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Bike that Runs on Compressed Air (let's move from black oil past to a green air future…)

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Abstract- In the present energy scenario the rate of depletion of fossil fuel sources is increasing day after day and their combustion products are causing global environmental problems. So it is inevitable to shift towards the use of renewable energy resources which in turn will reduce pollution and save fossil fuels.

AIR POWERED ENGINE is an alternative technology which uses compressed air to run the engine and thus eliminates the use of fossil fuels.

Exhaust coming out would be air only and thus would help in controlling global warming and reducing temperature rise.

As we are going to convert the already existing conventional 4 stroke SI engine into an air powered engine, this new technology is easy to adapt. Another benefit is that it uses air as fuel which is available abundantly in atmosphere.

I. TECHNICAL BENEFITS

- Smooth working of the engine due to very less wear and tear of the components.
- There is no possibility of knocking
- No need of cooling systems and spark plugs or complex fuel injection systems.

1.2 Economic benefits:

- Less costly and more effective.
- Simple in construction.
- Low manufacturing and maintenance cost.
- Comparatively the operation cost is less.
- No fire hazard problem due to overloading.
- The price of filling air tanks is significantly cheaper than petrol, diesel.
- The air tank can be refilled in relatively less time than batteries can be recharged.

1.3 Environmental benefit:

Since the air engine inhales and exhales air only (it is pollution free) thus it is surely the futuristic mode of transport.

II. FOUR STROKE SI ENGINE

Conventional 4 stroke SI engine bikes run on gasoline. The 4 strokes are:

- SUCTION: in this stroke the piston moves from TDC to BDC and the air fuel mixture enters the engine cylinder.
- COMPRESSION: in this stroke the charge entered gets compressed (piston moves from BDC to TDC)
- EXPANSION: in this stroke spark plug sparks and the compressed charge gets burnt producing a large amount of pressure and heat forcing the piston to move from TDC to BDC. This very stroke is known as power stroke. THIS HUGE AMOUNT OF ENERGY CREATED GETS STORED IN THE FLYWHEEL WHICH IS USED IN MOVING THE PISTON DURING THE OTHER 3 STROKES OF THE CYCLE.
  1 CYCLE GETS COMPLETED IN 2 STROKES OF THE CRANKSHAFT.
- EXHAUST: in this stroke the flue gases produced in the combustion are discharged in the surroundings.

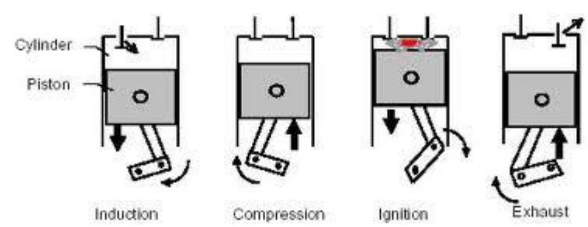
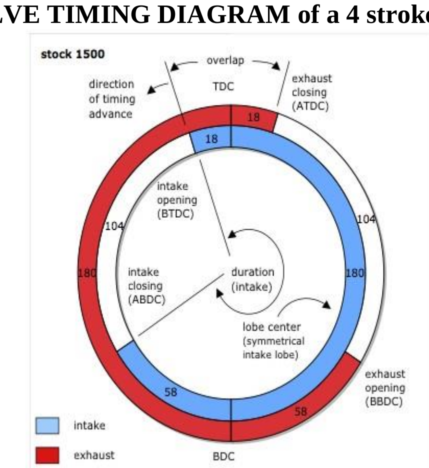
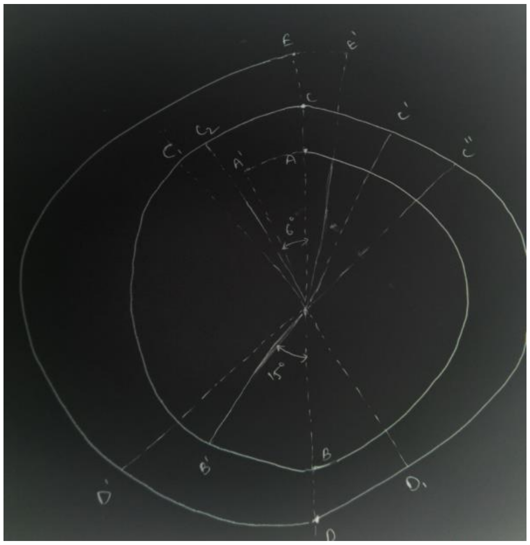


Fig 3.1 depicting the 4 strokes

3.2 VALVE TIMING DIAGRAM of a 4 stroke SI engine:





A' : 6 degrees remaining for exhaust stroke. IV begins to open.

A: exhaust is over. IV is fully OPENED.

B: suction stroke is over. IV begins to close. Piston is at BDC.

B': 15 degrees after beginning of compression stroke, IV is fully closed.

B' TO C1: only compression takes place.

C1: 20 degrees remaining for end of compression. Sparking begins.

C1 TO C2: 12 degrees of rotation during compression. Only sparking takes place.

C2: ignition begins.

C': 12 degrees of rotation is over from start of expansion.

C2 TO C': both sparking and ignition takes place.

C": 40 degrees of rotation is over from start of expansion.

C' TO C": only ignition takes place.

D1: 20 degrees of rotation remain for end of expansion.

B' TO D1: both valves remain closed. EV begins to open at D1. Heat rejection begins.

D: Piston is at BDC. EV is fully opened. Heat rejection continues.

D': 25 degrees of rotation is over from end of expansion. Heat rejection is over. Exhaust begins.

D' TO E: exhaust takes place. EV remains fully opened.

E: EV begins to close.

E TO E': 7 degrees of rotation takes place for suction of next cycle.

E": EV is fully closed.

KEY: IV – INLET VALVE, EV- EXHAUST VALVE, BDC – BOTTOM DEAD CENTER, TDC- TOP DEAD CENTER.

III. MODIFICATION OF THE 4 STROKE SI ENGINE INTO A PNEUMATIC ENGINE

The 4 stroke engine is modified into a pneumatic engine such that the suction stroke itself is the power stroke and the other stroke being the exhaust stroke.

The compressed air at 5 bar pressure is allowed to enter the engine cylinder in suction stroke which forces the piston to move from TDC to BDC. Now since during the second stroke of the 4 stroke SI engine, the EV remains closed so the problem of piston locking is faced. In order to move the piston back to TDC air admitted in the 1^{st} stroke must get out. So, it can be done by making changes in the cam profile(valve timing) such that both the valves open in alternating strokes(i.e in 1^{st} stroke IV opens, in 2^{nd} stroke EV opens, in 3^{rd} stroke IV opens and in 4^{th} stroke EV opens).

WE SOLVED THIS PROBLEM OF PISTON LOCKING BY CREATING A HOLE IN THE PISTON SINCE BEING STUDENTS WE COULD NOT ACCESS INDUSTRIES FOR MANUFACTURING CAMS.

We took out the fuel tank and incorporated a gas cylinder in place of the fuel tank supplying compressed air at a pressure of 5 bar in the engine cylinder.

4.1.1 CONVENTIONAL 4 STROKE SI ENGINE CAMS:

FIG 4.1.1 4 STROKE SI ENGINE CAMSHAFT

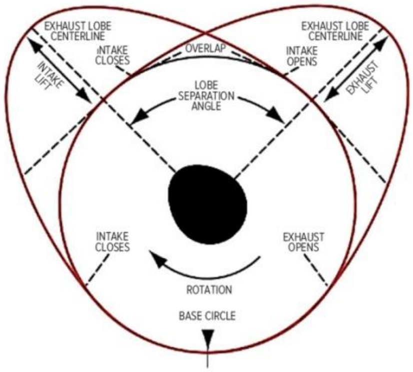


FIG 4.1.1 CONVENTIONAL CAM DESIGN

4.1.2. OUR PROPOSED DESIGN OF THE CAMSHAFT FOR MODIFYING CONVENTIONAL 4 STROKE SI ENGINE INTO A PNEUMATIC ENGINE:

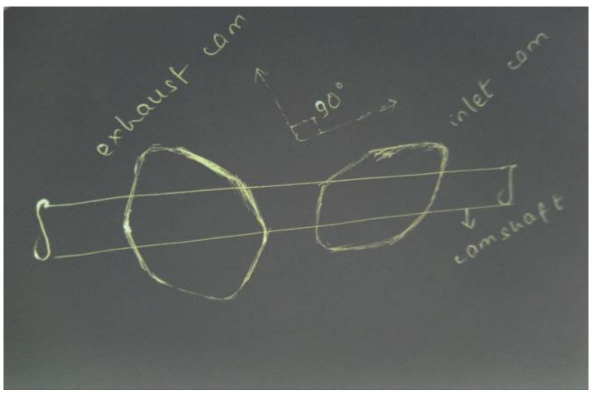


Fig 4.1.2 isometric view (both cams are at a phase angle of 90 degrees)

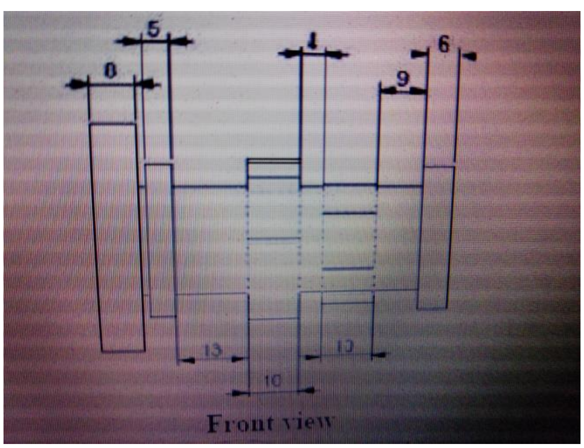


FIG 4.2.2 FRONT VIEW

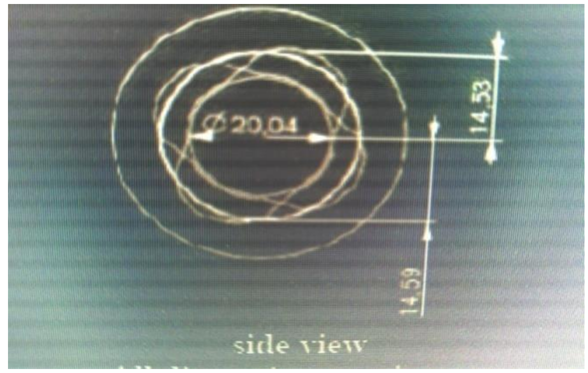


FIG 4.2.2 SIDE VIEW

WITH THE PROPOSED CHANGES IN CAM THE PNEUMATIC BIKE WITH THE HELP OF COMPRESSED AIR WOULD ACHIEVE A 50 KMPH SPEED AND THE RANGE OF REFILLING COMPRESSED AIR WOULD BE AFTER RUNNING OF 70-80 KILOMETERS.

IV. ADVANTAGES

- Less costly more effective.
- The air engine is an emission free piston engine that uses compressed air as the source of energy.
- Simple in construction.
- Easy to maintain and repair.
- No fire hazard problems due to overloading. Air on its own is non flammable.
- Low manufacturing and maintenance cost.
- Comparatively the operation cost is less.
- Light in weight and easy to handle.
- Compressed air tanks can be disposed off or recycled with less pollution than batteries.
- Compressed air engines are unconstrained by the degradation problem associated with the current battery systems.
- The air tank can be refilled in less time than the time taken by the batteries to get recharged.
- The cost of filling air tanks is significantly less than petrol or diesel.

V. CONCLUSION

Compressed air for vehicle propulsion is already being explored and now air powered vehicles are being developed as more fuel efficient means of transportation. Some automobile companies are further exploring compressed air hybrids and compressed fluids to store energy for vehicles which might point the way for the development of a cost effective air powered vehicle design. Unfortunately there are still serious problems to be sorted out before air powered vehicles become a reality for common use but there is a hope that with the development in science and technology well supported by the environmental conscious attitude and need to replace costly transportation methods, air powered vehicles will definitely see the light of the day.

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