Automatically Compressed Manual Resuscitator Bag

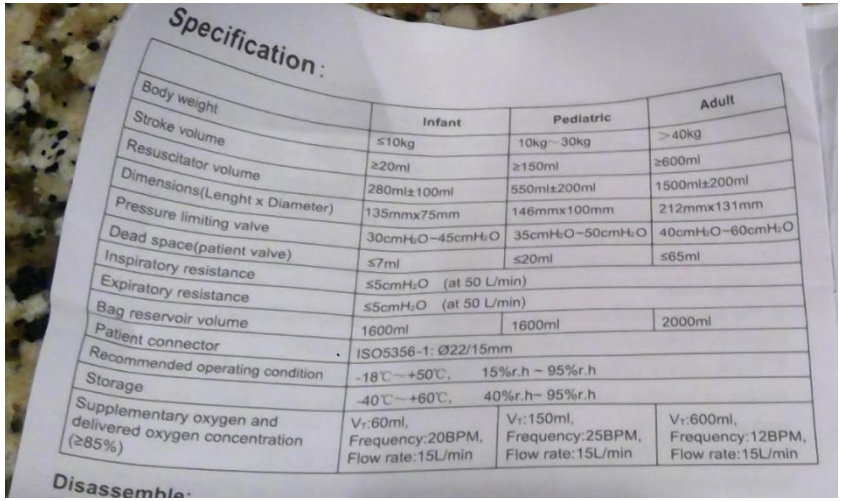
- Goal – Provide alternative low cost, easy build ventilation options for overwhelmed hospitals during COVID-19 crisis
- Limitations – Low cost, easy to produce and field, uses existing available medical equipment (manual res. Ambu bag) and off the shelf or low cost build hardware. No or low programming required. Distributable for build by whoever needs & has capability to do so. Aim for simple & effective.
- Concerns – I'm not an engineer nor a healthcare professional, these are concepts
- Inspiration - All those who may need emergency but not critical ventilation due to COVID-19 ARS
- Needs – input, feedback, oversight, teamwork…does this make sense?
- If this gets you thinking take it and run with it, no attribution req'd
- Other similar efforts
  - https://www.theblaze.com/news/rice-u-develops-low-cost-ventilator
  - https://news.rice.edu/2019/05/01/student-invention-gives-patients-the-breath-of-life-2/

Starting points/materials/requirements

- Motor
  - Many DC motors have high RPM
  - Avoid gearbox reduction if possible for reduced complexity
  - Must have torque necessary to compress bag in both concepts
  - ~5RPM High Torque 12V can lift 15kg? <$30

- Ambu / Manual Bag
  - Allows for Oxygen inlets
  - Will require restraint or cradle to hold bag in place & provide counter pressure
  - Readily available & adaptable
  - <$20 from Red Cross

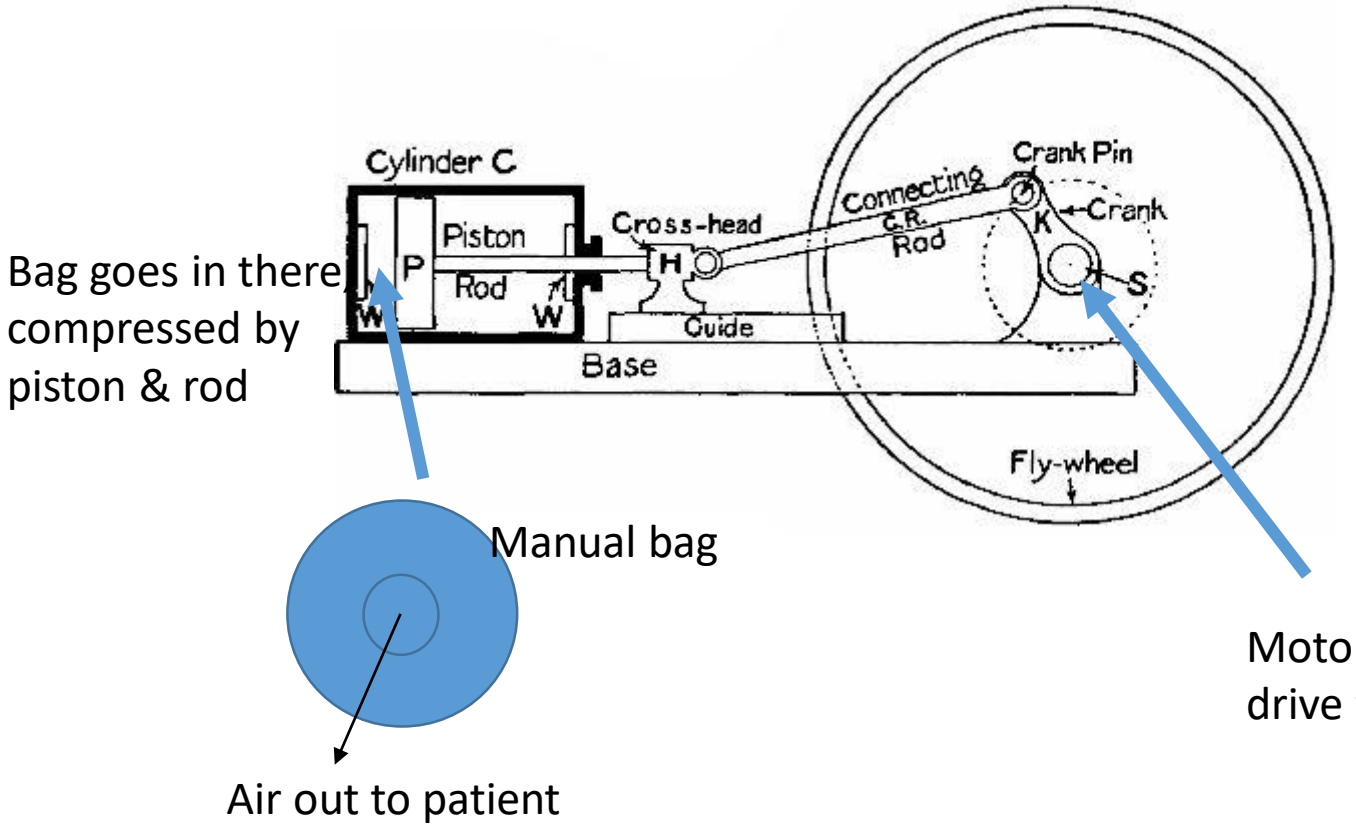
- Requirements
  - Must produce required airflow volumes for adult
  - Simplicity & effectiveness
  - Distributable
  - Reliable / low mnx / MTBF
  - Low cost build <$300 USD
  - Near term fielding <1mo
  - Funding – low, crowdsource, individually fund, or seek organizational funding



Concept 1 Locomotive / Flywheel style

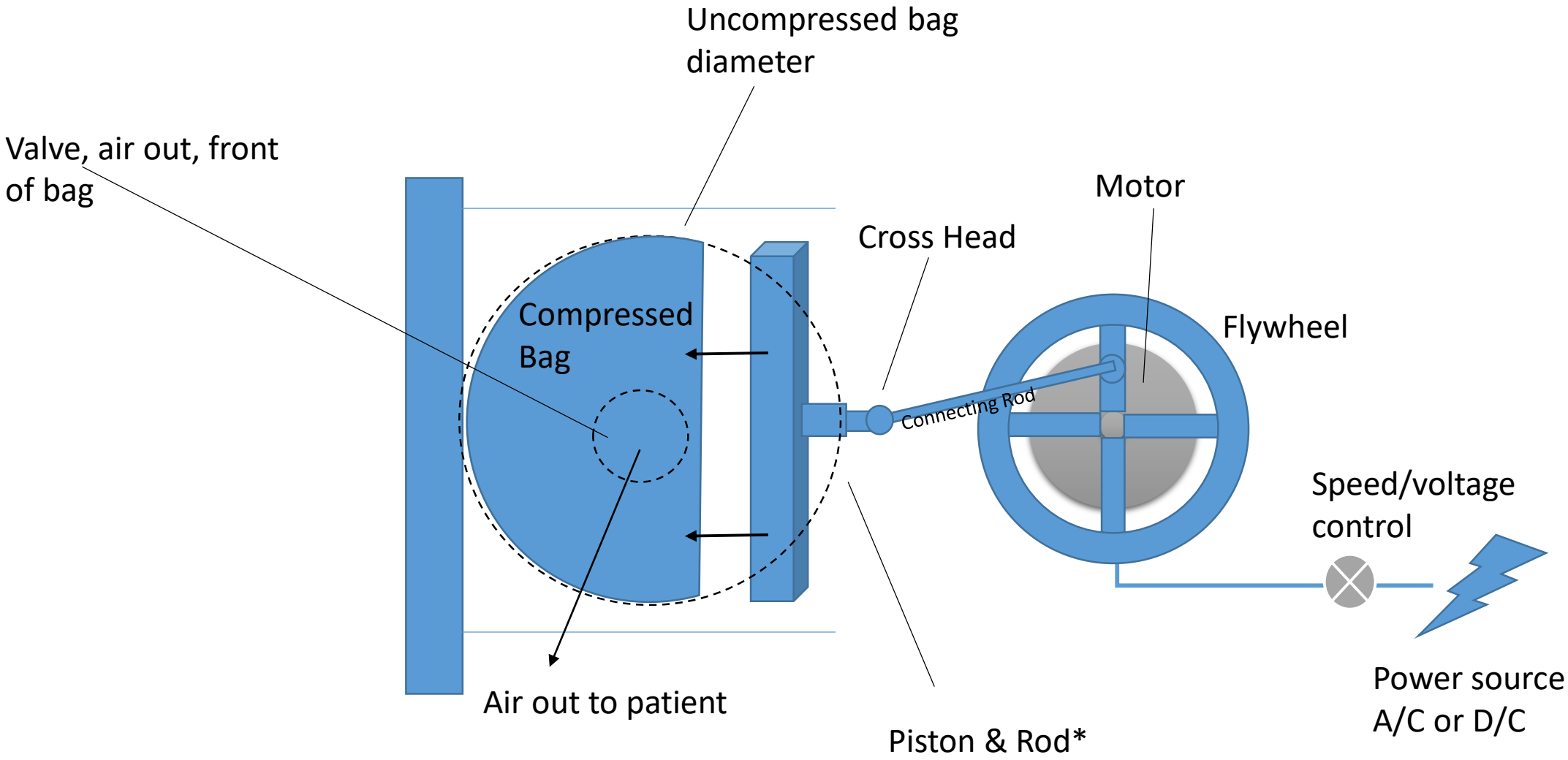
- Benefits
  - Relatively simple, this technology has been around forever (steam engines)
  - Easily translates circular motion into directional piston motion to compress bag
- Concerns
  - Requires build of piston guide and crosshead
  - Slightly more complex than Concept 2

Flywheel Locomotive style



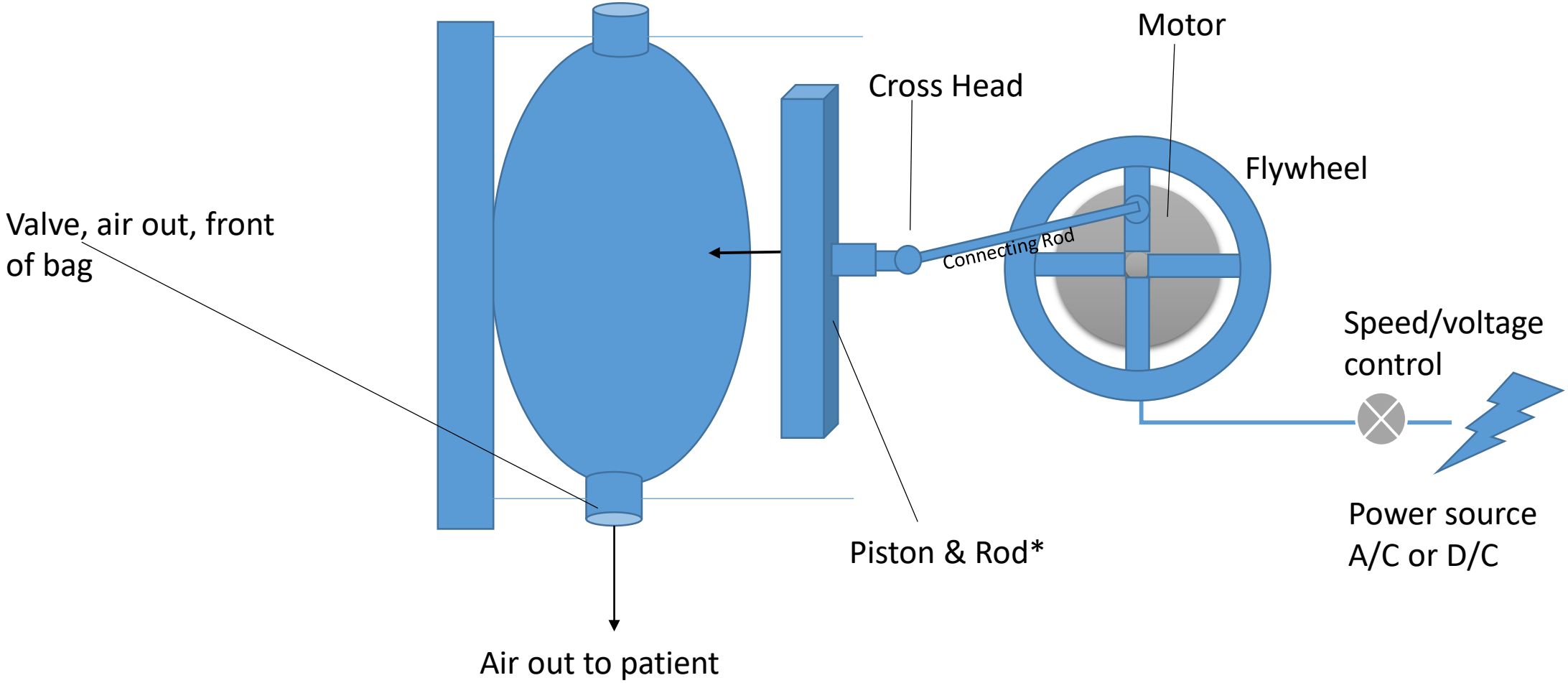
- Similar to diagram, but wheel drives piston compression
  - Instead of the piston driving the flywheel and crank & rod, the motor drives the axis of the flywheel
  - Manual resuscitator bag placed between piston and wall
  - The rod system pushes the piston and rod which compresses and releases the bag

Side View



*Yes there would need to be a guide for the piston/rod assembly but I don't have the artistic ability or time

Alternative Layout Concept - Top view



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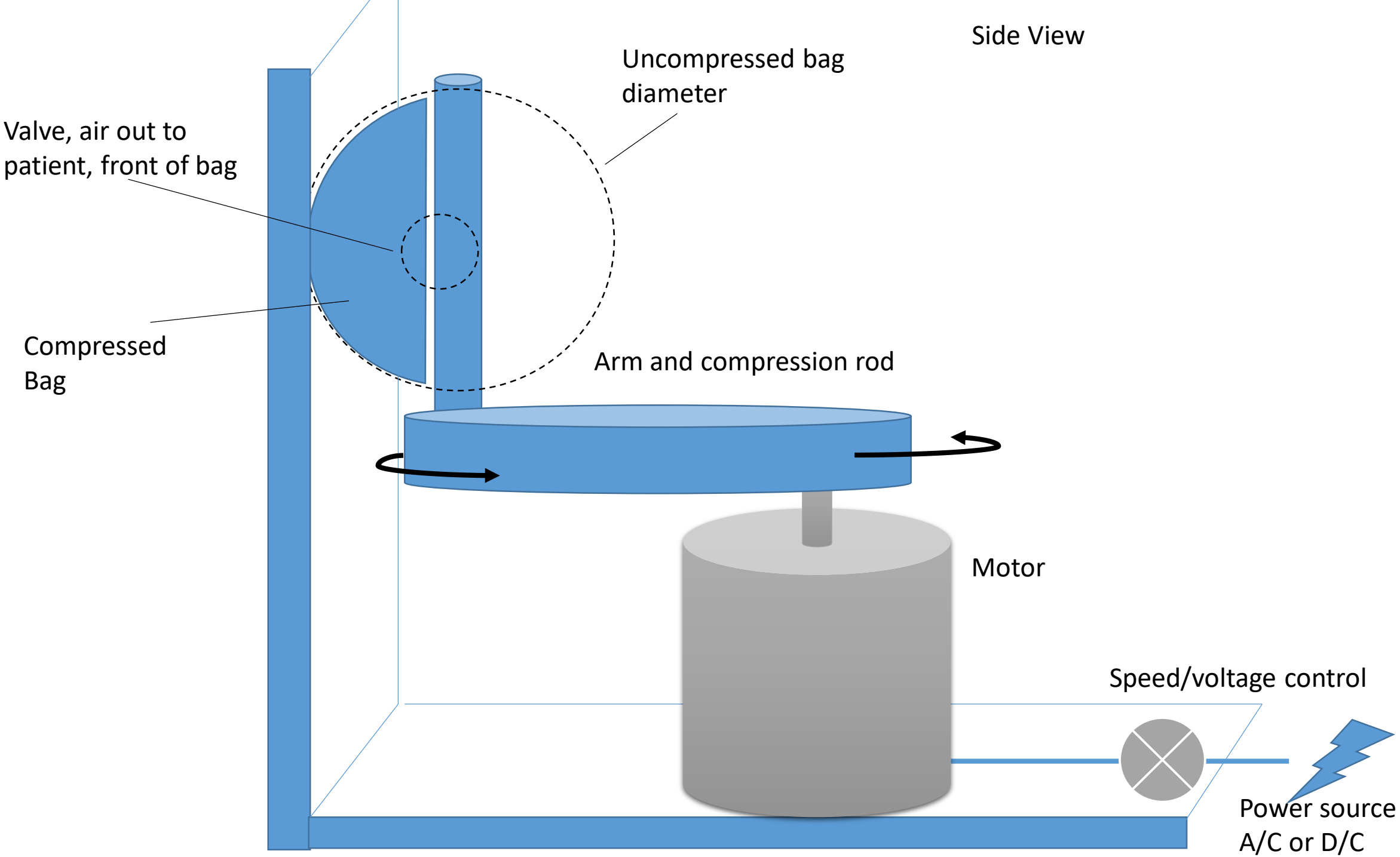
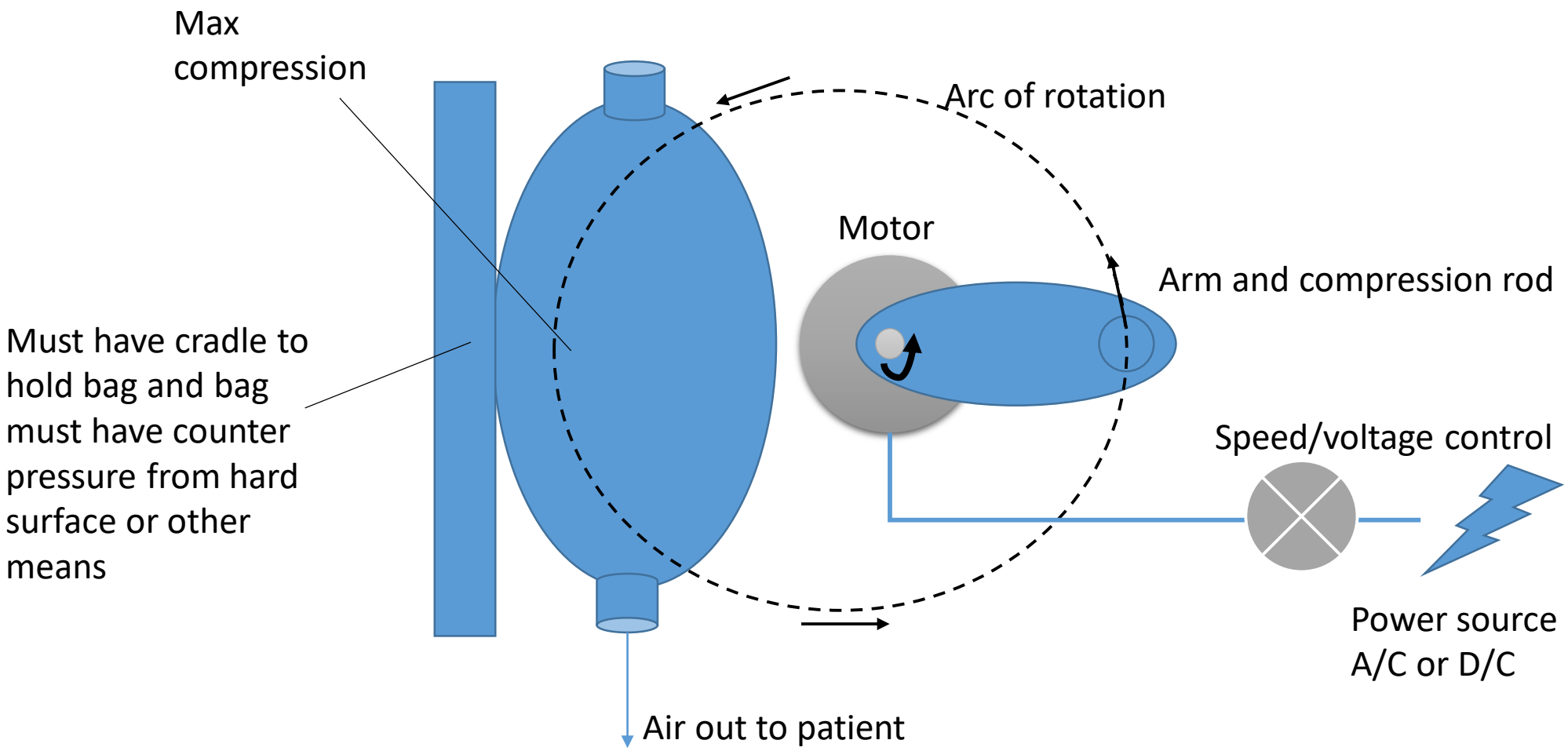
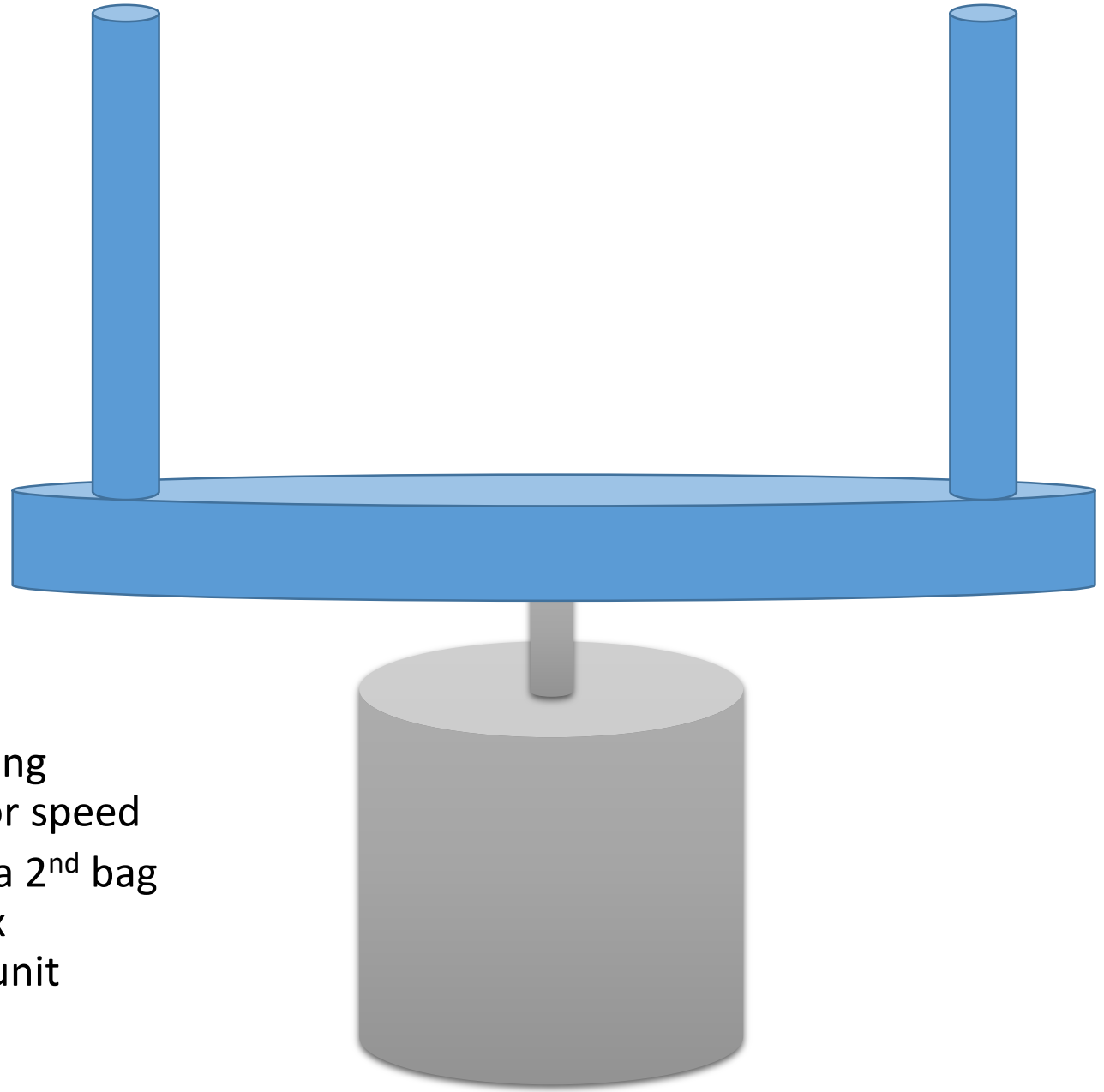
Concept 2 Rotating Compression Arm

- Benefits
  - Simple
  - Few parts - utilizes circular motion and kinetic energy to compress bag
- Concerns
  - Probably too simple
  - May require high torque motor
  - Maintenance and Mean Time Between Failure?
    - Pressure on compression arm, bag, motor, joints
  - Need to ensure correct amount of compression in the rotation arc
  - Avoid compression arm getting snagged on bag


Side View
Uncompressed bag diameter
Valve, air out to patient, front of bag
Compressed Bag
Arm and compression rod
Motor
Speed/voltage control
Power source A/C or D/C

Top View


Max compression
Arc of rotation
Motor
Arm and compression rod
Must have cradle to hold bag and bag must have counter pressure from hard surface or other means
Speed/voltage control
Power source A/C or D/C
Air out to patient



- Alternately -- 2x Arms
  - May need to change the timing depending on rqmts or motor speed
  - Alternately, could compress a 2nd bag on the other side allowing 2x patients to be aided by one unit