

Multipurpose Energy Saving Manual Compressor for Artisans in African Countries

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ABSTRACT

This Research work involves the design, fabrication and testing of a manually operated compressor for use of artisans and small scale vulcanizing activities. The developed machine consists of chain sprocket arrangement to a flywheel attached to a pulley which powers the compressor as well as a storage tank to receive air by foot pedaling. The article is an innovative product to meet the needs of rural African Artisans that uses air compressor for their daily activities. The design is such that the chain sprocket provides the compressor with a driving force in conjunction with the flywheel thereby replacing the prime mover. Prototype pilot test carried out on the developed manual air compressor could generate 10 Psi ie 0.69bar-volume of air in 60 seconds. A new design with better parameter of the machine was done to improve its proficiency after testing for broad application even for the handicap Artisans.

Keywords-- Development, Air, Energy, Compressor, Machine, Flywheel, Artisans, Sprocket, Tank, Chain, Pulley, V belt

improve the economy of every country. As energy is tied to our economy, our future is dependent upon equitable access to energy, this in turn set the framework of our dependence on oil.

The eighteenth century England industrial revolution, gave birth to improved labour, technology and more energy need. Energy is a world problem and with the rapid growth in automobile production in the United States and other developed countries, oil became the predominant source of energy. This means more emphasis on alternative energies sources could help ameliorate our dependence on oil. The dependence on oil is not tied only to the developed countries, African countries especially Nigeria one of the countries with large population also affected. However, small scale business artisans that form the bulk of the employment force need attention, those involve in the use of prime movers to generate energy to provide for their business need self-sufficiency in energy supply, especially those that need air compressors to function is being addressed by this energy saving compressor for artisans. The idea was to provide to the artisans with alternative tool that can help them carry out their activities without the use of prime movers.

The artisans in these categories that uses air compressor includes,

1. Tire menders for inflating of tires, and vulcanizing activities.

I. INTRODUCTION

Innovation comprises new products and processes and significant technological changes of products and processes, the processes of translating an idea into goods or service that creates value which customers will pay. It can trigger development there by



Plate. 1: An Artisan mending a tire

2. Welder for painting their finished jobs
3. Artist that does large format bill board and signboard etc.
4. Car refurbishing painting artisans.
5. Carpenters for wood-finishing by spraying.
6. Drilling activities
7. Users of air pressure to operate some machines.

These artisans predominantly depend on oil and electrical energy source for generating air required for their activities.

The need to simplify the methods in energy sourcing in view of the difficulties involve in procurement of energy in Nigeria and other African Countries triggered the development of an alternative energy source that could cut off the use of oil, prime movers yet, providing efficient air need for the running of Atisans small scale business. This intervention improves self-employment, low financial involvement in maintenance, hence the manual air compressor uses neither fuel nor electricity, thereby improving their profit margins. A design of a simple manual air compressor for use by the artisans is here being presented.

The design of the compressor followed the study conducted and piloted by [2] who developed a manual airbrush compressor with high efficiency for artists training in Nigeria's Universities.

II. MATERIALS AND METHODS

2.1 (a) The bicycle system:

The following parts were adopted, sprocket and pedal, hub, chain and their housing and a flywheel. The

compressor system adopted with all the accessories to meet the design concept and specifications.

2.1 (b) The air storage tank:

The tank has three opening so as to manage the pressured air

- i. Air Inlet valve, allowed air entry into the tank from the compressor only.
- ii. Air outlet valve, control outflow air to the desired out flow level for the users.
- iii. Air outlet, Control valve attached to air pressure meter, enable the user know the pressure level for the safety of his operation. The hose fix to the outlet opening enable the user to fix accessories for carrying out his activities.

The entire components used for the design were mounted on the flat iron sheet base on the storage tank as shown in figure 2. The storage tank stands firm on the ground supported from the rail with two solid square bars and in the front with two tires for easy movement.

2.2 Methodology

The study adopted an approach considered under research and development as instrumentation resource development. The approach is based on the system approach theory advocated by Dale (Heidi Milia Anderson, n.d.) [1].

Steps in the development of the manual compressor

(1) The design drawing of the prototype manual air compressor.

The design drawing are as shown below in figure 1 and 2

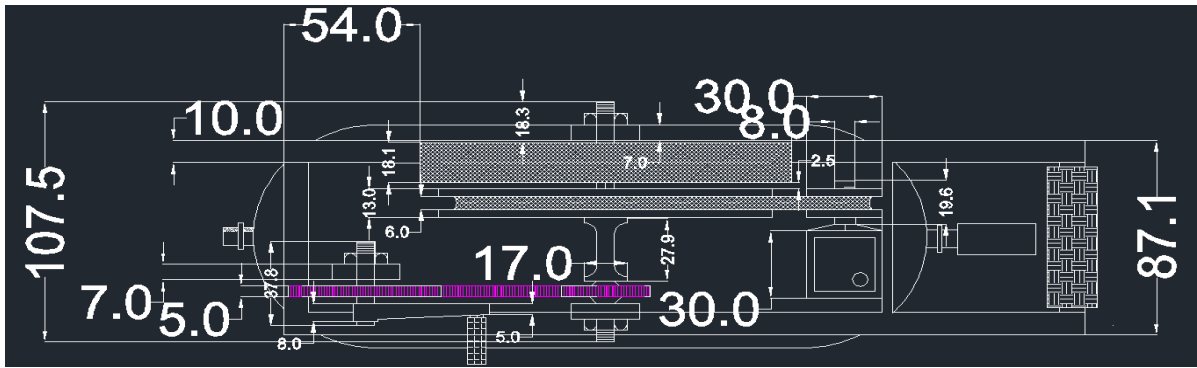


Fig. 1: Top view of Manual Compressor

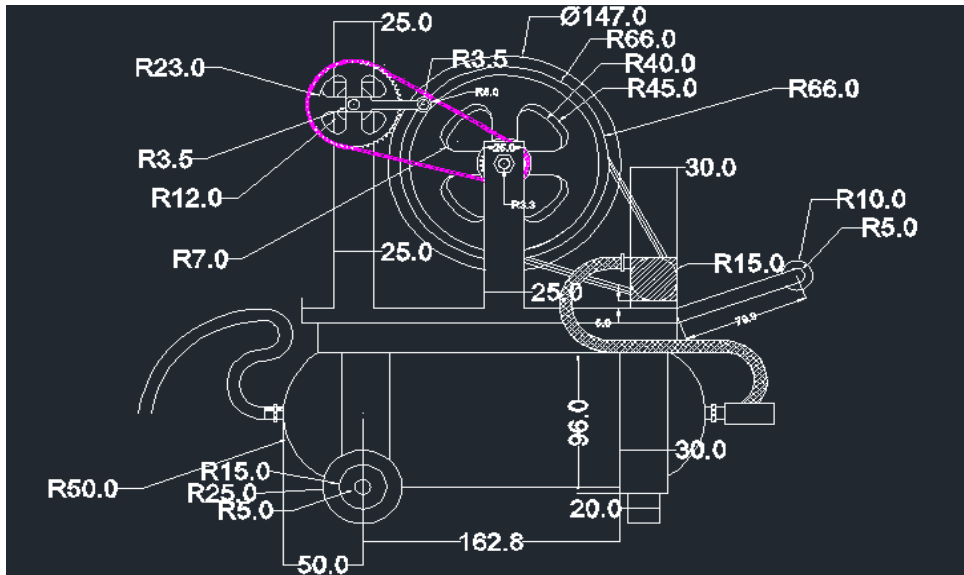


Fig. 2: Side view design of the prototype Manual Compressor

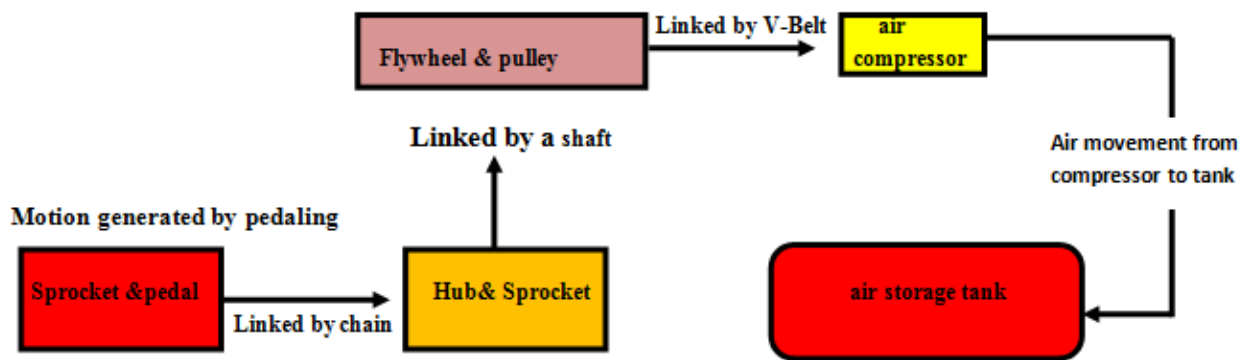


Fig. 3 Operation mechanism of the Energy Saving Compressor

III. MATERIALS

The following materials were used for the research work. The development of the equipment was done thus. The pedal was link to a bigger sprocket with 42 teeth; while the smaller sprocket with 20 teeth was linked to a hub by means of a chain, the hub and the pulley which are both sustained by a shaft, links the flywheel as well as the sprocket. Power is transmitted from the pedal to the hub via a chain drive. The flywheel is attached to the compressor by means of pulley and is

powered to generate air from the pedal by interconnectivity between the sprocket and the pulley. The flywheel is used to improve and sustain the generation of energy for air supply from the compressor to the storage tank for subsequent use. The prototype of the assembled equipment is as presented in plate 2. The fabricated manual motor which replaces the prime mover thereby eliminating the use of fuel and electricity energy as shown in plate 2. The air gauge is attached to the storage tank air exit. The gauge helps to monitor the air in the storage tank as well as gauging of the tire by tire

menders. The cost of fabricating the manual machine is relatively cheaper; hence the material for production can be gotten from automobile scraps. The flywheel used for the fabrication of the manual air compressor is a simple

technology, a network of bicycle parts and the flywheel for starting and speed, the simple network principle makes it easy to operate and manage.



Plate 2: The manual machine that replaces the prime



Plate 3. The prototype model

The pressure gauge

The pressure gauge meters are of different types depending on the levels of pressure needed by the user, the meters are use to monitor pressure level and for applications of the machine by the Artisans in their

various businesses. The measure of air pressure usually is in Bar\Psi.

The operation of the machine is such that, when the user is pedaling, all the parts are engage in motion enabling the compressor generate air into the storage

tank, a stored energy for the Artisans use for their daily operations.

Testing the prototype manual air compressor

The operation of the manual machine is by pedaling, with an rpm of ratio 1:2 x2x 2 x 60 seconds with an output rpm of 480, which engages all the parts into active motion, as the machine is in motion, the compressor begins to generate and transfer air into the cylinder via a hose through a returning valve opening into the tank until the required air is generated.

Steps in carrying out the test

Step 1. The machine operated for 60 seconds with an interval of one stroke per second.

Step 2. The machine operated for 60 seconds with an interval of two strokes per second.

Step 3. The machine operate for 120 seconds with an interval of one strokes per second.

The record of all the steps are profiled in table 1 below.

Table 1:Testing of the prototype manual air compressor results.

	Stroke per second	Number of seconds	Air generated in PSI	Air generated per second in bars
Step 1	Once	60	10	0.166666667
Step 2	Twice	60	20	0.333333333
Step 3	Once	120	20	0.166666667

Machine generate 20bars of air, the analysis is as follows;

1bar=14.5psi, therefore 20 bars=14.5 × 20=290psi ÷ by 10 psi per minute, =29 minutes. The implication of this calculation is that, if the manual machine is operated for 29 minutes nonstop at the same turning interval of one stroke per second, 20 bars of air can be generated.

IV. ANALYSES OF USAGE OF 290 PSI BY A TIRE MENDER

A manual air compressor was conceptualized, developed and tested and found suitable for artisans that use air compressors. The air compressor is an important tool in daily operations for the artisans. The designed manual air compressor replaces the use of prime movers and for Artisans’ small scale businesses.

The average air pressure for most cars is 35-40 psi, if car tire menders generate 290psi with the manual air compressor at his leisure time after his usual business period. The analyses as follows; 290psi÷40=7.25, therefore a car tire mender, can inflate six tires before he can regenerate air again. , because the 40.25 psi air that remains, can not inflate below the pressure air level in the tank. The implication of the analysis is that, the artisans can stand the presure of air need in thire daily activities if

bigger capacity of presure tank is instoled . The oral investigation among the users of presured air indicated that, a car painter and other Artisans that uses air for spaying can use 290psi presured air for 30minutes to 1hour before air can be regenerated.

Observations made after the testing

1. The rpm need be improved,
2. Design for handicapes and for nomal users be introduced.
3. Hand pedaling easily make users exhusted.
4. Accessories be introduced to improved machine performance.

V. REDESIGN OF THE MANNUAL AIR COMPRESSOR

Better parameter were introduced to improve the performance after testing for broad application even for the handicap Artisans. In the case of the rpm, the teeth of sprocket increase by 100% along side with the circumference size of the pulley attached to the flywheel there by rising the rpm from 480 to 960. An air pressure inverter was also introduced, which could substitute the manual foot pedaling after required pressure is generated.

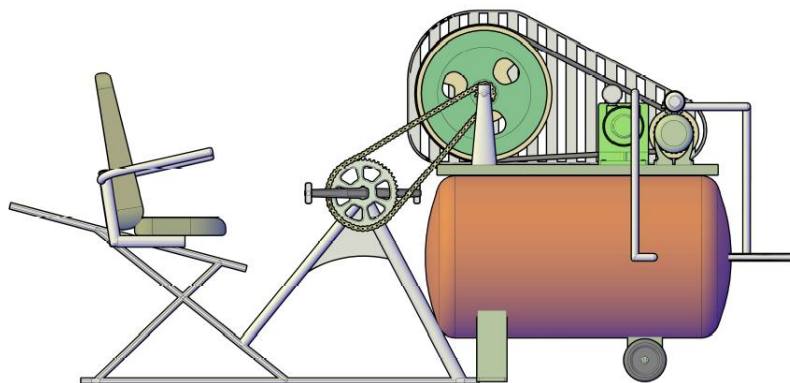


Fig. 4 The model for the handicaps by hand pedaling.

Table 2: The performance of the redesign manual air compressor results.

	Stroke per second	Number of seconds	Air generated in PSI	Air generated per second in bars
Step 1	Once	60	20	0.3333333333
Step 2	Twice	60	40	0.6666666666
Step 3	Once	120	40	0.3333333333

- The table above shows that 20 psi can be generated in one minute, and 1200 psi in one hour. The implication is that the product is

highly reliable, and is recommended for broad application.

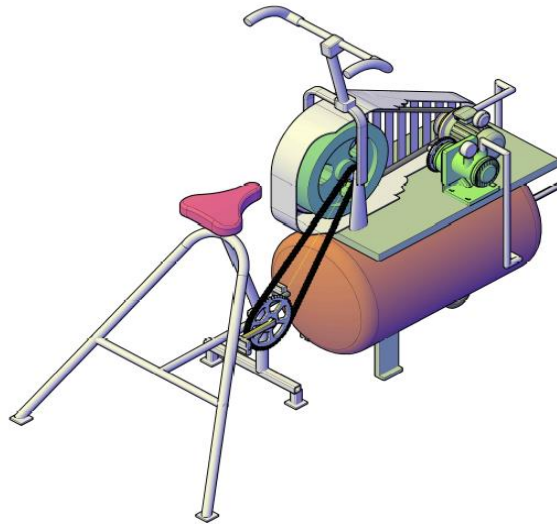


Fig. 5 The model design for normal use

VI. ADVANTAGES OF THE MANUAL AIR COMPRESSOR

The manual air compressor cost less with low cost of maintainance. It can be used in place of the prime mover and is noise free for the users. The cost of fueling is cutoff and maintainace cost is neglegible. It is environmentally friendly and no air pollution or fire hazard. The bicycle system adopted have very low cost implication and can be used in very remote locations where there is no power grid or need for a prime mover for use by a Artisans.

VII. CONCLUSION & SUMMARY OF FINDINGS

The findings revealed that the developed manual air compressor can help to improve the performance of artisans, the ou tcome therefore is that, beside using the manual air compressor to facilitate the teaching of airbrush application in art and design, it's emperically evident in the results that it can be used to make Artisans independent from the use of prime movers and dependancy on oils in running thire businesses.

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