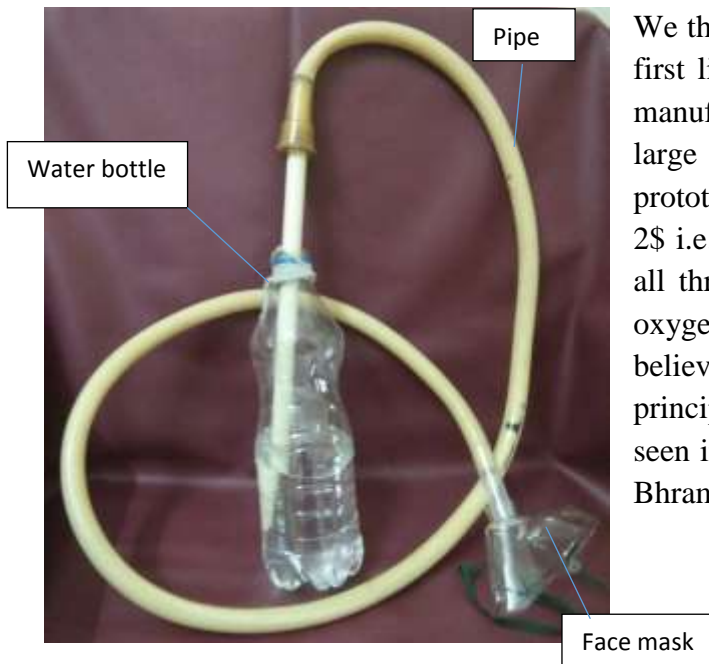
$$P = \rho * d * g$$

where ' g ' is the acceleration due to gravity

& ' ρ ' is the density of water

Note that added pressure or CPAP ' P ' can be adjusted by adjusting the depth ' d '

Prototype made from materials at home



We think this device may be useful as a first line of defence as it can be easily manufactured at homes as well as on large scale. Also, the cost of the entire prototype was estimated to be less than 2\$ i.e. less than 150 Indian rupees with all three components. We could attach oxygen supply if require. We also believe that this device uses same principle of passive respiration as that seen in high altitude flying insects & in Bhramari type of pranayam in yoga.

Fig 3. Prototype made using materials at home

Reference

Milliner, B. H., Bentley S, and DuCanto, J. A. (2019). A pilot study of improvised CPAP (iCPAP) via face mask for the treatment of adult respiratory distress in low-resource settings. *International Journal of Emergency Medicine* (12): 7 <http://doi.org/10.1186/s12245-019-0224-0> dt. 25/3/2020.

Declaration

1. The materials, concept diagram & device prototype were not approved by FDA or any other competent medical authority.
2. All designs are intended for investigatory use. The device has not been tested till date.
3. If anyone wants to call or name this device, he/she can name it as '*Bhramari*' device.