Triangular Air Compressor with Common Compression Chamber

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Abstract— Compressor is used to get high pressure air for much industrial and commercial purpose. The triangular air compressor with common compression chamber is a reciprocating type compressor, which delivers air at high pressure with less vibration and less power consumption than the existing ones. Triangular air compressor with common compression chamber uses three cylinders and the entire cylinder and all the cylinders will have their own connecting red, crank shaft, pistons and chain sprockets and it is driven by a chain drive. During operation the pistons will move in phase from BDC to TDC and hence air is compressed in the common compression head. This common in the compression chamber will have one inlet and outlet valve. From this valve air is intake and delivered. The common compression head will be being triangular shape with angle of 60* from one side to other.

***Index Terms*—Compressor, Common Compression Chamber**

I. INTRODUCTION

The need to improve the performance of compressor by several methods. Such as designs shape and construction are known and screw type compressor is the latest design as on date. The power required to compressor air to a known pressure is given in the attached tables. One cubic root of air equals approximately 28 liters its volume we brought of a novel idea to design the triangular compressor as per the attached sketches or diagrams with this.

It is three-cylinder compressor placed radially equally apart such that the cylinder openings tend to meet on a common triangular compression chamber that has one inlet and outlet value to a tank for receiving air in the compressed state. As an example, let us take a 100cc displacement single cylinder compression, e.g. that will have a bore of 50 mm and stroke 50mm. The volume displaced is

$50^2/4 \times \Pi \times h = 25^2 \times 3.14 \times 50$
$= 98.125cc$

Nearly,

$= 100cc.$

To have the identical capacity 3 cylinders for above 100cc capacity each cylinder. Displacement must be 100/3 = 33.33cc each. In the market sprayer 2 stroke engine has a displacement of 34cc 3 times that equals 102cc the bore is 35 and stroke 34.

i.e., Swept volume of each = $35^2 / 4 \times \Pi \times 34$
$= 32.695$
3 Cylinders $= 98.1cc$

The compressing area of single 100cc compressor as said above is 50 Q or 1962.5 mm^2

The compressing Area of 35cc piston in 961.625mm for 3 pistons area = 2884.875mm^2

This is bigger by = 922.375mm^2

Now all 3 pistons are made to compress air simultaneously on to common triangular chamber over shorter stroke and so the isothermal efficiency will be better than the single cylinder one of 50 pistons also there will be no vibration due to triangle force acting towards the center at the same time.

Adiabatically also this will be advantages since 3 cylinders displacement is pushed at the same velocity and force on the common chamber because the three pistons move at equal velocity driven by one chain to achieve these 3 compressors cranks

sprockets as teeth. For every rotation of crank each piston will move once from TDC to BDC and BDC to TDC two strokes. Therefore, theoretically 98cc of air will be taken in and compressed to the volume of smaller space is the common compression chamber which we have made as to 15 bore X 70 long = 18.78cc or 7 times the total 98cc volume = 7atmospheres. If space is smaller the pressure will be more and bigger the lower. If compressor is made to work at 1400 rpm air taken will be 98 X 1400 = 137.2 liters @ 7 atmospheres pressure the advantage with triangular compressor will be low vibration, smaller unit giving more output and so cheaper to make, ideal for air compressor is Air conditioning and Refrigeration, Vacuum pumps and General-purpose usage.

II.GENERAL ASPECTS OF A RECIPROCATING COMPRESSOR

2.1. SIGNIFICANCE OF COMPRESSED GASES AND VAPOUR

In industry and in economic life, in general the use of compressed gases and vapour are steadily increasing various gases are after required purposes and pressure for many chemical and industrial purpose and compressed air specially has numerous productivity is several fields such as metallurgy, chemical plants, hospitals, inflation of tyres hot air guns, to operate air driven hand tools such as die polishers, die grinders etc.

In fact, it would be difficult to find a branch of industry where utilization on compressed air would not affect a material rationalization of manufacturing process the advantages of pneumatic machine and tools are their safety simplicity and ruggedness combined with comparatively low weight of great importance is the use of compressed vapour in refrigerating plants which improves our standards of living by economic handling of perishable foods.

2.2. RECIPROCATING COMPRESSORS

This type machinery work in your discrete phase namely.

1) Expansion
2) Suction
3) Compression
4) Discharge

Which are accomplished by the reciprocating motion of the piston inside the cylinder by this we can achieve high pressure at relatively low Capacities.

The piston inside the cylinder is used to pressure the gas. The connecting rod and crank mechanism is incorporated for the Conversion of rotary motion to linear motion.

When the piston moved down the pressure inside the Cylinder falls below the atmospheric pressure this makes the inlet value opens, when the piston comes to BDC the inlet value closes. During upward motion of piston, the air gets compressed. If a certain pressure (The outlet value opening Pressure) the outlet value opens when the pressure inside the Cylinder in discrete require. This air can be stored in the tank and can be used whenever necessary.

2.3. RECIPROCATING COMPRESSOR TERMINOLOGY

2.3.1. SINGLE ACTING COMPRESSOR

In this type the suction, compression and delivery of air take place on one side of the piston only. Such compressor has one delivery stroke per revolution of the crank shaft.

2.3.2. DOUBLE ACTING COMPRESSOR

In this type suction, compression and delivery of air take on both side of the piston such compressor has two delivery strokes per revolution of the crank shaft.

2.4. SINGLE STAGE COMPRESSOR

The Compression of air from initial pressure to the final pressure is carried out in one cylinder only.

2.5. MULTISTAGE COMPRESSOR

The compression of air from the initial Pressure to the final pressure is carried out in more than one cylinder the air passing in series through these.

2.6. COMPRESSION RATIO (OR) PRESSURE RATIO

It is the ratio of the absolute discharge pressure to the absolute inlet pressure.

2.7. FREE AIR DELIVERED (FAD)

The volume if air Delivered under the condition of temperature and pressure existing at the compressor intake (i.e.) Volume if air delivered at surrounding air temperature and pressure.

2.8. ***DISPLACEMENT OF THE COMPRESSOR***

The swept volume of the piston in the first cylinder is known as displacement of the compressor.

It is given by $\pi R^2 L$
Where R is radians of the cylinder bore.
L is stroke of piston.

2.9. ACTUAL CAPACITY OF THE COMPRESSOR

The actual free air delivered by the cylinder per minute is known as capacity of the compressor. It is given in cubic meter of free air.

2.10.SUMMARY: -

From the theory of reciprocating Compressor, it is clear that single stage reciprocating compressor working in polytrophic process is suitable for low pressure compressor.

III.COMPARISION OF CONVENTIONAL ONE WITH OURS

We know of several types of compressors made in many renowned factories at Coimbatore for various applications piston type, screwed type value type etc., but three pistons compressing air into a common compression chamber is not known to be an existing and so we decide to make this novel design to prove its superiority to others in cost and performance.Any new product must be novel and useful it must be superior is performance, reliable and dependable compared to known models.The cost of making must be comparatively low and in the market, it should be capable of competing similar products, is every way, colour appearance, value etc.Range must be based on from prospective users and customers. However first working model is only to prove superiority as per maker's claims.When it is compared with the existing ones it has very lesser vibration and lesser oil consumption and it is move reliable than the connectional ones because having less vibration and also it is a Novel-idea.

IV.DRAWINGS AND DESIGN

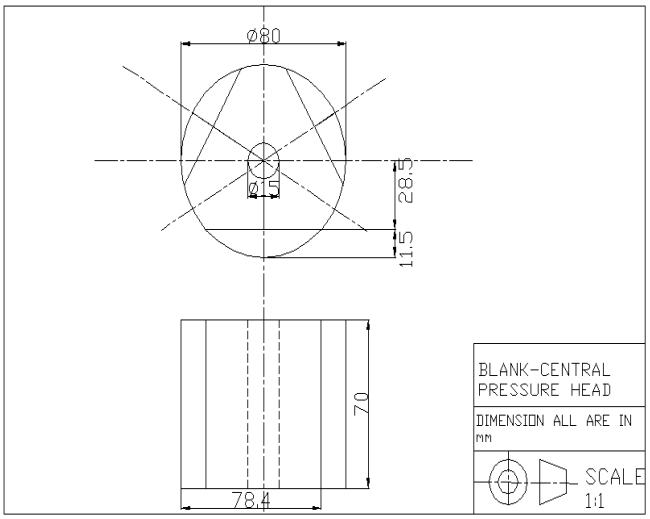

Fig. 1: Blank central pressure head

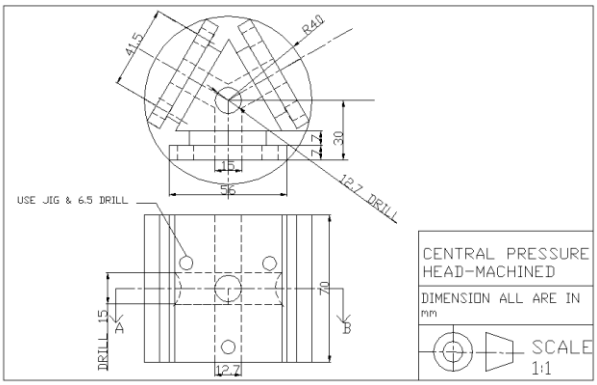

Fig. 2: Central pressure head-Machined

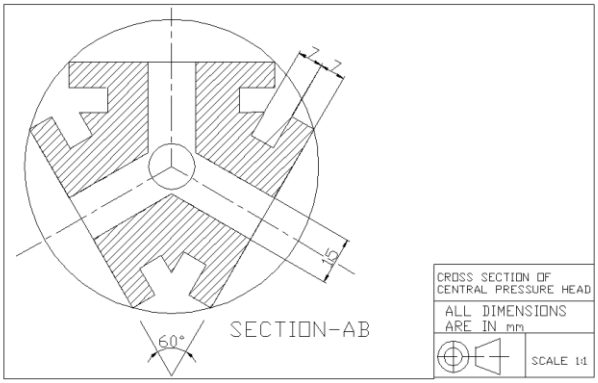

Fig. 3: Cross section of central pressure head

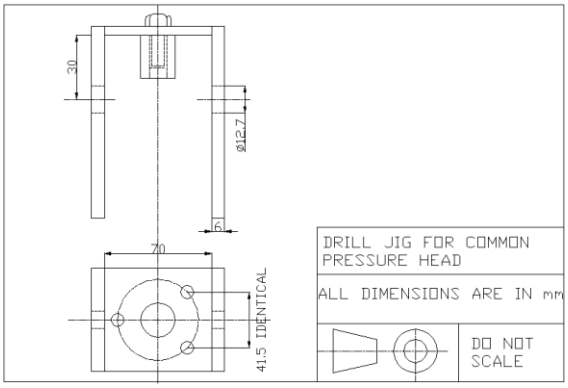

Fig. 4: Drill jig for common pressure head

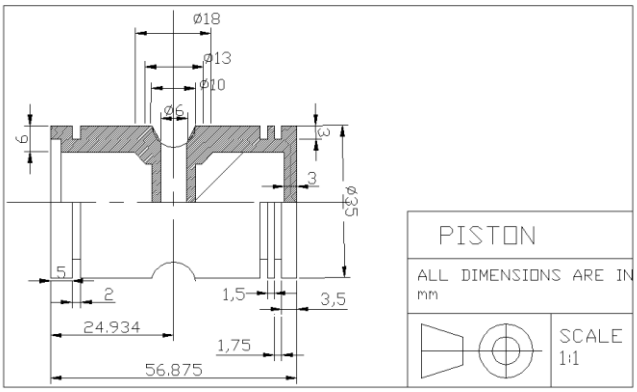

Fig. 5: Piston

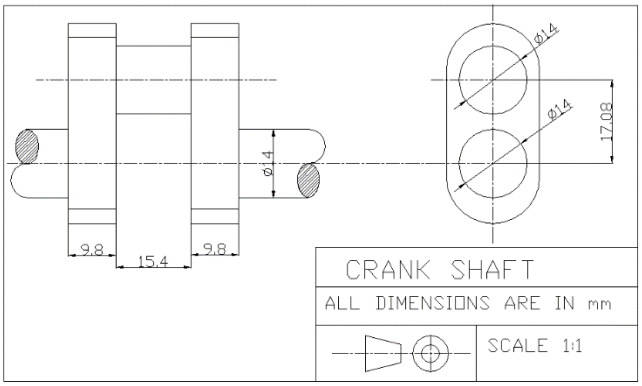

Fig. 6: Crank Shaft

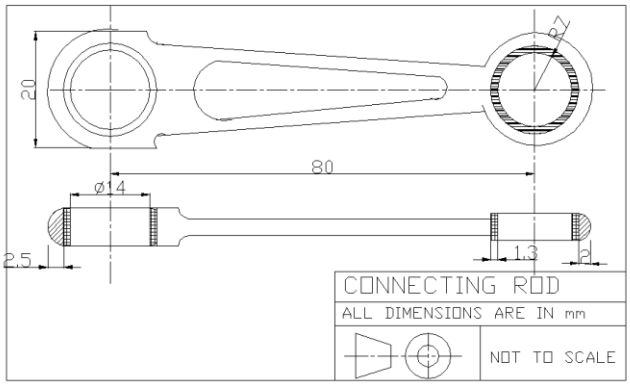

Fig. 7: Connecting Rod

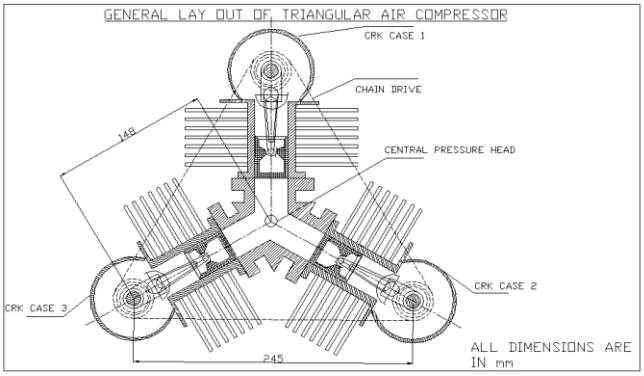

Fig. 8: General layout

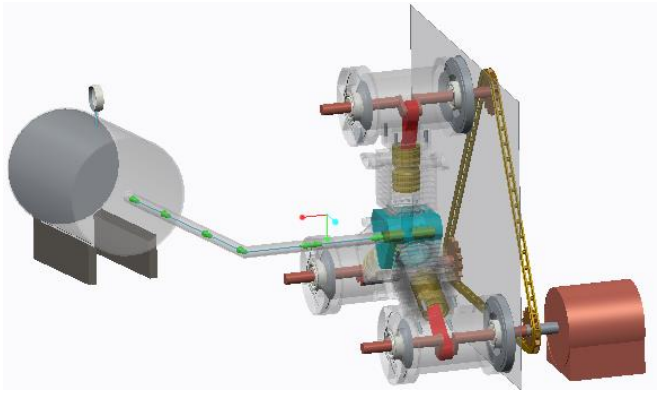

Fig. 9: 3D View

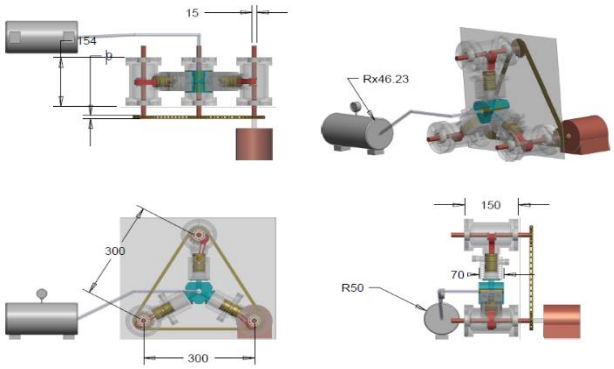

Fig. 10: Drafting View

V.MATERIAL SELECTION

It is an important part of engineering practice the choice of the material for our machine requirements, the proper use of those materials including the development of new ways of using them for greater effectiveness, all were or direct responsibility.

The selection of the material for the machine is reduced three broad constraints.

1. Service requirements
2. Fabrication requirements
3. Economic requirements

The service requirements, of course are permanent the material costs stand up to service demand. Such demands commonly include dimensional stability, corrosion resistance strength, hardness, toughness, heat resistance.

Fabrication requirements include the possibility to shape the material and to join it to other materials. The assessment of fabrication requirements concerns the question of machinability hardenability, ductility, castability and weldability, qualities which are sometimes difficult to assess.

Finally, there the economic requirement it is essential that the overall cost of machining and fabrication to be maintained to an optimum level without compromising and the quality.

Other factors which are considered for the selection of materials were

1. Availability
2. Economic (i.e.) Lower initial cost
3. Easy to fabricate
4. Capacity to meet service demands
5. Easy handling
6. durability

7. appearance
   The material used for fabrication of various parts of our compressor is: Mild steel, Cast Iron, Cast Aluminium.

5.1. Mild Steel

This is low Carbon steel with no precise Control over the Composition or mechanical properties. The cost is low in comparison with other steel and it with stand high pressure.

5.2. Cast Iron

It is the least expansion of all the meals that could be used for casting and hence it is considered first when a cast metal is being selected other metals are selected only when the mechanical and physical properties of grey cast iron are in adequate. Elastic modules is only 9×10^4 N/mm².

5.3. Cast Aluminium

Cast Aluminum is designation is 4250 it has good fluidity / pressure tightness and resistance to corrosion suitable for intricate casting, wieldable. The chemical composition of IS 4250 contains 0.1% Zn, 0.2%Sn, 0-1%Pn, 0-0.5%Sn rest aluminium.

VI.PARTS

Fig. 11: Common Compression chamber

Fig. 12: Chain and Sprockets

Fig. 13: Engine Assembly

Fig. 14: Motor

VII.OPERATION

7.1. Electrical Connection

The electrical power supply must be connected to the motor through starter. Start the unit momentarily and observe the direction of rotating the rotor. The direction should be clockwise. If the direction of rotation is not correct change the direction by interchanging and of the two places in the starter.

7.2. Adjusting Chain Tension

The chain tension between the motor and Crankshaft flywheel must be correctly adjusted with proper tension. Otherwise the Compressor will not run of the required speed.

7.3. Starting Procedure

The following are to be checked before starting the unit.

- Check the oil level in the oil indicator if the level is the oil level indicator if the level is below the minimum mark, add fresh oil to the correct grade.
- Check the chain tension
- Check the suction pipe air filler
- Check that the unit rotates freely by hard and that there is no mechanical obstructions
- Start the unit and allow it to run for a few minutes.

7.4. Checks during operation

- Check whether the running sound is normal
- Check the pressure developed by opening manometer safety device

If all the above preliminary checks are found satisfactory then the unit may be put to regular use.

VIII.MAINTENANCE PROCEDURE

A. Lubrication

The Crankshaft and Connecting Rod assembly is lubricated by lubricating oils as mentioned is the recommended lubricants chats oil should be filled in the oil tank which sprays oil into cylinder during the suction stroke. Care should be taken to see that the oil level is correctly maintained.

B. Daily

Check the oil level
Check the chain tension

C. Every two hours of operation

Clean the suction filter, to ensure long life for the values and the piston assembly.

D. Every 200 hours of operation

Check and adjust the chain tension.

Check all the bolts for tightness clean.
Check the developed pressure clean and adjust the safety valve if necessary.
Check the bearing sound.

E. Every 1000 Hours

The suction and delivery valves should be removed and the valve seats seating should be inspected for any score or damage. The valves may be lapped if necessary in their respective seats using fine lapping compound.Dismantle the crank shaft bearing and assemble it by new one or by applying grease.

F. Every 3000 Hours

The entire unit must be dismantled by an experienced hand who knows about the compressor in details and a general overhaul should be done. This will include inspection of all parts for wear and tear and replacement of damaged components, checking clearance between various components and assembling.

IX.FURTHER IMPROVEMENTS

The triangular air compressor with common compression chamber can be improved in following areas

1) Lubrication method to be improved to reduce wear and tear.
2) Inter cooling can be used to reduce the work done when multistage compression is used.
3) Pressure rise can be increased by reducing the clearance volume.
4) The production cost can be reduced by casting the cylinder and the head assembly in to a single piece.

X.CONCLUSION

The design and fabrication of triangular air compressor in the common compression chamber have been successfully completed and over all assembly of the compressor is drawn in this report. The performance of the compressor was found to be satisfaction and the output of the compressor is continuous it is up to the level expected further improvements can be done.

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