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"FABRICATION OF PADDLE POWER AIR COMPRESSOR"

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Abstract

Exercise method and apparatus activated air compressor driven by a pedal and exercise machine which is used for supplying kinetic energy to drive an air compressor. The compressed air is stored in storage device. The compressor being connected to the air storage chamber reaches a desired predetermined pressure. The kinetic energy thus stored in the storage chamber in the form of high pressure air is released at a controlled rate. The growth of technologies requested higher performance machine in order to fulfill human needs and market. This project is implemented to make human facility easier and can reduce the use of electrical power because of its potential applications. The project paddle power air compressor is device that compresses the air into compressor chamber. The purpose of this investigation is to determine the effect of peddling on maximum cycling power. Optimal peddling rate, and optimal peddling speed and to deter mine the optimal power production. Use of compressed air stored in storage chambers for the use of human pedal power from stationary bicycles for driving the fill the air into different types of tiers. The energy storage system based on using compressed air as a storage medium uses an exercise machine which, in the preferred embodiment, exercises all major portions of the human body, the legs, arms and torso, to drive an air compressor that fills the tires with compressed air.

Keywords: *Calculation, Solution of problem, Methodology, Future Scope.*

1. INTRODUCTION:

Air compressor is a device that converts power (usually from an electric motor, a diesel engine or a gasoline engine) into kinetic energy by compressing and pressurizing air, which, on command, can be released in quick bursts. An air compressor does most of its work during the compression stroke. This adds energy to the air by increasing its pressure. Compression also generates heat, however, and the amount of work required to compress a quantity of air to a given pressure depends on how fast this heat is removed. A peddle power air compressor in this we use cycle paddle arrangement for pedaling and we will attach cycle pump or foot pump with the help of scotch yoke coupling to the last gear of cycle pedal system when we will rotate the pedals the scotch yoke coupling move the air pump then air will be produce. This air will store into the air chamber. Thus the air stored in the air chamber can be used whenever required. In today's world air is compressed by compressor with the use of electricity, but in paddle power air compressor there is no use of electricity because air is compressed by paddle which results in saving of electricity. Thus paddle power air compressor is more beneficial.

2.1 General review of Air compressor

An air compressor operates by converting mechanical energy into pneumatic energy via compression. The input energy could come from a drive motor, gasoline engine, or power takeoff.
Modern compressors use pistons, vanes, and other pumping mechanisms to draw air from the atmosphere, compress it, and discharge it into a receiver or pressure system.

2.2 Compressed air

Compressed air is a form of stored energy that is used to operate machinery, equipment, or processes. Compressed air is used in most manufacturing and some service industries, often where it is impractical or hazardous to use electrical energy directly to supply power to tools and equipment.
Powered by electricity, a typical air compressor takes approximately 7 volumes of air at atmospheric conditions, and squeezes it into 1 volume at elevated pressure (about 100 psi. The resulting high pressure air is distributed to equipment or tools where it releases useful energy to the operating tool or equipment as it is expanded back to atmospheric pressure.

2.3 Why Compressed Air?

Compressed air is not free, but unfortunately it is often treated as such. You should be aware that compressed air is expensive to produce, and is likely consuming a

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significant slice of your energy dollar. In addition to system operating costs, there are system reliability and performance issues to be concerned with, as well as the quality of the compressed air. These direct and indirect costs can be determined by measuring system. Compressed air is a controllable cost, and this guidebook will help you to identify some common ways to reduce the energy, maintenance and capital costs associated with owning and operating your compressed air system.

2.4 Compressed Air Costs

It helps us to understand how much it costs to produce and use compressed air.Over the first ten years of life of a typical air cooled compressor with two shift operation, the operating cost will equal about 88% of the total lifetime cost. The cost of the original equipment and installation will account for the remaining 12%. As energy accounts for about 76% of the overall lifetime operating cost, it is very important to design and purchase the most efficient components for your compressed air system. It is recommended to make purchase decisions on the overall expected lifetime operating costs, and not just on the initial cost of the equipment.

3.5 Introduction to compressed air systems

Compressed air systems consist of a number of major subsystems and components. Compressed air systems can be subdivided into the Supply and Demand side. The Supply side includes compressors, air treatment and primary storage. A properly managed supply side will result in clean, dry, stable air being delivered at the appropriate pressure in a dependable, cost effective manner. Major compressed air supply subsystems typically include the air intake, air compressor (fixed speed and/or variable speed), aftercooler, motor, controls, treatment equipment and accessories. Controls serve to adjust the amount of compressed air being produced to maintain constant system pressure and manage the interaction between system components. Air filters and air dryers remove moisture, oil and contaminants from the compressed air. Compressed air storage (wet and dry receivers) can also be used to improve system efficiency and stability. Accumulated water is manually or automatically discharged through drains. Optional pressure controllers are used to maintain a constant pressure at an end use device. The Demand side includes distribution piping, secondary storage and end use equipment. A properly managed demand side minimizes pressure differentials, reduces wasted air from leakage and drainage and utilizes compressed air for appropriate applications. Distribution piping systems transport compressed air from the air compressor to the end use point where it is required. Compressed air storage receivers on the demand side can also be used to improve system pressure stability.

3.6 Air compressor types and controls

There are two basic types of air compressors:
Positive displacement and Dynamic.

Positive Displacement. In the positive displacement type, a specified quantity of air is trapped in a compression chamber and the volume which it occupies is mechanically reduced, causing a corresponding rise in pressure prior to discharge. Rotary screw, vane and reciprocating air compressors are the three most common types of air positive displacement compressors found in small and medium sized industries Dynamic air compressors include centrifugal and axial machines, and are used in very large manufacturing facilities. These units are beyond the scope of this document.

a. Rotary Screw Compressors

Rotary screw compressors have gained popularity and market share (compared to reciprocating compressors) since the 1980s. These units are most commonly used in sizes ranging from about 5 to 900 HP. The most common type of rotary compressor is the helical twin, screw compressor. Two mated rotors mesh together, trapping air, and reducing the volume of the air along the rotors. Depending on the air purity requirements, rotary screw compressors are available as lubricated or dry (oil free) types.

b. Reciprocating Compressors

Reciprocating compressors have a piston that is driven through a crankshaft and by an electric motor. Reciprocating compressors for general purpose use are commercially obtainable in sizes from less than 1 HP to about 30 HP. Reciprocating compressors are often used to supply air to building control and automation systems.

c. Vane Compressors

A rotary vane compressor uses an elliptical slotted rotor situated within a cylinder. The rotor has slots along its length, each slot contains a vane. The vanes are forced outwards by centrifugal force when the compressor is rotating, and the vanes move in and out of the slot because the rotor is eccentric to the casing. The vanes sweep the cylinder, sucking air in on one side and ejecting it on the other. In general, vane compressors are used for smaller applications where floor space is an issue;

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however, they are not as efficient as rotary screw compressors.

d. Compressor Motors

Electric motors are widely used to provide the power to drive compressors. As a prime mover, the motor needs to supply sufficient power to start the compressor, accelerate it to full speed, and keep the unit operating under various design conditions. Most air compressors use standard, three phase induction motors.

e. Compressor Controls and System Performance

As air systems seldom operate at full load all of the time, the ability to efficiently control flow at part loads is essential. Start/Stop: This is the simplest and most efficient control strategy. It can be applied to either reciprocating or rotary screw compressors. Essentially, the motor driving the compressor is turned on or off in response to the discharge pressure of the machine. For this strategy, a pressure switch provides the motor start/stop signal. Start/Stop strategies are generally appropriate for compressors smaller than 30 horsepower in size. Load/Unload: This control mode is sometimes called online/offline control. It keeps the motor running continuously, but unloads the compressor when the discharge pressure is adequate. Unloaded rotary screw compressors typically consume 15-35% of their full load power demand, while producing no useful compressed air output. Optional unload timers are available that will save energy by automatically turning off the compressor and placing it in standby if the unit runs unloaded for a period of time (usually 15 minutes). Modulating Control: This mode of control varies the compressor output to meet flow requirements by adjusting the inlet valve, resulting in air restrictions to the compressor. Even fully modulated at zero flow rotary screw compressors typically consume about 70% of their full load power demand. The use of pressure switch activated unloading controls can reduce the unloaded power consumption to 15 to 35%. Modulating control is unique to lubricated screw compressors and is the least efficient way to operate these units.

f. Multiple Compressor System Controls

The goal in controlling multiple compressors is to automatically maintain the lowest and most constant pressure, through all flow conditions, while ensuring all running compressors except one are either running at full load or off. The remaining compressor (trim unit) should be the one most capable of running efficiently at partial loads. Local compressor controls independently balance the compressor output with the system demand and are always included in the compressor package. To achieve the stated goals, systems with multiple compressors require more advanced controls or control strategies (cascaded pressure bands, network or system master controls) to coordinate compressor operation and air delivery to the system. Because compressor systems are generally sized to meet a facility's maximum demand, but are normally running at partial loads, a method of control is required to ensure the running compressors are at their maximum efficiency. A description of some common control methods follows:

Cascaded Pressure Band Control-

This type of control is the simplest method of coordinating multiple compressors. With this control strategy the local compressor pressure switch controls are arranged in an overlapping or cascaded pattern this method of control will unload and/or load compressors at varying system pressures as the load decreases or increases. The cascaded control method results in higher than necessary system pressures during partial loads which causes higher than required energy consumption. Also, as the number of coordinated compressors increases, it becomes more and more difficult to achieve accurate compressor control without exceeding the pressure rating of the connected compressors at low loads or experiencing low system pressure at high loads.

2.7 Receivers and Air Storage

The presence of adequate storage receiver capacity helps to maintain air quality, air system stability and air system efficiency. Adequate air storage is extremely important in systems using screw compressors. Receivers can be Primary or Secondary as discussed below

A primary air receiver acts as general system storage and is usually located close to the main air compressors and can be 6 Compressed Air Auxiliary Equipment 50 located upstream and/or downstream of the clean-up equipment.

Primary air receivers have a number of important uses in air systems:

- Damping pulsations caused by reciprocating compressors.
- Providing a location for free water and lubricant to settle from the compressed air stream.
- Supplying peak demands from stored air without needing to run an extra compressor.
- Reducing load/unload or start/stop cycle frequencies to help screw compressors run more efficiently and

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reduce motor starts. Most screw compressors have internal protection that prevents more than 4 to 6 starts per hour.

- Slowing system pressure changes to allow better compressor control and more stable system pressures. Secondary receivers (located in the distribution system of a facility or at and end use) have the following general uses:
- Protection of sensitive end uses from temporary system pressure dips.
- Protection of multiple end uses from large transient users of compressed air.
- To provide general pressure stability in systems with undersized distribution piping.

Many industrial plants have equipment located at the end of a long air distribution pipe, or machinery requiring large amounts of compressed air for short periods of time. This condition often results in severe localized pressure fluctuations with many essential end points being starved for compressed air. Sometimes this situation can be relieved by correctly sizing and locating a secondary air receiver close to the point of high intermittent demand. If the intermittent demand occurs over a short duration, it may be possible to supply the required air directly from the storage tank rather than running added compressor capacity. By installing a flow restriction before the secondary air receiver, the storage tank can be refilled at a reasonable lower flow rate so as not to affect other local pressure sensitive end uses.

2.8 Introduction to compressed air systems

Compressed air is used for a diverse range of commercial and industrial applications. As it is widely employed throughout industry, it is sometimes considered to be the fourth utility at many facilities. In many facilities, compressed air systems are the least energy efficient of all equipment. There is a tremendous potential to implement compressed air energy efficiency practices. It has been common practice in the past to make decisions about compressed air equipment and the end uses based on a first cost notion. Ongoing energy, productivity and maintenance costs need to be considered for optimal systems. In other words, best practice calls for decisions to be based on the life cycle cost of the compressed air system and components. Improving and maintaining peak compressed air system optimization requires addressing both the supply and demand sides of the system and understanding how the two interact. Properly managing a compressed air system can not only save electricity, but also decrease downtime, increase productivity, reduce maintenance, and improve product quality. Optimal performance can be ensured by properly specifying and sizing equipment, operating the system at the lowest possible pressure, shutting down unnecessary equipment, and managing compressor controls and air storage. In addition, the repair of chronic air leaks will further reduce costs.

3.1 Problem Identification

1. Importable
2. Use of electricity result in increasing cost
3. Noise is serious problem
4. Domestic purpose
5. High cost

3.2 Solution of the Problem

1. In paddling air compressor air is compressed by paddle result in saving of electricity.
2. The problem of noise is less in paddling air compressor as compare to electric air compressor.
3. This is dual purpose device as like pumping air in tires as well as exercise.

To understand the methodology of paddle power air compressor, first of all we have to know the parts that are generally used in this paddle power air compressor.

4.1 Parts used in paddle power air compressor

1. Scotch yoke coupling
2. Sprocket
3. Air chamber
4. Chain
5. Air pump
6. Frame and base
7. Nozzles
8. Air gauge
9. Air tubes

4.2 Description of important parts

4.2.1 Scotch yoke mechanism

The Scotch yoke (also known as slotted link mechanism is a reciprocating motion mechanism, converting the linear motion of a slider into rotational motion or vice versa. The piston or other reciprocating part is directly coupled to a sliding yoke with a slot that engages a pin on the rotating part. The shape of the motion of the piston is a pure sine wave over time given a constant rotational speed.

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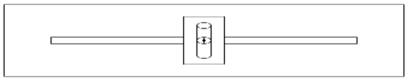

4.2.1.1 Diagram of scotch yoke mechanism

4.2.2 Sprocket:

A sprocket or sprocket-wheel is a profiled wheel with teeth, cogs, or even sprockets that mesh with a chain, track or other perforated or indented material. The name 'sprocket' applies generally to any wheel upon which are radial projections that engage a chain passing over it. It is distinguished from a gear in that sprockets are never meshed together directly, and differs from a pulley in that sprockets have teeth and pulleys are smooth

4.2.2.1 Sprocket

Sprockets are used in bicycles, motorcycles, cars, tracked vehicles, and other machinery either to transmit rotary motion between two shafts where gears are unsuitable or to impart linear motion to a track, tape etc. Perhaps the most common form of sprocket may be found in the bicycle, in which the pedal shaft carries a large sprocket-wheel, which drives a chain, which, in turn, drives a small sprocket on the axle of the rear wheel. Early automobiles were also largely driven by sprocket and chain mechanism, a practice largely copied from bicycles. Sprockets are of various designs, a maximum of efficiency being claimed for each by its originator. Sprockets typically do not have a flange. Some sprockets used with timing belts have flanges to keep the timing belt centered. Sprockets and chains are also used for power transmission from one shaft to another where slippage is not admissible, sprocket chains being used instead of belts or ropes and sprocket-wheels instead of pulleys. They can be run at high speed and some forms of chain are so constructed as to be noiseless even at high speed.

4.2.3 Chain:

A chain is made up of a series of links with the links held together with steel pins. This arranges makes a chain a strong, long lasting way of transmitting rotary motion from one gear wheel to another. Chain drive has one main advantage over a traditional gear train. Only two gear wheels and a chain are needed to transmit rotary motion over a distance. With a traditional gear train, many gears must be arranged meshing with each other in order to transmit motion. Two distinct chains can be connected using a quick link_which resembles a carabiner with a screw close rather than a latch. A chain is a series of connected links which are typically made of metal. A chain may consist of two or more links. Chain types are identified by number; ie. a number 40 chain. The rightmost digit is 0 for chain of the standard dimensions; 1 for lightweight chain; and 5 for rollerless bushing chain. The digits to the left indicate the pitch of the chain in eighths of an inch. For example, a number 40 chain would have a pitch of four-eighths of an inch, or 1/2", and would be of the standard dimensions in width, roller diameter, etc.

4.2.3.1 Chain

Chains are usually made in one of two styles, according to their intended use: Those designed for lifting, such as when used with a hoist; for pulling; or for securing, such as with a bicycle lock, have links that are torus shaped, which make the chain flexible in two dimensions (The fixed third dimension being a chain's length.) Those designed for transferring power in machines have links designed to mesh with the teeth of the sprockets of the machine, and are flexible in only one dimension. They are known as roller chains, though there are also non-roller chains such as block chain.

4.2.4 Air pump

An air pump is a device for pushing air. Examples include a bicycle pump, pumps that are used to aerate an aquarium or a pond via an airstone; a gas compressor

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used to power a pneumatic tool, air horn or pipe organ; a bellows used to encourage a fire; a vacuum cleaner and a vacuum pump. The first effective air pump constructed in England for scientific purposes was made in 1658 by Robert Hooke for Robert Boyle. A device for pumping air into or out of an enclosed space is called as air pump. A pump for exhausting air from a closed space or for compressing air or forcing it through other apparatus

4.2.5 Nozzle

A nozzle is a device designed to control the direction or characteristics of a fluid flow (especially to increase velocity) as it exits (or enters) an enclosed chamber or pipe. A nozzle is often a pipe or tube of varying cross sectional area, and it can be used to direct or modify the flow of a fluid (liquid or gas). Nozzles are frequently used to control the rate of flow, speed, direction, mass, shape, and/or the pressure of the stream that emerges from them.
Frequently, the goal is to increase the kinetic energy of the flowing medium at the expense of its pressure and internal energy. Nozzles can be described as convergent (narrowing down from a wide diameter to a smaller diameter in the direction of the flow) or divergent (expanding from a smaller diameter to a larger one). A de Laval nozzle has a convergent section followed by a divergent section and is often called a convergent-divergent nozzle. Convergent nozzles accelerate subsonic fluids. If the nozzle pressure ratio is high enough, then the flow will reach sonic velocity at the narrowest point (i.e. the nozzle throat). In this situation, the nozzle is said to be choked. Increasing the nozzle pressure ratio further will not increase the throat Mach number above one. Downstream (i.e. external to the nozzle) the flow is free to expand to supersonic velocities; however Mach 1 can be a very high speed for a hot gas because the speed of sound varies as the square root of absolute temperature. This fact is used extensively in rocketry where hypersonic flows are required and where propellant mixtures are deliberately chosen to further increase the sonic speed.
Divergent nozzles slow fluids if the flow is subsonic, but they accelerate sonic or supersonic fluids. Convergent-divergent nozzles can therefore accelerate fluids that have choked in the convergent section to supersonic speeds. This CD process is more efficient than allowing a convergent nozzle to expand supersonically externally. The shape of the divergent section also ensures that the direction of the escaping gases is directly backwards, as any sideways component would not contribute to thrust.

4.2.6 Air gauge

An instrument for measuring the pressure of a gas or liquid. It is an instrument used to determine the pressure in the bore or chamber of a gun when the charge explodes. A pressure gauge is made up of the following parts: the head, a hollow tube, oiled piston and a spring. The spring, the most important part of the pressure gauge, provides the resistance to accurately measure air pressure pushing on the piston when the air rushes through the hollow tube. An indicator that displays the reading of air pressure in the tire is connected to the piston. When the piston recedes, the indicator remains in the same position, indicating the maximum pressure that was exerted on the piston. It's very important to measure and maintain optimal tire pressure. Low tire pressure generates excessive heat at speed and could put the tire at risk for blow out. To understand how a tire pressure gauge works, it is first necessary to understand the parts of a tire pressure gauge. There is the head, which couples with the valve stem from the tire. A hollow tube makes up the bulk of the gauge. Inside that tube is a lightly oiled piston.

4.2.7 Air tube

A long hollow and typically cylindrical object, used for the passage of fluids or as a container. a collapsible cylindrical container of soft metal or plastic closed with a cap, used to hold viscous liquids or pastes.

4.3 Specifications:

1.Base (frame)	
Length	800 mm
Width	600 mm (approx)
Height	150 mm

Table 4.3.1 Base specification

2. Sprocket	
big gear diameter	160 mm
small gear diameter	60 mm (approx)

Table 4.3.2 Sprocket specification

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3.Chain	
Length of chain	1100 mm

Table 4.3.3 Chain Specification

4.Scotch yoke coupling	
circular plate diameter	250 mm

Table 4.3.4 Scotch yoke coupling Specification

5.Air chamber	
Length	400 mm
Height	350 mm

Table 4.3.5 Air chamber Specification

Table 4.4- Quantity of parts used

S. No.	Parts	Quantity
1	Scotch yoke coupling	1
2	Sprocket	2
3	Air chamber	1
4	Chain	1
5	Air pump	1
6	Frame and base	1
7	Nozzle	1
8	Air gauge	1
9	Air tube	1

4.5 Construction:

In the construction of paddle power air compressor the structure is supported on a iron frame. the chain and sprocket arrangement of cycle is directly connected with scotch yoke mechanism, and a air pump is connected with scotch yoke mechanism. The tube of the air pump is connected with air chamber. The diameter of both the sprocket are different. A pressure gauge is mounted on the air chamber to measure the pressure inside the chamber. The air chamber contains two valves one for filling the compressed air in the chamber and another to supply the compressed air where required.

4.5.1 Arrangement of paddle air compressor

4.6 Working:

The Scotch yoke also known as slotted link mechanism is a reciprocating motion mechanism, converting the linear motion of a slider into rotational motion or vice versa. The piston or other reciprocating part is directly coupled to a sliding yoke with a slot that engages a pin on the rotating part. The shape of the motion of the piston is a pure sine wave over time given a constant rotational speed. We will attach this coupling with the gear and air pump when we operate the pedal then scotch yoke coupling start working and piston of air pump will also move with the coupling and produce air which will be stored into the air chamber. Thus, in paddle power air compressor air is compressed by paddle. These stored compressed air in the chamber thus supply with the help of tube where required.

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4.6.1 Paddle power air compressor

5.1Calculation:

Compressor Displacement = Πx D2x L x S x χx n4
D = Cylinder bore, metre
L = Cylinder stroke, metre
S = Compressor speed rpm
χ = 1 for single acting and
2 for double acting cylinders
n = No. of cylinders
Air compressor calculations
Compressor Reference

	Measured Capacity CMM (@ 7 kg/ cm2)
A	13.17
B	12.32
C	13.14
D	12.75
E	13.65

For a cycle time of 45 minutes
i) Compressed air generated in m3
= 45 (13.17) + 45 (12.32) + 45 (13.14) + 45 (12.75) + 5.88 (13.65)
= 2392.36 m
Compressed air generation actual capacity on line in m3
= 45 [13.17 + 12.32 + 13.14 + 12.75 + 13.65] = 2926.35 m3
The consumption rate of the section connected
= 2392.36 / 45 = 53.16 m3 /minute
Compressor air drawal as a % of capacity on line is
= [2392.36 / 2926.35] ×100 = 81.75 %

Pressure generate in cylinder = 0.5 Mpa
= 72 psi

Pedaling power = force on pedals x speed of pedals
= 75N x 1m/s
= 75W

Forwards force = pedaling power ÷ speed of bike
= 75W ÷ 2.5m/s
= 25N

Chain length
L=2C+1.57(D+d) + (D-d)2 / 4C
Where :
L= length of chain at pitch line(in inches)
C = center distance(in inches)
D = pitch diameter (in inches) of large sprocket
d = pitch diameter (in inches) of small sprocket

5.2 Advantages:

1. Light weight, compact and extremely portable air compressor
2. Simple in construction and operating.
3. In paddle air compressor there is no use of electricity result in low cost.

5.3 Disadvantages:

1. Compression of air takes more time.
2. The system may have a limited level of intelligence.

6.1 Conclusion of paper:

In this fast growing world there are different new technologies adopted to increase work rate in minimum time period. Thus Paddle air compressor is a device that compresses the air by paddling which results in saving of electricity. It is simple in operation and have low maintenance cost. Based on the successful performance of the equipment the paddle air compressor can offer high performance dewatering from an easy to maintain, quiet, low energy consuming package. This is a major obstacle for acceptance of the technology which has been subject to numerous intensive attacks during the project lifetime. Specialized solutions tailored for scheduling problems and optimizations of existing tools have led to significant improvements that make TA-based methods not inferior to other commonly-used methods. Although the team proved that the paddle power system is possible and functional, it does not prove to be very efficient compared to the compressor systems that are currently in use. This

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means that this system will most likely not be used in a practical situation. However, it may be beneficial in situations where the well is extremely sandy, causing the seals of air chamber to wear at an accelerated rate. In these wells, the paddle power air compressor would be a viable option.

7.1 Future Scope of the paper:

If we boost the research on paddle power technology trying to make up for seven decades of lost opportunities and steer it in the right direction, paddles could make an important contribution to running a post carbon society that maintains many of the comforts of a modern life. The possibilities of paddle power largelt exceed the use of the bicycle. Paddle power air compressor is also a new technology to compress air by paddling which results in saving of electricity. There are many things that we think in future in paddle power air compressor to increase its efficiency, and save power by reducing weight and also by use of other power transmission device rather than chain and sprocket, results in reducing noise.

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