p. 25  Eq. 1.4.5 should read:

\[ F_{tdc} + G_{tdc} = \sqrt{(L_{cr} + L_{ct})^2 - D^2} \]

Eq. 1.4.6 should read:

\[ \theta_{tdc} = \tan^{-1}\left(\frac{D}{F_{tdc} + G_{tdc}}\right) \]

Eq. 1.4.8 should read:

\[ F_{tdc} = -L_{ct} \cos \theta_{tdc} + \sqrt{(L_{cr} + L_{ct})^2 - D^2} \]

Eq. 1.4.9 should read:

\[ F_{bdc} = \sqrt{(L_{cr} - L_{ct})^2 - D^2} \]

p. 26  Eq. 1.4.18 should read:

\[ H_i = \sqrt{(L_{cr} + L_{ct})^2 - D^2} - \sqrt{L_{cr}^2 - (L_{ct} \sin \theta - D)^2} - L_{ct} \cos \theta \]

p. 412  Paragraph 4, last line, “enging” should read “engine.”

pp. 568 and 569  In the captions of Figs. 5.36(b) through 5.40, “Ducati 995” should read “Ducati 955.”

pp. 294 and 296  Figures 2.58(a) and 2.58(b), referred to on these pages, are missing from the text. These two figures are reproduced below:

![Friction causing wave reflections from compression and expansion waves.](image)

Fig. 2.58 Friction causing wave reflections from compression and expansion waves.
Postscript

I can think of no better postscript for this book than to continue the unimaginative pattern of applying the doggerel verse that originally appeared on the flyleaf of the previous book. The fact is that the sentiments expressed then are even more apt in this book than they were in that dedicated to the design of two-stroke engines, particularly as the four-stroke engine is highlighted in a winning context, Jack Williams and Joe Craig and their 7R AJS and Manx Norton racers are rightly lauded in the text, and the last line became prophetic.

THE SECOND MULLED TOAST

When as a student a long time ago
my books gave no theory glimmers,
why two-strokes ended in second place slow,
and four-strokes were always the winners.

Williams and Craig were heroes enough
whose singles thumped to Tornagrough,
such as black 7R or silver Manx,
on open megas they enthused the cranks.

Wallace and Bannister gave me the start
into an unsteady gas dynamic art,
where lambdas and betas meshed in toil
for thirty years consumed midnight oil.

With the parrot on Bush a mental penny
into slot in brain fell quite uncanny.
Lubrication of grey cells finally gave
an alternative way to follow a wave.

That student curiosity is sated today
and many would describe that as winning.
Is this then the end of the way?
No, learning is aye a beginning.

Gordon Blair, July 1994

…and finally, to answer those many queries…

Tornagrough (pronounced as “tawernagruff”) is a bend on the Dundrod circuit where the Ulster Grand Prix is held and at which spot I watched Juan Manuel Fangio flip a BRM backward and was a flag marshal forty years ago when John Surtees won on the MV Agusta…and Bush is the local colloquialism for the amber nectar produced at the world’s oldest licensed whiskey distillery at Bushmills, Co. Antrim, a modicum of which has been known to ease the pain caused by reading a book containing excessive quantities of thermodynamics and unsteady gas dynamics…
Appendix

Computer Software and Engine Simulation Model

1. Computer Software for Education and Design

The following software is available from SAE as a single executable file for installation on either IBM® PC (or compatible) or Macintosh® computers. This software has been written by the author of this book and contains a series of programs based on the theory within the various chapters of the book. These can be easily accessed in a user-friendly format.

Each program contains an information page detailing precisely the theory being employed and its location within the book. Included are tips and hints on how to use the program most effectively.

Each program also contains a set of input data straight from the relevant section of the book. By clicking the 'calculate' button, the program produces the same numbers and graphics that appear on the printed page. The ensuing variation of, and computation of, input data greatly enhances the discussion presented in the book.

Many of the programs allow input and output data to be inserted into other graphics packages, retrieved for further design activity, or transmitted to others for, say, manufacturing purposes.

The following is a complete listing of the programs in this software package:

1. Engine and Crank Geometry (based on theory in Chapter 1)
2. Basic Engine Performance (based on theory in Chapter 1)
3. Four-Valve Head Layout (based on theory in Chapter 1)
4. Two-Valve Head Layout (based on theory in Chapter 1)
5. Exhaust Valve Design (based on theory in Chapters 1 and 6)
6. Intake Valve Design (based on theory in Chapters 1 and 6)
7. Air Standard Otto Cycle (based on theory in Chapter 1)
8. Air Standard Diesel Cycle (based on theory in Chapter 1)
9. Otto Cycle (Phased Burn) (based on theory in Chapters 1 and 4)
10. Diesel Cycle (Phased Burn) (based on theory in Chapters 1 and 4)
11. Simple Wave Flow (based on theory in Chapter 2)
12. Wave Superposition (based on theory in Chapter 2)
13. Friction and Heat Transfer (based on theory in Chapter 2)
Design and Simulation of Four-Stroke Engines

14. Temperature Discontinuity (based on theory in Chapter 2)
15. Restricted Pipe (based on theory in Chapter 2)
16. Three-Way Branched Duct (based on theory in Chapter 2)
17. Cylinder-Pipe Boundary (based on theory in Chapter 2)
18. Valve Discharge Coefficient (based on theory in Chapter 3)
19. Intake Ramming (based on theory in Chapter 6)
20. Exhaust Tuning (based on theory in Chapter 6)
21. Diffusing Silencer (based on theory in Chapter 7)
22. Side-Resonant Silencer (based on theory in Chapter 7)

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2. Engine Simulation Model

An engine simulation model, similar to the GPB simulation model described in this book, is available for installation on IBM® PC (or compatible) computers. This model is based on the theory within the various chapters of the book. The application of the model is discussed in Chapters 5–7.

The GPB simulation model described within this book was written by the author exclusively for the Macintosh® Power PC computer, whereas that written for the IBM® PC platform has been produced through the joint efforts of the author and the personnel of OPTIMUM Power Technology of Bridgeville, Pa.

The engine simulation model for the IBM® PC platform will simulate a single-cylinder naturally-aspirated four-stroke engine with the following attributes:

- Almost any two-valve or four-valve cylinder head
- Almost any intake ducting geometry and simple silencer
- Almost any exhaust ducting geometry and simple silencers

In addition, the model allows the following:

- Selection from a menu of Diesel and Otto cycle combustion processes
- Varying of Otto and Diesel fueling over a sufficiently wide range
- Selection from a limited menu of discharge coefficient maps for valves, etc.
- Selection from a limited menu of diesel and gasoline fuels

The input data for the simulation have been prepared in a user-friendly format, and are supplied in a separate program with the simulation. This program contains information and help pages to assist the user.

The simulation model and the input preparer package permit the user to insert input and output data into other graphics packages and retrieve the input data for further design activity. The output data appears as a prediction of the engine performance characteristics, including power, torque, fuel consumption, airflow, emissions and noise characteristics, etc., and the associated time-varying data of pressures, temperatures, etc., much as presented within
Appendix

Chapters 5–7 of the book. Users must have Microsoft® Excel available on the computer to observe the graphic output data from the simulation.

For more information on this or other SAE products, contact SAE Customer Sales and Support at 724-776-4970; fax 724-776-0790; e-mail: publications@sae.org; web: www.sae.org/BOOKSTORE.
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