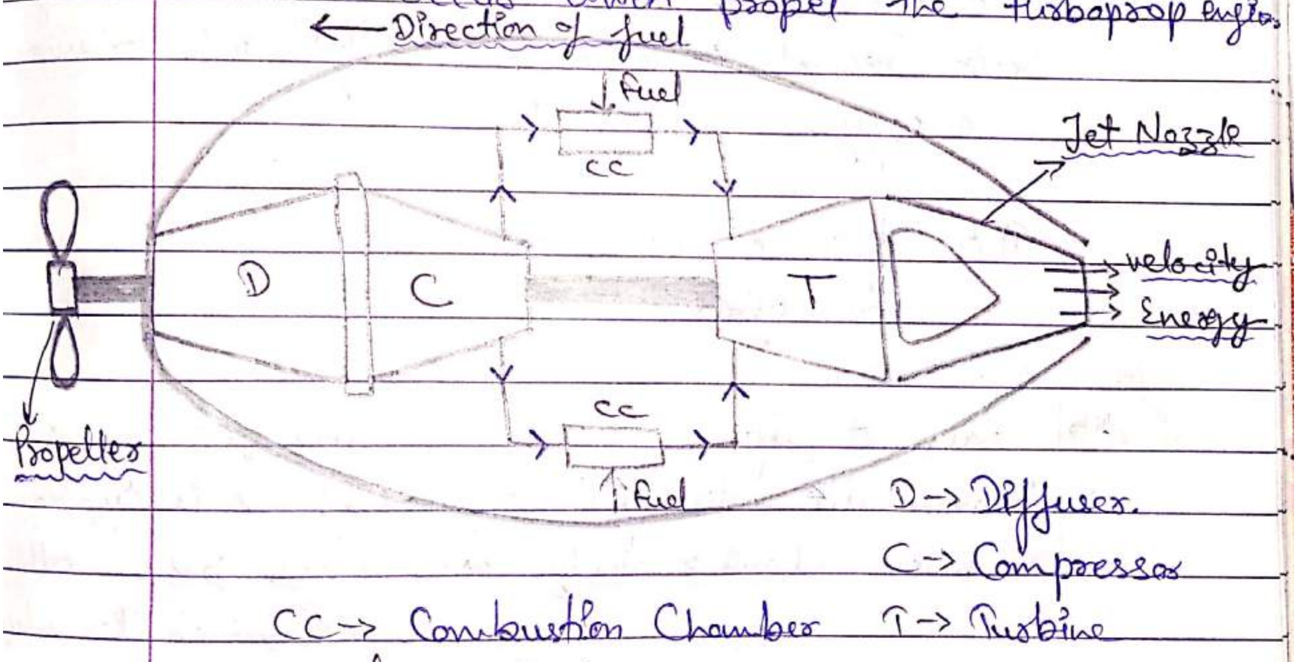
Section-2

Q1 Ans

i) Construction of Turboprop :- Turboprop engine, also called turbo shaft engine or prop-jet engine.

- It consists of following parts such as:-

(a) Compressor → To compress the inlet air.
(b) Combustion Chamber → To burn the compressed air with fuel.
(c) Turbine :- To expand the burnt air-fuel mixture.
(d) Nozzle :- Expansion of burnt air-fuel mixture occurs which propel the turboprop engine.



D → Diffuser.
C → Compressor
CC → Combustion Chamber T → Turbine

fig :- Turboprop.

ii) Principle of Turboprop :- In this system, the gases are partly expanded in turbine & partly in nozzle which means about 80% expansion of gases take place in turbine and 20% expansion takes place in nozzle.

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⇒ <u>Working of Turboprop</u> :- The turbine develops power to run the Compressor and propeller.

- The propeller & jet produced by the nozzle give forward motion to air craft.

- By using diffuser before the compressor, overall efficiency of the turboprop is improved.

- In diffuser, pressure of gases rise, due to conversion of Kinetic energy of the incoming air (equal to aircraft velocity) into pressure energy.

- This type of compression is known as Ram effect.

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Principle of Jet Propulsion :- (Ram Jet Engine)

- Principle of Jet propulsion involves imparting momentum to a mass of fluid in such a manner that the reaction of imparted momentum provides a propulsive force.

- Jet propulsion refers to the imparting of forward motion to the object as a reaction to exit to high velocity gas or liquid stream from the rear end of object.

- It is based on the principle of Newton's Second law & third law of motion.

- Due to change of momentum in fluid stream, the rxn to the impulse is created which gives propelling thrust to the engine.

Working of Jet Propulsion System :-

- A fan at the front sucks the cold air into the engine & forces it through the inlet. This slows down the air by about 60 percent.

- A second fan called a compressor squeezes the air (inc.(ies) its pressure) by about eight times & this dramatically inc.(ies) its temp.

- Kerosene (liquid fuel) is squirted into the engines from a fuel tank in the plane wing.

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- In the combustion chamber, just behind the compressor, the kerosene mixes with the compressed & burns fiercely, giving off hot exhaust gases which results a huge inc.(ies) temp. The burning mixture reaches a temp. of around 900°C.

- The exhaust gases rush past a set of turbine blades spinning them like a windmill.

- The turbine blades are connected to a long axle that runs the length of the engine.
- The compressor & the fan are also connected to this axle.
- So, as the turbine blades spin, they also turn the compressor & the fan.

- The hot exhaust gases exit the engine through a tapering exhaust nozzle.
Just as water squeezed through a narrow pipe accelerates dramatically into a fast jet.

⇒ Propulsive Power :- It is defined as the difference b/w the rate of kinetic energy entering with air & leaving with jet of exit gases.

⇒ Propulsive Efficiency :- It is defined as the ratio of thrust power to propulsive power.

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The Basic Solid Rocket Motor or Engine:-

- A soild propellant rocket is formed by four main components. (fig 1)

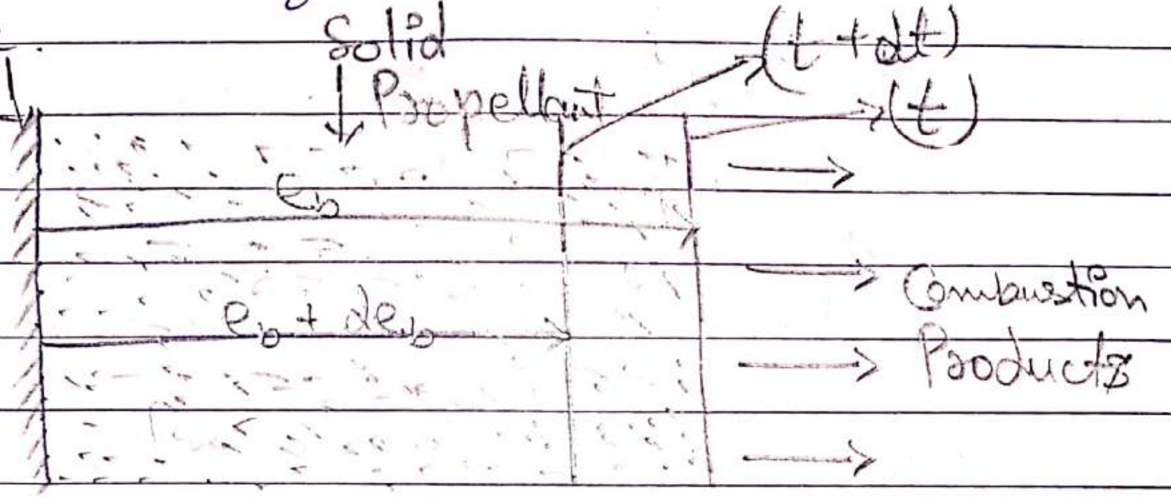
- A case containing the soild propellant & withstanding internal pressure when the rocket is operating.

- The solid propellant charge (or grain), which is usually bonded to the inner wall of the case, & occupies before ignition the greater part of its volume.

- The nozzle channels the discharge of the combustion products & because of its shape accelerates them to supersonic velocity.

- The igniter, which can be a pyrotechnic device or small rocket, starts the rocket operating when an electrical signal is received.

- one can consider that the solid propellant after manufacturing is in a metastable state.
- It can remain inert when stored or it can support after ignition its continuous transformation into hot combustion products. The velocity of the transformation front is called burning rate.



$r_b = de_b / dt$

Fig 8 – Solid Propellant Rocket Engine.

Liquid Propellant Rocket Engine :-

- Liquid propellant engines pioneered by Pedro Paulet in 19th Century.
- Propellants not burned the same place they are stored (like solids are)
- Must have a way to transport propellants from tanks to combustor(s)
- Methods of moving propellant vary in cost, complexity, weight & performance
- Relies on a press. to force propellant from the tank to the combustor.
- Thrust-limited due to the size of the press. tank.
- Shuttle OMS, AJ-10 (Delta-II), Kestrel (Falcon 1), Apollo LM Descent engine.

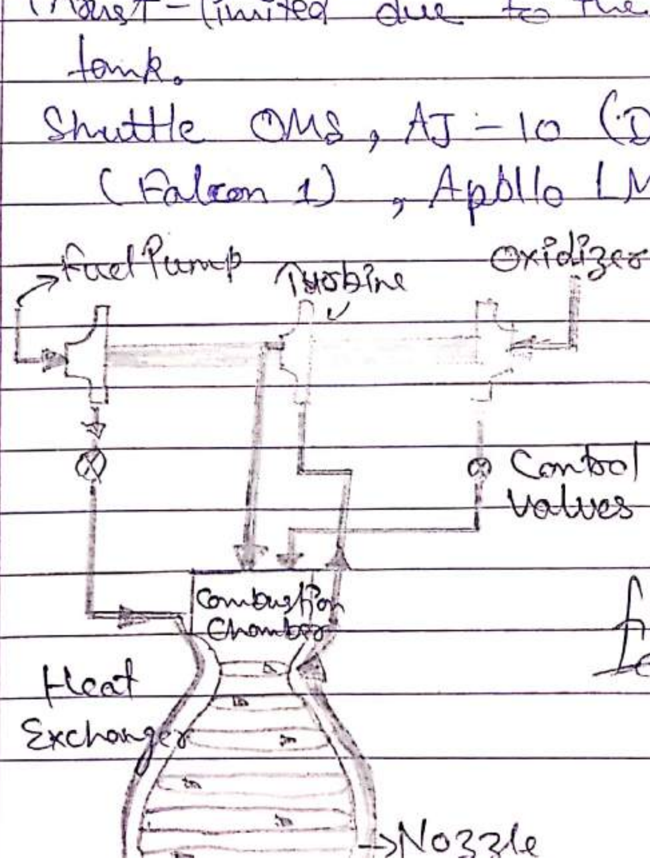


fig :- Liquid Propellant Rocket Engine