CHAPTER 1

INTRODUCTION

The spark-ignition engine requires a fuel that will readily evaporate in the air stream drawn into the carburettor, be readily ignited in the cylinder by a spark, and burn smoothly without knocking or other operational difficulties. Petroleum gases, town gas, gasoline, kerosine, benzole, and lower alcohols can and have all been used, but gasoline is the preferred fuel in almost universal use. All of the fuel has been converted into carbon dioxide and water. In the practical case, however, some of the hydrocarbons are unburnt or incompletely burnt, carbon monoxide is formed as well as carbon dioxide, and to a small extent some of the nitrogen and oxygen from the air combine together under the temperature conditions in the combustion chamber to form oxides of nitrogen are undesirable constituents of exhaust gas because of their contribution to atmospheric pollution. Different hydrocarbons show marked variations in their pre-flame and ignition characteristics, and so differ in their combustion behaviour in an engine. Studies of the pre-flame reactions taking place in the cylinder indicate in general that those fuels which undergo the greatest amount of pre-flame

oxidation have the greatest tendency to self-ignite, and are therefore the most susceptible to knock. The problem of knock is important in spark-ignition engines for a number of reasons. First, it represents a design limitation in achieving maximum power output and efficiency. Secondly, it can cause or contribute to engine damage under severe conditions and lastly, the disturbing noise it makes can cause apprehension on the part of the motorist. It is well known that lead alkyls have provided the most cost-effective anti-knock additives for the last 60 years. At present, in many countries it is necessary to use exhaust catalyst systems in new car models to achieve the required levels, and this has meant that unleaded fuel is required. Concerns about the toxicity of lead itself have also played a large part in forcing the introduction of unleaded fuels. Compared with leaded, unleaded gasoline needs higher octane quality components in order to achieve the specified octane levels, and this has given rise to major changes in composition. Certain oxygenated compounds such as methanol, ethanol, methyl tertiary butyl ether and others have been promoted as lead substitutes, since they have proved to be valuable in helping to achieve the required octane quality for low-leaded and unleaded gasolines. These materials are perhaps more appropriately regarded as blend components than additives, since they are used at relatively high concentrations. Suitable

non-toxic organometallic compounds which could be used in place of lead as octane dope in gasoline would be very useful. A group of compounds selected for detailed investigation in this study were organotin compounds.