CHAPTER XVII

ENGINE STARTING

Air-cooled engines are started in the same manner as water-cooled types, but they reach operating temperature sooner, which makes for lower cylinder wear. With ambient temperatures below freezing point, an air-cooled engine is at an advantage, there being no water to attend to.

At temperatures from —20 to —25 °C frictional loss with the oil stiff is equal to the m.e.p. and the engine is therefore unable to overcome its own resistance.

At extremely low temperatures (such as —30 to —40 °C) the engine must be pre-heated directly by a petrol blow-lamp. Heating of cylinders and inlet manifold takes from 3 to 10 minutes according to outside temperature. The overall time for starting an air-cooled engine is about one third of the time needed for a water-cooled engine. A water- cooled engine must be pre-heated with steam at such low temperatures for even hot water poured into the cold engine freezes immediately at temperatures around —40 °C. Condensed steam may also freeze in the engine and preparations are thus delayed. After pre-heating with steam, the cooling system must be filled up with hot water, this all adding to the time needed for engine starting. The induction of warm air during starting is important. For this reason the inlet manifold is heated, or in the case of oil engines, auxiliary combustion is provided in the inlet manifold, by an ignited spray of fuel. The burning mixture of fuel and air enters the cylinder, increasing temperature at the end of the compression stroke. The fuel spray is ignited by a sparking plug (JAZ 204) or by a glowing coil.

During the starting of a compression-ignition engine at very low temperatures, almost double the usual quantity of fuel must be injected into the cylinders and injection must be retarded until almost t.d.c. in order to inject the fuel into heated air. Precautions must be taken to prevent fuel oil from solidifying by heating the injection pump and by leading the exhaust in the proximity of the fuel supply line and the fuel tank.

In tractor engine design, provision must be made by the designer for the generally poor standard of maintenance and an accumulator therefore cannot be relied on to supply current for the usual type of electric starter. Inertia starters are therefore employed. Kinetic energy is accumulated in such a starter by the cranking of a flywheel by hand and the flywheel is then con-

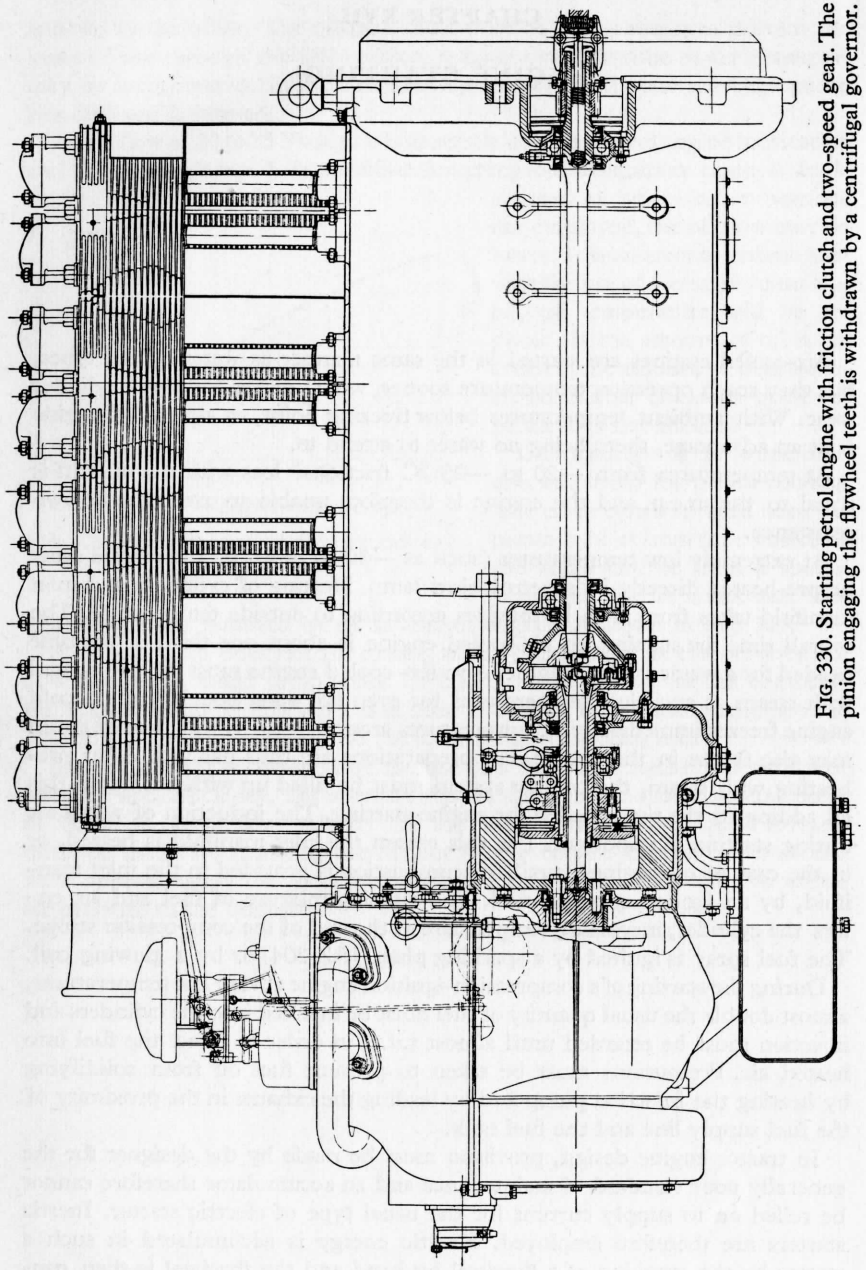

FIG. 330. Starting petrol engine with friction clutch and two-speed gear. The pinion engaging the flywheel teeth is withdrawn by a centrifugal governor.

nected to the crankshaft by a dog clutch. The energy accumulated will turn the engine crank several times; such a method of starting is reliable, but a great amount of physical effort is required when temperature is low [9].

Very satisfactory results have been obtained by the use of an auxiliary starting engine run on petrol. Compression-ignition engines are fitted with a small petrol engine, usually a twin-cylinder type, which is easy to start by hand even at very low temperatures. This auxiliary engine also assists starting by heating the engine by the outgoing cooling air and by heating the induction manifold or oil by its exhaust gases.

This method of engine starting is employed on the Tatra 904 engine shown in Fig. 330. The output of the small engine is transmitted through a friction clutch and two-speed gear to the geared flywheel. The higher gear is for turning the engine, the lower for actual starting. The pinion engaging with the flywheel teeth is withdrawn at a given flywheel speed by a centrifugal governor which releases a spring to withdraw the pinion. Such a starting mechanism is very convenient and has proved its value also on the ČKD caterpillar tractor.

In order to facilitate engine heating with a blow-lamp the cooling air duct should be provided with a detachable cover and a correctly set lamp holder. After heating the engine the duct must naturally be closed again in order to prevent large cooling air losses.

If the vehicle is equipped with a heating system independent of the engine (e.g. South Wind, Eberspächer etc.) the hot air produced may also be used to heat the engine prior to starting.

Starting difficulties in summer may arise when petrol evaporates from the warm carburettor after the engine has stopped. When the usual type of fuel pump driven from the engine is employed, the engine must be run on the starter for a long time before the carburettor is filled up again. The remedy lies in providing good heat insulation for the carburettor, the prevention of vapour loss from the float chamber by a special valve or in the use of an electric fuel pump switched on together with the ignition.

The fuel line to the fuel pump must lead through a cool region and avoid the exhaust pipe area in order to minimise the formation of vapour locks.