AN INVESTIGATION OF COMBUSTION PHENOMENA
ASSOCIATED WITH DETONATION IN
INTERNAL COMBUSTION ENGINES

by

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Except where specific reference is made to the work of others, this work is original and has not been submitted to any other University in any form.

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SYNOPSIS

The various theories on the possible combustion mechanism of the end-gas in an engine cylinder are first reviewed.

The development of a dynamic capacity-strain type pressure measuring cell to investigate the physical phenomena associated with explosive combustion is then described. Where extraneous effects caused by metallic ringing become prohibitive, it was found possible to isolate the pick-up to reduce such to a minimum. With a high-frequency response in the measuring equipment such effects can mask the recording of the actual phenomena under investigation. The pick-up requirements to follow a steep transient disturbance, experienced in explosive combustion, are also discussed. It is concluded that a pick-up cell resonant frequency of at least 360 Kc. is necessary.

The pre-knock behaviour, with possible two-stage or single-stage combustion, is evident from the many photographic traces taken. No definite confirmation of a detonation-wave passing through the end-gas is indicated and this must await the outcome of further work. Evidence of the "vibratory combustion" type of gas vibration appears to show that a detonation wave need not be a pre-requisite for engine knock. It is also shown that pre-knock vibrations may or may not be present before knock. It would seem that knocking-combustion in an actual engine cylinder takes on a form closely resembling that found by the N.A.C.A. investigators in their special combustion apparatus.

The post-knock behaviour of the cylinder gases is shown to be of a complex form. One or more modes of gas vibration may be excited. A change in mode as the piston descends and
a distortion of the nodal surfaces caused by the chemical and physical non-homogeneity of the gases is indicated.
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