

pression. In both cases the combustion gases expand, thus forcing the piston downwards. On completion of the third stroke, the crankshaft has passed through one and a half revolution (Fig. 28).

Fourth stroke – exhaust. The piston moves towards the top dead-centre, while the exhaust valve is open. The gases in the combustion chamber escape through the exhaust valve due to the fact that their pressure is above atmospheric. Remaining gases are finally pushed out by the piston. On completion of the fourth stroke, the crankshaft has completed two revolutions (Fig. 29).

(c) Peculiarities of the Four-stroke Cycle

To ensure a high efficiency of the engine, the combustion chamber should be filled completely with fuel-air mixture or, in case of a compression-ignition engine, with pure air. For this reason, the intake valve is opened before the piston has reached top dead-centre, that is to say, while the discharge of the burnt gases has not yet been completed. This is necessary because the process of opening the intake valve from the beginning until the intake port is completely open, takes some time, no matter how short it is.

Taking into consideration that the piston moves in the cylinder at a high speed, we know that the period of time which is necessary to allow the valve to open is sufficient for the piston to move through the short distance up to top dead-centre. When the piston moves downwards, the intake valve is fully open.

The exhaust valve is also opened shortly before the power stroke is completed, that is to say, before the piston has reached bottom dead-centre. This ensures that the still compressed gases can escape quickly and completely. Further, only a very small resistance is offered to the piston in discharging the remaining gases from the cylinder. This has a favourable effect on the efficiency of the engine.

The heat of combustion generated by the high ratio of compression in the combustion chambers of compression-ignition engines is in the order of 50° to 700°C . The ignition temperature of Diesel fuel normally is about 350°C so that self-ignition is ensured. Unlike the petrol engine, where only highly-volatile fuels are used, in the compression-ignition engine a non-volatile fuel is used. These fuels, oils or heavy-oils, are atomised when they are injected through the injection nozzle into the combustion chamber at pressures between 65 and 300 atmospheres gauge pressure and thus are mixed with the compressed air.

(3) Two-stroke Engines

(a) Design

Besides the four-stroke cycle described above, there is the two-stroke cycle which has proved successful in practice. Above all, small passenger cars and lorries are equipped with two-stroke engines, and recently even light tractors have been operated on this cycle. Fig. 30 shows a two-wheel tractor equipped