BRITISH DIESEL ENGINE CATALOGUE

SECOND EDITION

Issued by
THE BRITISH INTERNAL COMBUSTION ENGINE MANUFACTURERS' ASSOCIATION
London

BRITISH DIESEL ENGINE CATALOGUE

Second Edition

Oil Engines of the Compression-ignition Type for Industrial (Stationary and Transportable), Railway Traction and Marine Duties, made by Member Concerns of the British Internal Combustion Engine Manufacturers' Association.

Published for the
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INTRODUCTION
TO THE
BRITISH DIESEL ENGINE CATALOGUE
(Second Edition)

THE purpose of this book is to provide, in a speedy and convenient manner, information about Diesel engines of 33 makes emanating from the United Kingdom. The particulars given are planned to assist both expert and novice, the facts and figures being simply set forth so that the reader can select any that are of use to him.

Since the issue of the first edition of this Catalogue in 1947 we have embodied additional information and made the unique Lightning Index of even greater value for rapid identification of required engine models. As before, engines are separately indexed for : (1) Industrial duties ; (2) railway traction purposes ; (3) marine propulsion; (4) marine auxiliary services.

The tables of specifications, in appropriate sections devoted to the various makes, are similar in layout and contents, so that quick and accurate comparisons can be made. All vital statistics regarding any engine are in these tables ; there is no need to search through pages of text for commonly required vital figures.

Engine types in this book are those listed by their respective manufacturers as available in 1950.

D. S. DODSLEY WILLIAMS, A.M.I.Mech.E.
Editor.

Translations of this introduction, in French, Spanish and Portuguese, appear on page iv.

Introduction Du Catalogue des Moteurs Diesel Britanniques (" B.D.E.C.")

CE LIVRE a pour but de donner, d'une manière rapide et pratique, des informations sur les Moteurs Diesel de 33 marques différentes produits par le Royaume-Uni. Les indications données sont étudiées de façon à assister l'expert aussi bien que le novice, les faits et les chiffres étant cités simplement pour que le lecteur puisse choisir parmi eux ceux qui lui sont utiles.

Depuis la publication de la première édition de ce catalogue en 1947, nous avons englobé des informations supplémentaires et nous avons donné à l'unique Index Eclair une valeur plus grande encore pour aider à l'identification rapide des modèles de moteurs requis. Comme auparavant, les moteurs sont classés séparément en (1) Services industriels ; (2) pour les Services de traction de Chemins de fer ; (3) Pour la propulsion marine ; (4) pour les services auxiliaries marins.

Les tables des spécifications, dans les sections consacrées aux différentes fabrications, sont d'une disposition et d'un contenu similaires, de sorte qu'il est possible de faire rapidement des comparaisons précises. Toutes les statistiques importantes concernant les moteurs sont indiquées dans ces tables ; il n'est point nécessaire de chercher à travers les pages du texte pour trouver les chiffres de valeur vitale que l'on désire de temps à autre.

Les types de moteurs présentés dans ce livre sont ceux qui sont catalogués par les différents fabricants comme étant disponibles en 1950.

D. S. DODSLEY WILLIAMS, A.M.I.Mech.E.
Editeur.

Introduccion al Catalogo del Motor Diesel Britanico (" B.D.E.C.")

EL objeto de este libro es el de ofrecer, de una manera rápida y conveniente, información con respecto a los motores Diesel de 33 marcas provenientes del Reino Unido. La información proporcionada ha sido proyectada para servir de ayuda tanto al experto como al novicio, siendo que los datos y las cifras se recopilan de modo tan sencillo que el lector puede fácilmente seleccionar aquellos que le sean útiles.

Desde la publicación de la primera edición de este Catálogo en 1947, hemos incorporado información adicional, y compilado el " Indice Relámpago " único en su género, que resulta de ayuda aun más valiosa en la rápida identificación de modelos deseados de motor. Como antes, hay divisiones separadas en el índice para :—(1) Motores para servicios industriales ; (2) para tracción en ferrocarriles ; (3) para propulsión marítima ; (4) para servicios marítimos auxiliares.

Los cuadros de especificaciones, en secciones apropriadas dedicadas a las diversas marcas, son similares en disposición y contenido, de modo que se puedan hacer comparaciones rápidas y exactas. Todos los datos estadísticos vitales con respecto a cualquier motor figuran en estos cuadros, y, en consecuencia, no hay necesidad de escudriñar páginas de texto para buscar las cifras vitales que con mayor frecuencia se exigen.

Los tipos de motores que figuran en este libro son aquellos que sus fabricantes tienen en su lista de modelos disponibles en 1950.

D. S. DODSLEY WILLIAMS, A.M.I.Mech.E.
Editor.

Prefacio ao Catalogo do Motor Diesel Britanico (" B.D.E.C.")

TEM este livro por fim fornecer, duma maneira rápida e conveniente, informações sôbre motores Diesel de 33 marcas procedentes do Reino Unido. As informações prestadas são de molde a ajudar tanto o especialista como o leigo, achando-se os fatos e os dados estatísticos dispostos de modo simples para que o leitor possa escolher quaisquer que lhe sejam úteis.

Desde a publicação da primeira edição deste Catálogo, em 1947, incluimos informações adicionais e tornamos o Indice Relâmpago de ainda maior valor para a rápida identificaçao dos modelos de motores. Como dantes, os motores acham-se distribuidos por índices separados, para : (1) serviços industriais ; (2) fins de tracção ferroviária ; (3) propulsão marítima ; (4) serviços auxiliares marítimos.

Os quadros de especificações, nas secções apropriadas consagradas às respectivas marcas, são idênticos quanto à sua disposição e matéria, de modo a tornar possíveis comparações rápidas e exatas. Todas as estatísticas essenciais relativas a qualquer dos motores consta destes quadros ; não há necessidade de procurar laboriosamente pelas páginas do texto por algarismos essenciais de uso comum.

Os tipos de motores neste livro são os que constam das listas de material disponível em 1950 publicadas pelos respectivos fabricantes.

D. S. DODSLEY WILLIAMS, A.M.I.Mech.E.
Editor.

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OF

BRITISH DIESEL ENGINE CATALOGUE

(Second Edition)

BRITISH DIESEL ENGINE CATALOGUE

(Second Edition)

FOREWORD
by
THE BRITISH INTERNAL COMBUSTION ENGINE MANUFACTURERS' ASSOCIATION

THE first edition of the British Diesel Engine Catalogue gave the position as at March, 1947. It met with an encouraging reception in every country in which it circulated, and quickly ran out of print. The period between its publication and the appearance of this, the Second Edition, has been marked by development and expansion in every branch of the British internal-combustion engine industry.

The ranges of engines included in the industry covered by the British Internal Combustion Engine Manufacturers' Association are all internal-combustion engines, exclusive of those for road vehicles, aircraft and propulsion engines for the largest sizes of vessels. Taking the total horse-power produced by the industry in 1948 as represented by 100, that produced in 1949 is represented by 127. This rise indicates that British engines are not only holding their own in world markets but are steadily gaining in popularity.

British official (B.O.T.) export figures of internal-combustion engines coming within the scope of this industry are incomplete and insufficient to present an accurate picture, as a whole, of this particular line of exports ; the reason is that the Customs returns on which these figures are based relate only to " direct exports "—i.e., engines and spare parts separately consigned. There are, however, many engines exported forrning the prime movers in groups of plant coming under other classifications such as " electrical generating plant " (classified as electrical machinery), " pumping plant " (pumping machinery), " contractors' plant " (compressors, concrete mixers, etc.), the export returns of which make no reference to the value of the engines so incorporated. The value of such " indirect " exports of engines is approximately 50 per cent. of that of the " direct " internal-combustion engine exports ; taking the 1947 figure for " direct " exports as 100, the figure for 1949 would be 189—a striking tribute to the re-established and growing demand for British internal-combustion engines in overseas markets as well as to the efforts developed by the industry in this country to meet and satisfy it. Combining the " direct " and " indirect " exports of the whole of the industry, over 90 per cent. of the total output, measured in sterling, of the British internal-combustion engine industry is sold to markets outside the United Kingdom.

The increase in output of the industry has been achieved by a steadily pursued policy of expanding productive capacity, although subject to restrictions on capital expenditure and on building. New engine shops on the most modern lines have been built, old shops have been extended and reorganized, both new and old shops have been, and are being, equipped with the most modern machine tools. In every direction, British engine makers have taken full advantage of the best technical experience and of methods for obtaining increased efficiency of production.

The increase in the industry's volume of exports, notwithstanding the limitation on import licences imposed by many countries, is due to the post-war re-establishment of the old-time attention paid by British engine makers to the special requirements of purchasers in overseas countries. Experience has demonstrated that overseas purchasers do value engines which are adapted to their particular circumstances, and to the climatic and other conditions of the countries in which they have to operate. It is by catering particularly for such individual requirements that the industry has succeeded in the past in building up its comprehensive overseas trade. That policy is being pursued with greater vigour than ever before. Added to this is the value attached by purchasers to the expert advice that the established agents and representatives of British internal-combustion engine makers in overseas countries are qualified to give, and to the arrangements which are being made for an adequate and assured supply of spares.

British Diesel engines alone are included in this Catalogue, and some notable advances have been made in their design since the issue of the first edition. Particular attention has been given to increased economy in fuel consumption, a matter of major importance to the great majority of would-be purchasers. Some of the important matters to which special consideration has been directed during the past two years are summarized below :

- A wider range of operating speeds for any given design of any one make of engine.
- Ability of British engines to meet more severe standards in respect of temperature, altitude and humidity conditions than those produced in most other oil-engine-making countries.
- A greater choice of small Diesel engines—e.g., up to 10-12 b.h.p.—at speeds up to 1,200 r.p.m., of both two- and four-stroke-cycle types.
- Development of dual-fuel engines, for operation on sludge gas in sewage works, on town gas for booster drive in gasworks, and on natural gas in oilfields and elsewhere.
- Adaptation of standard oil engines to burn gas fuel with Diesel-cycle efficiency.
- More extended development of vee-form engines.
- Increased use of single-piece or built-up baseplates to simplify installation on site, and to secure good alignment between the engine and driven unit.
- Increased employment of non-resonant mountings and reduced use of mass foundations.
- Improved design and consequently increased efficiency of fuel-injection apparatus.
- Further development of pressure-charging, especially by exhaust turbo pressure-chargers of British manufacture.
- Introduction of after-cooling of the air charge (i.e., reducing the air temperature after compression and before entry to the cylinders), in conjunction with pressure-chargers, for special applications, in particular for operation in high ambient temperatures.
- Increased development in the air cooling of small engines.
- More use of four-valve cylinder heads, with consequent fuel economy.
- Increased enclosure of parts to meet conditions in dusty, tropical countries.

One prominent feature of the British oil engine industry during the past few years has been its capacity to meet the increasing demand for oil engines, especially high-speed engines, to serve as the prime movers of a rapidly extending class of plant of all descriptions. This increased demand has, to an extent, been caused by the tendency to replace petrol engines by Diesels. To enumerate all the types within this class of plant is hardly possible. It includes electrical generators, air compressors, pumping installations, cranes, hoists, lifting trucks, winches, saw benches, welding sets, contractors' plant of all descriptions (concrete pavers, pumps and mixers, road finishers, dumpers of all sizes, pile-drivers), oil-well drilling rigs and marine propulsion and auxiliary engines. This has led to the development by particular manufacturers of oil engines specially suitable for universal duties, as, for example, for stationary engine work as well as for incorporation in locomotives for use on railways or in mines, and for installation on board ships for propulsion or auxiliary work. It is not merely a matter of the relative cheapness of oil as compared with petrol. The oil engine seems to be regarded with increasing favour as the most efficient and reliable prime mover for all such types of plant.

The British Internal Combustion Engine Manufacturers' Association, commonly known as B.I.C.E.M.A., represents, and is the official mouthpiece of, that section of the British engineering industry which manufactures internal-combustion engines of the types referred to in the second paragraph of this foreword.

The objects of B.I.C.E.M.A. are to promote the efficiency and prosperity of the British I.C.-engine industry; to encourage the scientific training and promotion of technical skill and competence on the part of all concerned in the industry; to carry out technical, scientific and industrial research in connection with engine construction; and to maintain high standards of manufacture and of commercial integrity.

The organization of B.I.C.E.M.A. is as follows :—

President : Engineer Vice-Admiral Sir Harold Brown, G.B.E., K.C.B.

Independent Chairman : Sir Lynden Macassey, K.B.E., K.C., LL.D., D.Sc.

Solicitors : Messrs. Linklaters and Paines, 6, Austin Friars, London, E.C.2.

Auditors : Messrs. Deloitte, Plender, Griffiths and Co., (Chartered Accountants), 5, London Wall Buildings, Finsbury Circus, London, E.C.2.

The affairs of the industry, as represented by B.I.C.E.M.A., are administered by a Council elected by the member firms from among themselves. In addition to the elected members of the Council, that body itself may appoint as members of the Council not more than four persons to represent any sections or sections of the industry which are not, in its view, adequately represented on that body.

The offices of B.I.C.E.M.A. are in 6, Grafton Street, London, W.1. Its telephone numbers are: Regent 5107, 5108 and 5109; and its telegraphic and cable address is INTCOMENAS, PICCY, LONDON.

Research

In order to secure for the industry the fullest possible application of scientific and technical progress, the important research work undertaken by individual member firms of B.I.C.E.M.A. is supplemented by research work carried out for the benefit of the industry as a whole. With the support of the Department of Scientific and Industrial Research, the British Internal Combustion Engine Research Association (B.I.C.E.R.A.) was incorporated by the British Board of Trade. Its laboratories and offices are at 111/112, Buckingham Avenue, Slough, Buckinghamshire, where it conducts valuable research work, financed by contributions from members of the industry, supplemented by grants from the British Government. Its telephone number is Slough 20295, and its telegraphic and cable address is BICERA, SLOUGH.

The organization of B.I.C.E.R.A. is as follows :—

President : The Rt. Hon. The Viscount Falmouth, M.I.Mech.E., Companion I.E.E.

Vice-Presidents : Vice-Admiral (E) The Hon. D. C. Maxwell, C.B., C.B.E., M.I.Mech.E., Engineer-in-Chief of the Fleet.

Lieut.-General Sir Frederick Wrisberg, K.B.E., C.B.

Dr. S. F. Dorey, C.B.E., F.R.S., M.Inst.C.E., M.I.Mech.E., Chief Engineer Surveyor, Lloyd's Register of Shipping.

Air-Commodore F. R. Banks, C.B., O.B.E.

Major-General E. H. Clayton, C.B., C.B.E., Director-General Fighting Vehicles Division, Ministry of Supply.

Sir Lynden Macassey, K.B.E., K.C., LL.D., D.Sc., Independent Chairman of The British Internal Combustion Engine Manufacturers' Association.

The affairs of B.I.C.E.R.A. are, likewise, administered by a Council elected by the members of that organization.

The engines listed in this Catalogue are, in accordance with commercial convention, called " Diesels." That assumes that Dr. Rudolph Diesel was the inventor of the modern compression-ignition oil engine : for that there is no foundation. His first compression-ignition engine was not produced until five years after the production, on a commercial scale, of the compression-ignition engine of the British engineer, Herbert Akroyd Stuart.

On trouvera, à la page viii du catalogue, une traduction en français, sous forme abrégée.

Una traducción en español de este prólogo, en forma abreviada, parece en la página ix.

Una tradução deste preâmbulo de forma abreviada, aparece na página x.

NOTICE
DE
L'ASSOCIATION DES FABRICANTS DE MOTEURS Á COMBUSTION INTERNE BRITANNIQUES
pour la
SECONDE EDITION DU CATALOGUE DES MOTEURS DIESEL BRITANNIQUES (" B.D.E.C.")

LA première édition du Catalogue des Moteurs Diesel Britanniques a été accueillie par le public d'une façon des plus encourageantes, lors de sa publication en 1947. Par la suite, au cours de leur développement, toutes les branches de l'Industrie du Moteur à Combustion Interne Britannique ont vu s'introduire beaucoup de perfectionnements, que l'on trouvera dans cette seconde édition qui porte exclusivement sur les Moteurs Britanniques.

La vaste diversité des moteurs fabriqués par cette industrie qu'embrasse l'Association des Fabricants de Moteurs à Combustion Interne Britanniques comprend les types de toutes sortes, sauf ceux qui s'appliquent aux véhicules routiers, à l'aéronautique et à la propulsion des plus grands navires.

Un indice significatif de la croissance de l'industrie en question est le fait que la production de 1949 (en termes de chevaux-vapeur) représente 127 pour cent de celle de 1948. Pour ce qui est des exportations, elles sont de deux sortes : directes et indirectes. Ces dernières comprennent les moteurs qui sont exportés comme unités de force motrice pour commande de machines mécaniques, et qui figurent dans les statistiques officielles parmi la nomenclature des machines à commande motrice destinées à l'exportation. Ces exportations indirectes atteignent environ la moitié du volume des exportations directes. Si l'on prend le chiffre officiel de 100 pour les exportations directes de 1947, on troube le chiffre de 189 pour celles de 1949—signe évident de la faveur croissante dont jouissent les Moteurs Britanniques. Mesurée en sterling, la valeur combinée des exportations directes et indirectes de ces moteurs placés sur les marchés étrangers représente plus de 90 pour cent de la production totale.

Ce notable accroissement de production a été obtenu grâce au perfectionnement et au développement de la capacité de rendement parallèlement avec une amélioration constante de l'efficacité des méthodes de fabrication.

Si le volume de ces exportations industrielles a pu ainsi s'accroitre, en dépit des limites imposées aux importations par de nombreux pays, le mérite en revient en grande partie au souci qu'ont les Fabricants Britanniques de satisfaire leur clientèle d'outremer et de répondre à leurs besoins locaux et particuliers ; ce qui, d'ailleurs, a toujours été un trait caractéristique des méthodes commerciales britanniques. En outre, les fabricants de moteurs britanniques se font un point d'honneur de fournir à leurs acheteurs des pays d'outremer un approvisionnement constant et assuré de pièces détachées, ainsi que tous conseils d'experts que demande la bonne utilisation des moteurs.

Nombre de progrès techniques importants ont été réalisés depuis la publication de la première édition de ce Catalogue. Une attention toute spéciale a été consacrée à l'utilisation économique du combustible. En plus, les points suivants méritent une attention particulière :

- Une gamme plus étendue des vitesses d'opération pour tout modèle ou tout genre de moteurs ;
- La capacité des moteurs britanniques de résister à des conditions climatiques plus sevères (de température, d'altitude et d'humidité), qu'ont la plupart des produits des constructeurs étrangers.
- Une plus grande gamme de petits Moteurs Diesel, c'est-à-dire avec des forces motrices allant jusqu'à 10 à 12 H.P. au frein, et des vitesses allant jusqu'à 1200 tours à la minute, tant pour les types à deux temps qu'à quatre temps ;
- Emploi de plus en plus courant de moteurs à double carburant, marchant au gaz des égouts, au gaz de ville lors de l'emploi comme equilibreur aux usines a gaz, au gaz naturel dans les exploitations petrolifères, etc.
- Adaptation aux moteurs employant normalement du mazout, de l'emploi du gaz comme combustible, tout en conservant l'efficacité de course du moteur Diesel ;
- Emploi plus fréquent des moteurs en forme de "V" ;
- Emploi de plus en plus répandu des socles en une seule pièce ou de chassis en acier soudés, pour simplifier l'installation sur place, et pour assurer un bon alignement entre le moteur et l'unité commandée ;
- Emploi croissant de montages spéciaux supprimant la transmission des vibrations, et emploi de moins en moins fréquent de fondations massives ;
- Améliorations apportées aux formes de construction de l'appareil à injection de combustible, avec accroissement correspondant d'efficacité ;
- Nouvelles améliorations apportées à la suralimentation spécialement à celle par turbo-compresseur aux gaz d'echappement, de fabrication britannique ;
- Nouveau système de refroidissement appliqué à la charge d'air, c.d. abaissant la température de l'air après compression et avant son entrée dans le cylindre, en combinaison avec des suralimenteurs appelés à fonctionner dans des conditions spéciales, en particulier dans une ambiance de températures elevées. Perfectionnements apportés au refroidissement de l'air dans les petits moteurs ;
- Emploi plus généralisé de culasses de cylindre à 4 soupapes, avec économie correspondante de combustible.

Un des plus importants succès qu'a remporté l'Industrie du Moteur à Huile lourde Britannique au cours de ces récentes années, est la capacité de fournir des moteurs, en particulier ceux à régime rapide, comme source d'origine de force motrice adaptée aux besoins d'une nouvelle catégorie d'installations de tous genres qui se multiplie de plus en plus rapidement. Cette nouvelle orientation était en partie causée par la tendance de préférer l'emploi des moteurs Diesel plutót que des moteurs à essence. Cette utilisation de plus en plus fréquente des Diesels n'est pas simplement dûe à une question de prix : les coûts relatifs de l'huile lourde et de l'essence. C'est aussi parce que le moteur à huile lourde est de plus en plus recherché à cause de son efficacité et de sa sûreté de fonctionnement.

Ceci concerne surtoût des moteurs transportables employés par des entrepreneurs de travaux publiques, dans le bâtiment, ou pour les travaux à ciel ouvert. A cause de celà certains fabricants de moteurs ont construit des générateurs de force motrice universels ; par exemple un moteur pourrait être désigné pour le même rendement satisfaisant lors de l'emploi dans l'industrie, chemins de fer, ou dans la marine.

L'Association Britannique des Fabricants de Moteurs à Combustion Interne (la B.I.C.E.M.A.) est le représentant et le porte-parole officiel de cette branche de l'Industrie Mécanique Britannique qui se spécialise dans la fabrication des moteurs à combustion interne du genre de ceux dont il est question au deuxième paragraphe de cette notice.

Les buts de la B.I.C.E.M.A. sont : de favoriser tout ce qui peut contribuer à l'efficacité et à la prospérité de l'industrie du moteur ; d'encourager les méthodes d'entrainement scientifique ; d'éveiller le sens de capacité et de compétence techniques chez tous les intéressés ; d'exécuter tous travaux d'études techniques, scientifiques et industrielles portent sur la construction des moteurs et de maintenir à leur haut degré de perfection la fabrication et l'intégrité commerciale de l'industrie.

Le Président de la B.I.C.E.M.A. est un Ingénieur, le Vice-Amiral Sir Harold Brown, G.B.E., K.C.B., et son Administrateur délégué est Sir Lynden Macassey, K.B.E., K.C., LL.D., D.Sc.

Les affaires de l'Industrie que représente la B.I.C.E.M.A. sont administrées par un Conseil, élu par les Firmes qui font partie de la B.I.C.E.M.A. parmi leurs propres membres. Outre les membres élus du Conseil, ce dernier peut lui-même désigner comme membres du Conseil un maximum de 4 personnes pour y représenter toute section ou toutes sections de l'industrie qu'il jugerait ne pas y être adéquatement représentées.

Les Bureaux de la B.I.C.E.M.A. sont installés au No 6 de Grafton Street, Londres, W.1. Ses numéros de téléphone sont : REGent 5107, 5108, 5109, et son adresse pour télégrammes et câblogrammes est : " INTCOMENAS, PICCY, LONDON."

TRAVAUX D'ETUDES

Pour profiter entièrement des avantages offerts par le progrès scientifique et technique en tout ce qui concerne la construction des moteurs, aux travaux des entreprises memberes de la B.I.C.E.M.A. s'ajoutent les travaux d'études effectués pour l'ensemble de l'industrie par l'Association Britannique des Recherches sur le Moteur è Combustion Interne (la B.I.C.E.R.A.), avec l'appui du Service d'Etudes Scientifiques et Industrielles du Gouvernement Britannique.

Les laboratoires et bureaux de la B.I.C.E.R.A. sont situés aux numéros 111 et 112 de Buckingham Avenue, à Slough, dans le Buckinghamshire.

Bien que les moteurs à combustion à pression constante qui figurent dans ce catalogue, soient désignés sous le nom de " Diesels," suivant l'appellation courante dans le monde entier, il ne faut pas oublier que la production sur une échelle commerciale de moteurs à combustion à pression constante est l'oeuvre de l'Ingénieur Britannique H. Akroyd Stuart, et qu'elle avait déjà cinq ans d'existence, lors de l'apparition sur le marché du premier modele de moteur construit par le Dr. Rudolf Diesel.

PROLOGO DE LA SEGUNDA EDICION DEL CATALOGO DE MOTORES DIESEL BRITANICOS ("B.D.E.C.")

por

LA ASOCIACION DE FABRICANTES BRITANICOS DE MOTORES DE COMBUSTION INTERNA

LA primera edición del Catálogo de Motores Diesel Británicos, publicada en 1947, encontró una acogida alentadora dondequiera que se puso en circulación. Posteriormente, ha habido muchos desarrollos en todos los ramos de la Industria Británica de los Motores de Combustión Interna, los cuales se delinean en esta segunda edición. El catálogo se dedica exclusivamente a los motores británicos.

Las series de motores fabricados por la industria representada por la Asociación de Fabricantes Británicos de Motores de Combustión Interna incluyen todos los tipos de motores excepto los de vehículos de carretera, los de aviones, y los de propulsión de los buques mayores.

Una indicación del desarrollo de la industria es el hecho de que la producción de 1949 (expresada en caballos efectivos de fuerza) representa 127 por cada 100 de producción en 1948. En cuanto a las exportaciones, estas son de dos clases, directas e indirectas, y estas últimas se constituyen de aquellos motores que se exportan como unidades de fuerza motriz para el accionamiento de maquinaria y que están inscritos como exportaciones bajo las clasificaciones de la maquinaria accionada en las estadísticas oficiales. Estas exportaciones indirectas tienen un volumen aproximadamente igual a la mitad del volumen de las exportaciones directas. Si se toma 100 como la cifra oficial de las exportaciones directas de 1947, la cifra correspondiente a 1949 fue 189, una clara indicación de la demanda creciente de motores británicos y una confirmación de sus méritos. Combinando las exportaciones directas e indirectas de la industria, más del 90 por ciento de la producción total, expresada en libras esterlinas, se vende en los mercados extranjeros.

Este aumento notable en la producción se ha conseguido por el desarrollo de la capacidad productiva unido al progreso constante en los métados perfeccionados de fabricación.

No obstante las limitaciones en las importaciones impuestas en muchos países, el aumento en el volumen de las exportaciones de la industria es, en gran parte, debido a la atención prestada por los fabricantes británicos a las condiciones locales y especiales de los compradores de los países de ultramar ; y esto ha sido siempre un rasgo característico de la práctica británica. Además de esto, los fabricantes británicos de motores de combustión interna están concentrando sus esfuerzos en la provisión de un surtido adecuado y seguro de piezas de repuesto y en dar consejos expertos sobre la utilización de los motores a los compradores de los mercados de ultramar.

Se han hecho muchos avances técnicos importantes desde la publicación de la primera edición de este Catálogo. Se ha prestado una atención especial a aumentar la economía de combustible ; y además se han introducide perfeccionamientos cuyos puntos de mayor interés son los siguientes :—

- Una serie más extensa de velocidades de funcionamiento para un tipo dado de cualquier marca de motor. Capacidad de los motores británicos para hacer frente a normas más severas en lo que se refiere a condiciones de temperatura, altitud y humedad, que los motores producidos en la mayoría de los otros países fabricantes de motores de aceites pesados. Una serie mayor de motores Diesel pequeños, por ejemplo, hasta 10–12 C.V. efectivos a velocidades hasta 1,200 v.p.m. de tipos tanto de dos tiempos como de cuatro tiempos.
- Desarrollo de motores pudiendo aprovechar dos combustibles, para funcionamiento con gas de cieno en los sistemas de aguas cloacales, para accionamiento de los reforzadores de presión en las fábricas de gas, y para funcionamiento con gas natural en los yacimientos petrolíferos y en otras partes. Adaptación de los motores de aceite pesado normales para que funcionen con gas combustible con el rendimiento termico del ciclo Diesel.
- Desarrollo más extenso de los motores con los cilindros en V.
- Uso más extenso de las placas de base de una sola pieza o de vigas de acero soldadas para simplificar la instalación en el lugar de utilización, y para asegurar una buena alineación entre el motor y la unidad accionada.
- Empleo más extenso de monturas no resonantes y uso reducido de fundaciones macizas.
- Diseños perfeccionados y, por consiguiente, mejores rendimientos de los aparatos de inyección de combustible.
- Nuevos desarrollos de la sobre-alimentación especialmente por turboalimentadores accionados por los gases de escape, de fabricación británica.
- Introducción de refrigeración final del aire de admisión (es decir, reducción de la temperatura del aire después de la compresión y antes de la admisión en los cilindros) combinada con la sobrealimentacion, para aplicaciones especiales, en particular para funcionamiento a altas temperaturas de ambiente.
- Desarrollo aumentado de la refrigeración por aire de los motores pequeños.
- Uso mayor de las culatas de cilindro con cuatro válvulas y la economía de combustible consiguiente.
- Blindaje cada vez mayor de las piezas de roce de los motores para hacer frente a las condiciones existentes en los paises polvorientos y tropicales.

Un detalle saliente de la industria británica de los motores de aceite pesado en los años recientes ha sido su capacidad para suministrar motores, en particular de los tipos rápidos, que sirvan como unidades de fuerza motriz en las clases rápidamente crecientes de instalaciones de todos los tipos, sustituyendo estos motores, en gran parte a los de gasolina y de nafta etc. La utilización más extensa de los motores Diesel no es solamente un asunto de los costes relativos del combustible, sino que el motor de aceite pesado tiene preferencia debido a su rendimiento, eficacia y seguridad de maicha. La clase de instalaciones a que nos referimos es la de carácter móvil tal como la que usan los contratistas de ingeniería civil, los constructores, y los ingenieros en el campo. Esto ha conducido al desarrollo por los fabricantes particulares de motores de unidades de fuerza motriz para usos universales ; por ejemplo, un motor puede proyectarse para que trabaje con el mismo grado de satisfacción en los servicios industriales, ferroviarios y marinos.

La British Internal Combustion Engine Manufacturers' Association (B.I.C.E.M.A.) (Asociación de Fabricantes Británicos de Motores de Combustión Interna) representa y lleva oficialmente la voz de aquella sección de la industria mecánica británica que fabrica motores de combustión interna de los tipos a les cuales nos hemos referido en el párrafo segundo de este prefacio.

Los objetivos de la B.I.C.E.M.A. son fomentar la eficacia y prosperidad de la industria, estimular la instrucción científica y el mejoramiento de la destreza técnica y competencia de todos los interesados, el llevar a cabo investigaciones técnicas, científicas e industriales en relación con la fabricación de motores, y mantener altas normas de fabricación e integridad comercial en la industria.

El Presidente de la B.I.C.E.M.A. es el Ingeniero Vicealmirante Sir Harold Brown, G.B.E., K.C.B., y el Presidente Independiente es Sir Lynden Macassey, K.B.E., K.C., LL.D., D.Sc.

Los asuntos de la industria representada por la B.I.C.E.M.A. están administrados por una Junta Directiva elegida por las casas miembros de la B.I.C.E.M.A. entre ellas mismas. Ademas de los miembros elegidos para la Junta Directiva, esa corporación puede nombrar por sí misma como miembros de la Junta Directiva no más de cuatro personas que representen cualquier sección o secciones de la industria que no estén, a su juicio, representadas adecuadamente.

Las Oficinas de la B.I.C.E.M.A. están ubicadas en 6, Grafton Street, Londres, W.1, Inglaterra. Los números de sus teléfonos son Regent 5107, 5108, 5109, y su dirección telegráfica y cablegráfica es INTCOMENAS, PICCY, LONDON.

INVESTIGACIONES

Para asegurar los beneficios más completos del progreso científico y técnico en el diseño de los motores, el trabajo de las empresas miembros de la B.I.C.E.M.A. está suplementado por las investigaciones llevadas a cabo para el conjunto de la industria por la British Internal Combustion Engine Research Association (B.I.C.E.R.A.) (Asociación Británica de Investigaciones sobre los Motores de Combustión Interna) con el apoyo del Gobierno Británico por medio del Departamento de Investigaciones Científicas e Industriales. Los laboratorios y oficinas de la B.I.C.E.R.A. están ubicados en 111/112, Buckingham Avenue, Slough, Buckinghamshire, Inglaterra.

Aunque los motores de encendido por compresión descritos en este Catálogo reciben el nombre de " Diesel " de acuerdo con la costumbre mundial, se debe recordar que la producción en una escala comercial de los motores de encendido por compresión, fabricados según el diseño del ingeniero británico H. Akroyd Stuart, estaba ya entre manos *cinco anos antes* que la primera unidad de trabajo producida por el Dr. Rudolf Diesel.

PREÂMBULO À SEGUNDA EDIÇÃO DO CATÁLOGO DE MOTORES DIESEL BRITÂNICOS ("B.D.E.C.")

pela

ASSOCIAÇÃO DOS FABRICANTES DE MOTORES A COMBUSTÃO INTERNA BRITÂNICOS

A PRIMEIRA edição do Catálogo de Motores Diesel Britânicos, publicada em 1947, teve um acolhimento animador em toda parte onde foi circulada. Subsequentemente tem havido grande número de aperfeiçoamentos em todos os setores da indústria britânica de motores a combustão interna os quais estão refletidos nesta segunda edição. O Catálogo é consagrado exclusivamente a motores britânicos.

As séries de motores fabricados pela indústria servida pela Associação dos Fabricantes de Motores a Combustão Interna Britânicos incluem todos os tipos com exceção dos destinados a veículos de estrada, aviões, e a propulsão dos maiores navios.

Como prova do desenvolvimento da indústria há o fato de que a produção de 1949 (em cavalos-vapor) representa 127 para cada 100 em 1948. Quanto às exportações, estas dividem-se em dois grupos, a saber, diretas e indiretas. Estas últimas compreendem os motores que são exportados como unidades motrizes de maquinária movida por transmissão, e constam das estatísticas oficiais sob êsse título. Tais exportações indiretas representam cêrca da metade do volume das exportações diretas. Considerando-se a cifra oficial para 1947 de exportações diretas como 100, a cifra de 1949 foi de 189—um tributo eloquente à crescente demanda por motores britânicos. Combinando-se as exportações diretas e indiretas da indústria, mais de 90 por cento da produção total, computada em libras esterlinas, é vendida aos mercados estrangeiros.

Este notável aumento da produção tem sido alcançado pelo desenvolvimento da capacidade produtiva juntamente com um progreso crescente no que diz respeito a métodos eficazes de fabricacão.

Não obstante as restrições das importações impostas por grande número de paises, o aumento no volume de exportações desta indústria é devido em grande proporção à atenção prestada pelos fabricantes às exigências especiais e locais dos compradores nos paises estrangeiros ; isso tem sido sempre uma das características da prática britânica. Além disso, os fabricantes britânicos de motores estão se concentrando na provisão de um fornecimento adequado e assegurado de peças sobressalentes e um serviço de conselhos dados por técnicos sobre a utilização dos motores, para o benefício dos compradores nos paises de ultramar.

Muitos avanços técnicos foram feitos desde a publicação da primeira edição deste Catálogo. Especial atenção foi prestada à questão de aperfeiçoamento na economia de combustível ; e além disso há os seguintes pontos de interêsse máximo :—

- Uma série mais ampla de velocidades de operação para qualquer desenho dado de qualquer marca individual de motor.
- Capacidade dos motores britânicos de satisfazerem condições mais exigentes com relação a temperatura, altitude e humidade do que os produzidos na maioria dos outros paises fabricantes de motores a óleo.
- Uma variedade mais ampla de pequenos motores Diesel, por exemplo, a começar de 10–12 cav. ef. a velocidades de até 1.200 rev./min. dos dois tipos : ciclo de dois e quatro tempos.
- Aperfeiçoamento de motores de dois combustíveis para operar com gás de lodo nas obras de esgotos, para transmissão com sobrevoltador em fábricas de gás, e para funcionar com gás natural em jazidas de petróleo e em outras partes.
- Adaptação de motores a óleo padronizados para funcionarem com combustível de gás com a eficiência do ciclo Diesel.
- Aperfeiçoamento mais extensivo dos motores em forma de " V."
- Uso mais generalizado de chapas de assento inteiriças ou prèviamente montadas a fim de simplificar a instalação no local, e de assegurar um bom alinhamento entre o motor e o grupo receptor da transmissão.
- Emprêgo mais geral de guarnições não ressoantes e emprêgo limitado de alicerces em massa.
- Aperfeiçoamento no desenho, e por conseguinte maior eficácia do aparelho injetor de combustível.
- Novos aperfeiçoamentos no carregamento sob pressão, especialmente os carregadores a pressão descarga-turbo de fabricação britânica.
- Adoção do esfriamento posterior da carga de ar (isto é, reduzindo-se a temperatura do ar depois da compressão e antes da entrada no cilindro) em conjunto com os carregadores sob pressão para aplicações especiais, em particular para operação em temperaturas de ambiente elevado.
- Importante aperfeiçoamento do esfriamento em pequenos motores.
- Emprêgo aumentado das cabeças de cilindro de 4 válvulas, com a consequente economia de combustível.
- Proteção mais completa das peças a fim de evitar excesso de poeira nos paises tropicais.

Uma característica proeminente da indústria britânica de motores a óleo nestes últimos anos tem sido a sua capacidade de fornecer motores, especialmente dos tipos de grande velocidade, para servirem de geradores de fôrça matriz numa classe sempre e ràpidamente crescente de instalações de todos os tipos. Até certo ponto isso é resultado da tendência de empregar motores Diesel ao em vez dos de gasolina. O emprêgo mais generalizado dos motores Diesel não é meramente uma questão da diferença de preço do óleo combustível e da gasolina, mas é que o motor a óleo está tendo crescente preferência devido à sua eficiência e à confiança que nêle se pode depositar. A classe de instalação a que nos referimos é, em particular, a de carácter transportável utilizada por empreteiros de engenharia civil, construtores, e engenheiros no campo. Isso conduziu à evoluçäa e aperfeiçoamento por fabricantes de motores individuais de grupos geradores de fôrça motriz para serviços universais ; por exemplo, um motor pode destinar-se indiferentemente a serviços industriais, ferroviários e marítimos.

A Associação de Fabricantes de Motores a Combustão Interna Britânicos (B.I.C.E.M.A.) representa e á o porta-voz oficial da secção da indústria de engenharia britânica que fabrica motores a explosão dos tipos a que se refere o segundo parágrafo deste prefácio.

Os objectivos da B.I.C.E.M.A. são : promover a eficácia e a prosperidade da indústria, fomentar o treino científico e promover a perícia e competência técnica por parte de todos os interessados, executar pesquizas técnicas, científicas e industriais com relação à construção de motores, e manter normas elevadas de fabricação e de integridade comercial na indústria.

O Presidente da B.I.C.E.M.A. é o Engenheiro Vice-Almirante Sir Harold Brown, G.B.E., K.C.B., e o Presidente do Conselho Independente é Sir Lynden Macassey, K.B.E., K.C., LL.D., D.Sc.

Os assuntos da indústria, conforme representados pela B.I.C.E.M.A., são administrados por um Conselho de firmas membros da B.I.C.E.M.A. eleito por elas mesmas. Além dos membros eleitos ao Conselho, esta entidade por si própria está habilitada a nomear como membros do conselho não mais do que quatro pessoas para representarem qualquer secção ou ramos da indústria que não estejam, na sua opinião, adequadamente representadas.

A séde da B.I.C.E.M.A. acha-se em 6, Grafton Street, Londres, W.1. Os seus números de telefone são : Regent 5107, 5108, 5109, e os seus endereços, telegráficos são, respectivamente : interno : INTCOMENAS, PICCY, LONDON e externo : INTCOMENAS, LONDON.

PESQUIZAS

A fim de conseguir os mais amplos benefícios proporcionado pelo progresso científico e técnico em matéria de desenho de motores, o trabalho das organizações membros da B.I.C.E.M.A. é suplementado por pesquizas executadas a favor da indústria como um todo pela B.I.C.E.R.A. com o apoio do Govêrno britânico por intermédio do Departamento de Pesquiza Cientifica e Industrial. Os laboratórios da B.I.C.E.R.A. estão situados em : Buckingham Avenue, 111/112, Slough, Buckinghamshire.

Se bem que os motores de ignição por compressão, constantes das listas neste catálogo, sejam chamados de " Diesel," de acôrdo xom a prática universal, deve ter-se em mente que a produção, numa escala comercial, de motores de ignição por compressão, segundo o desenho do engenheiro britânico H. Akroyd Stuart, estava em andamento cinco anos antes do primeiro grupo capaz de funcionar produzido pelo Dr. Rudolf Diesel.

DIESEL ENGINE WORKING PRINCIPLES

Explanations of Four-stroke and Two-stroke Engine Operation

The Two-revolution Engine

IN the **four-stroke oil engine** air is first drawn into the cylinder through the inlet valve port by the piston, or air is forced in by a blower (i.e., pressure charging). The second stroke of the piston compresses the air in the cylinder to a pressure of about 500 lb. per sq. in. At or near the end of this compression stroke oil is sprayed into the combustion space by a timed pump operated by the engine. The oil spray becomes mixed with the compressed air and almost immediately begins to burn, because the temperature of the air in the cylinder is considerably higher than the spontaneous-ignition temperature of the oil fuel. Pressure rises accordingly, and the piston is forced outward on the third or power stroke. Near the end of the power stroke the exhaust valve opens and the burnt gases subsequently are expelled by the piston on its fourth, or exhaust, stroke. This cycle is complete in two revolutions of the crankshaft. (See accompanying diagram.)

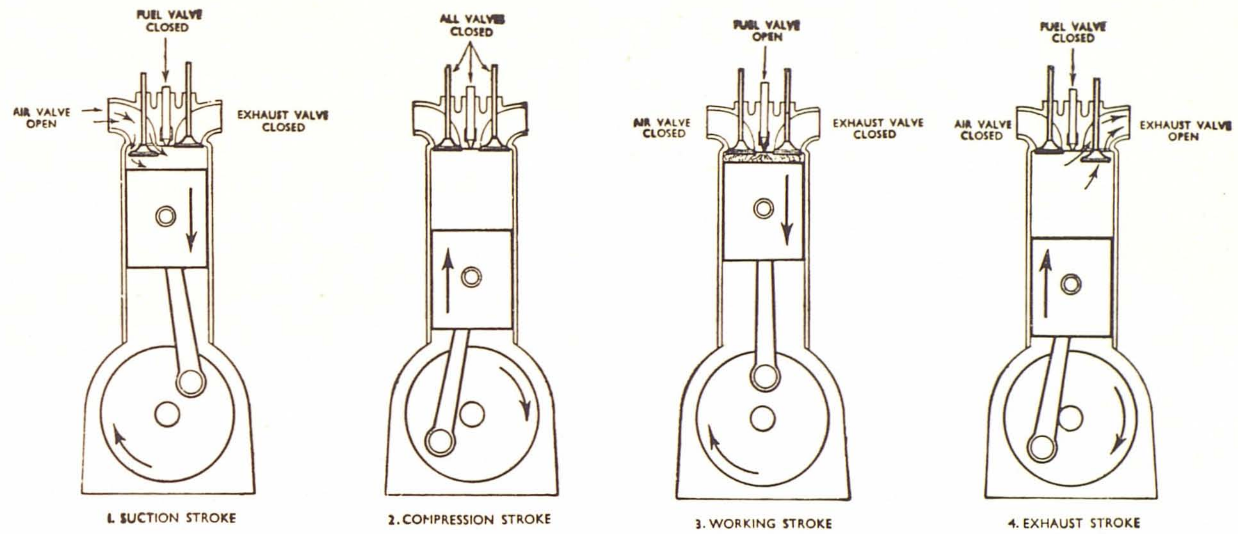
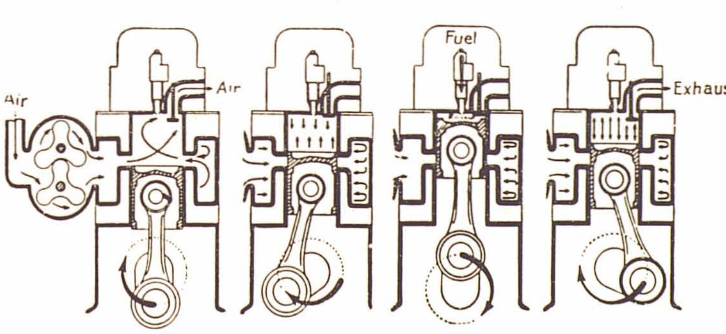


Diagram showing the four-stroke Diesel engine cycle. Ignition is spontaneous, following injection of fuel into the air compressed in the combustion chamber.

The One-revolution Engine

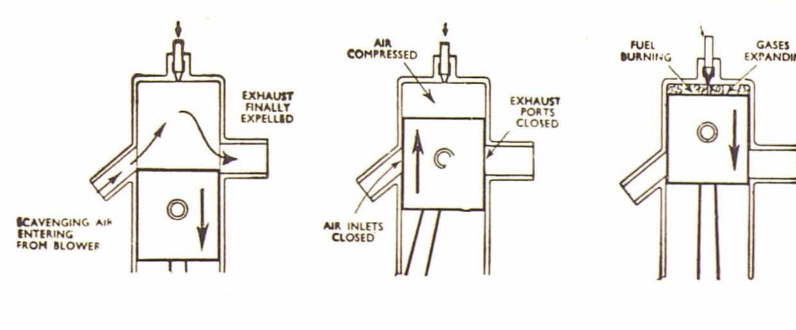
IN the **two-stroke oil engine** air inlet ports in the cylinder wall are uncovered by the outward movement of the piston on its working stroke; air then enters through these ports. Just before this induction process the exhaust gases have begun to be discharged through ports in the cylinder liner, or via an exhaust valve or valves in the cylinder head. Following this air admission and exhaust discharge is the first or compression stroke, with the automatic ignition of the air-cum-injected fuel at its end. The resulting expansion forces the piston outwards on the second or working stroke, towards the end of which admission and exhaust again occur. This cycle is complete in one revolution of the crankshaft. (See accompanying diagrams.)



(Above) Diagram of the two-stroke engine cycle (uniflow type).

From left to right: 1, scavenging; 2, compression; 3, combustion; 4, exhaust.

(Below) Diagram of the two-stroke engine cycle (valveless form).



DEFINITIONS OF TECHNICAL TERMS

A Guide to Terminology Used in Subsequent Descriptions of Engines and Auxiliaries.

FOR ease of reading, definitions of technical terms are put forward in succeeding paragraphs in the form of a consecutive description of engine working.

The **Diesel, oil** or **compression-ignition** engine is a prime mover actuated by the expansion of gases resulting from the spontaneous combustion of fuel in air that has been highly heated by pre-compression. Practically all oil engines are of the **reciprocating-piston type,** that is, having a backwards and forwards motion as distinct from a rotary one. There are **two cycles of operation** in common use for reciprocating engines ; the **four-stroke cycle** is performed in two crankshaft revolutions, and comprises separate piston strokes for induction of air, its compression, expansion of gases resulting from the burning of the fuel-air mixture, and exhaust or expulsion of the combustion products, whilst in the **two-stroke** or **one-revolution cycle** the exhaust and induction processes are performed almost simultaneously between the end of the expansion stroke and the beginning of compression.

As the piston reciprocates, it sweeps out a volume equal to the product of its length of stroke and cross-sectional area ; this is the **swept volume** or **capacity** of the cylinder. There is some space in the cylinder into which the piston never intrudes, and it is into this **clearance volume** that the air charge is compressed. The **compression** ratio of the engine is the ratio of the sum of the swept and clearance volumes to the clearance volume, and is usually between 12–1 and 16–1 ; on it depends largely the air temperature at the end of compression, which must be high enough to cause spontaneous ignition of the fuel when it is introduced. Of the two ideal laws of compression and expansion for gases, the **isothermal law** presupposes that the temperature of the gas does not vary during a change of volume ; under the **adiabatic law,** which applies to oil engine compression, the gas should neither lose heat to, nor gain heat from, its surroundings, while its volume alters ; but the reduction of volume does effect a temperature increase.

Oil engines are constructed with their cylinder axes **vertical, horizontal** or **inclined** (as in vee engines). An **opposed-cylinder** or **vis-a-vis engine,** has its cylinders arranged in pairs, those of each pair being in line, but on opposite sides of the crankshaft to which their pistons are connected. The **opposed-piston engine** has open-ended cylinders, in each of which are two pistons which travel in opposite directions, so that the compression and expansion of air and gases occur in the varying space between the pistons. **Single-acting engines** have working cycles performed only at one end of each cylinder, but in **double-acting engines** both ends of the cylinder contribute to the total work. Oscillating connecting-rods and reciprocating piston-rods are used to connect pistons to crankshafts in **crosshead engines,** which may be single- or double-acting, but in single-acting **trunk-piston engines** only connecting-rods are employed. The crosshead is the connection between piston-rod and connecting-rod, and is supported in guides to counteract the side thrust due to **obliquity** or **inclination** of the connecting-rod. In trunk-piston engines this side thrust acts between the piston and the cylinder wall.

Several methods of introducing the fuel into the cylinder are available. The first is **air injection,** a fuel system utilizing highly compressed air to force the metered fuel charge into the combustion space. **Airless,** also known as **mechanical** or **solid injection,** which has almost entirely displaced air injection, is a method of forcing fuel into the combustion space by means of a high-pressure variable-delivery pump. In the **common-rail injection** system fuel is stored under pressure, and is admitted to the combustion space by means of a mechanically operated fuel valve which meters the charge. **Fuel injectors,** also called **nozzles, sprayers, atomizers** or **fuel valves,** may be of the open, valveless type or closed ; the latter contain spring-loaded valves, to prevent **fuel leakage** or **dribble ;** these are opened by hydraulic or mechanical action to admit fuel to the combustion space. The closed type is almost universally employed.

An **open combustion chamber** has no subsidiary air-storage or combustion space, and the fuel is delivered by **direct injection** into the combustion chamber. In the **ante-chamber** or **pre-combustion chamber engine,** a subsidiary space is provided, in communication with the space between cylinder head and piston crown by means of a restricted passage ; into this subsidiary chamber fuel is injected **(indirect injection),** and the combustion may or may not be completed in the chamber. In the **air-cell system** there is a cavity in the cylinder head, cylinder wall, or piston crown, to store part of the air charge, and fuel is not injected into this cell. Combustion chambers are often designed so that orderly whirling motion of the air **(air swirl)** replaces haphazard turbulence, as air swirl can provide an efficient means for distributing the fuel charge in the air available for combustion. In all combustion chambers more air than is actually necessary for combustion of the fuel must be provided ; thus there is an **excess of air,** its amount being usually expressed as a percentage of the air consumed.

After the injection pump commences to deliver fuel, there is a slight **injection delay** before fuel issues from the injection nozzle ; similarly, combustion does not start immediately fuel is injected from the nozzle into the combustion space, as there is some **ignition delay.** Both of these delay periods are measured commonly in degrees of crankshaft rotation. It is important to control the ignition delay so that the **rate of pressure rise** in the combustion space per degree of crankshaft rotation, consequent on combustion, may not be too great. When **two-phase** or **pilot** injection is used, the first phase occurs at low pressure for a short period, followed by the main phase at higher pressure. This gives a more uniform rate of pressure rise than the usual single-phase system.

In the ideal oil engine there would occur **constant-pressure combustion,** i.e., the compression pressure is maintained as the gas volume in the cylinder increases until the combustion process is completed. **Constant-volume combustion** is so rapid that no piston movement occurs during combustion and the maximum pressure attained greatly exceeds the compression pressure. Large slow-running engines tend to constant-pressure combustion, and fast-running engines to constant-volume combustion.

The **useful rate of working** of an engine as measurable by a brake is expressed in **brake horse-power** (1 b.h.p.—33,000 ft.-lb. per minute), and its **fuel consumption** in weight or volume per b.h.p.-hour. From the value of b.h.p. can be calculated the constant pressure which would have to be applied throughout one stroke to a frictionless piston of the same size and stroke as the actual piston, to obtain the same power as the latter gives per cycle. This is the **brake mean effective pressure.** By means of an **indicator,** an instrument for indicating the actual pressures in a cylinder at every instant throughout the strokes of a working cycle, the power developed in the cylinder (the **indicated horse-power)** and the average pressure on the piston over one complete cycle (the **indicated mean pressure)** can be calculated, and the fuel consumption can be expressed in terms of quantity per i.h.p.-hour. By **supercharging** or **pressure-charging**—i.e., having the air charge in the cylinder already at a pressure greater than atmospheric at the commencement of the compression stroke, the rate of working of the engine can be increased.

Only a proportion of the heat or **thermal energy** available in the fuel supplied can be changed to **mechanical energy** by the best engine, and the percentage of energy thus successfully transformed, as calculated from the indicator diagram, is called the **indicated thermal efficiency.** Some of this mechanical energy, in amount exactly equal to the difference between the engine i.h.p. and b.h.p., reverts to heat due to the friction between moving parts, and the percentage available for work outside the engine is known as the **brake thermal efficiency.** Thus it is clear that the **mechanical efficiency** of the engine is the ratio of its brake and indicated horse-powers, mean effective pressures, fuel consumptions per h.p.-hour and thermal efficiencies. Mechanical efficiency is affected by rotational speed ; generally the faster an engine runs the lower is the mechanical efficiency. On the other hand, mechanical efficiency, assuming a constant mean effective pressure, is practically unaffected by the size of the engine.

DEFINITIONS OF OTHER ITEMS

Alternative-fuel engine.—An engine capable of working on oil fuel *or* gaseous fuel with spark ignition. It may be (a) of the type which can be changed from one fuel to the other while running, or (b) the change may necessitate stopping for change of parts—usually known as a convertible engine. Units of the (a) type employ the same compression ratio for both fuels, whilst (b)-type engines have a low compression ratio for gas operation. (See also dual-fuel engine.)

Clearance-volume Ratio.— $\frac{\text{Clearance Volume}}{\text{Piston-swept Volume}}$

Cyclic Irregularity.—This is the ratio of the maximum variation in angular velocity at the flywheel during one engine cycle to the mean angular velocity, when the engine is running at any load up to and including rated load, and at rated speed.

Diesel, Oil or Compression-ignition Engines.—These are of three types :—

(1) Solid (or liquid) injection—cold-starting type. One in which the fuel, in liquid form, is injected into the combustion chamber without air blast, and which is capable of starting under service conditions and running without externally applied heat. The vast majority of British-built engines is in this category.

(2) Solid (or liquid) injection—assisted-starting type. Similar to (1), but which requires the application of heat from some external source for starting from cold.

(3) Air-blast injection. Similar to (1), but with air-blast injection.

Dual-fuel (or Oil-cum-gas) Engine.—An engine of high compression ratio capable of running on (a) oil fuel alone—i.e., as normal Diesel—or (b) on a combination of oil and gas. In the latter case combustion is initiated by the oil fuel charge ; ratio of liquid to gaseous fuel is variable. Change-over from (a) to (b) condition, or vice versa, is usually effected while running. (See also alternative-fuel engine ; the two are different types and must not be confused.)

Full-load Fuel Consumption.—The rate of fuel consumption at the rated output of the engine in question.

Gas Engines.—A gas engine is an internal-combustion prime mover designed to utilize gaseous fuels. The fuel-air mixture may be ignited in the combustion space by means of an electric spark. See also " alternative-fuel " and " dual-fuel " engine definitions above.

Hand of Engine.—The hand of an horizontal engine is decided by the position of the side shaft. When the engine is viewed from the cylinder end, the side shaft is on the right on a right-hand engine, and on the left on a left-hand engine.

Maximum Mean Piston Speed.—Mean piston speed at maximum crankshaft speed of the engine. It is calculated by multiplying the stroke (in feet) by two and by the crankshaft speed in r.p.m.

ENGINE AND FUEL STANDARDS

The Bases of British Practice

ENGINE RATINGS

IN describing their products, makers of British internal-combustion engines are guided by British Standard No. 649 of 1949. This specification applies to reciprocating oil engines and gas engines used for stationary and industrial purposes, also for auxiliary duties on board ship.

Rated Output and Speed

One of the most important points is that of power rating. In most cases this is given on a 12-hour basis at the rated speed; it is the load in brake horse-power which the engine is capable of carrying for that period, the three specified conditions including a mean barometric pressure of 29.5 ins. of mercury (749 mm.), an atmospheric temperature of 85 degrees F. (29.4 degrees C.), and a humidity of 0.6 ins. (15 mm.) of mercury vapour pressure.

In the case of gas engines, the gas temperature shall be the same as the specified atmospheric temperature. The gas calorific value should be stated.

When working conditions vary from the above figures, modifications shall be made as follows: Where atmospheric pressure differs the rated output of the engine shall be decreased by 4 per cent. per inch of mercury decrease (1.6 per cent. per cm. of mercury), or at the rate of 4 per cent. per 1,000 ft. (305 metres) of altitude above 500 ft. (152.5 metres). In the case of engine-room temperature a further deduction of 2 per cent. shall be made for each 10 degrees F. (5.6 degrees C.) above 85 degrees F.

With regard to humidity correction, figures are given in the table:

Use the percentage humidity corresponding to the maximum temperature being considered. It is very rarely that high humidity is combined with very high temperature to justify more than 6 per cent. derating for humidity in any part of the world. Figures underlined indicate the maxima for normal conditions.

For example, if an engine is installed (1) at 2,300 ft. above sea-level; (2) and has an engine-room temperature of 95 degrees F.; (3) with a 90 per cent. humidity, the total deduction of rated power would be 12.8 per cent., being made up of 7.2 per cent. (1), 2 per cent. (2), and 3.6 per cent. (3).

Now follows an example of derating for a marine auxiliary engine.

Where an engine rated at 400 b.h.p. under normal conditions is to work in an ambient temperature of 113 degrees F., combined with 90 per cent. humidity, the actual output is calculated thus:—

$$\text{Deduction for temperature } \frac{113-85}{10} \times 2 = 5.6 \text{ per cent.}$$

$$\text{Deduction for humidity (from table)} = 5.7 \text{ per cent.}$$

$$\text{Total } 11.3 \text{ per cent.}$$

The engine will, therefore, be rated on a 12-hour basis as 354.8 b.h.p. For continuous duty (more than 24 hours) the corrected value will be 319.3 b.h.p., i.e., 90 per cent. of 12-hour figure.

Margin of Capacity

For a period of one hour the engine shall be capable of carrying a load 10 per cent. above its rated output, within the limits of speed governing; there shall be no undue heating of the engine or other mechanical trouble in that hour.

For continuous day and night running for more than 24 hours the maximum output of the engine shall not exceed 90 per cent. of the output obtained after the appropriate deductions have been made for altitude, temperature and humidity.

Readers are reminded that this standard is more rigorous in regard to power output than those of other nations, so that British engines have a power reserve sometimes lacking in competitive types from other lands. This point should always be remembered when considering rival quotations.

Governing

The engine shall run steadily at any load within its rating at rated speed, and the changes in speed due to changes in load shall not exceed the values given in the "governing" table.

Speed Adjustment

For engines rated at 20 b.h.p. per cylinder or over, the speed shall be adjustable temporarily by an amount to be agreed; the range of temporary speed variation for synchronous purposes with engines driving generators shall be not less than 5 per cent. above and 5 per cent. below the rated speed.

Derating for Combination of Engine-room Temperature and Humidity

Atmospheric temperature degrees F.	PERCENTAGE HUMIDITY								
	20	30	40	50	60	70	80	90	100
	Derating, per cent.	Derating, per cent.	Derating, per cent.	Derating, per cent.	Derating, per cent.	Derating, per cent.	Derating, per cent.	Derating, per cent.	Derating, per cent.
85	—	—	—	—	0.5	1.0	1.5	2.0	2.4
90	—	—	—	0.4	1.0	1.6	2.2	2.7	3.3
95	—	—	0.2	0.9	1.6	2.2	2.9	3.6	4.2
100	—	—	0.7	1.5	2.2	3.0	3.8	4.6	5.3
105	—	0.3	1.2	2.1	3.0	3.9	4.8	5.7	6.6
110	—	0.7	1.8	2.8	3.8	4.9	5.9	6.9	8.0
115	—	1.2	2.4	3.6	4.8	6.0	7.2	8.4	9.6
120	0.4	1.7	3.1	4.5	5.9	7.3	8.6	10.0	11.4
125	0.8	2.3	3.9	5.5	7.1	8.7	10.2	11.8	13.4

Governing

	Maximum change of speed, r.p.m.	
	When driving A.C. generators in parallel	When driving D.C. generators or a single A.C. generator
	Per cent. of rated speed	Per cent. of rated speed
On suddenly taking off or applying the rated load—		
Temporary change	10	10
Permanent change	6	4
On change of load gradually, or by steps not exceeding 20 per cent. of the rated load—		
Temporary change	5	3

Fuel Consumption

When required, the engine maker shall state the fuel consumption rate under the conditions laid down in the " rating " section at full load, three-quarter and half-loads. For oil engines, it shall be expressed in lb. per b.h.p.-hour and based upon the fuel having a gross calorific value of 19,350 B.Th.U.s per lb. (10,750 calories per kg.). For gas engines, the consumption shall be stated in B.Th.U.s per b.h.p.-hour at the higher or gross calorific value. In fuel-consumption tests a tolerance of 5 per cent. is allowed unless otherwise agreed between maker and purchaser.

Standard Equipment

Standard equipment for all oil engines covers : (a) Suitable barring means ; (b) air silencer (for engines of 10 b.h.p. and above only), unless already embodied in the engine design ; (c) spanners and special tools ; (d) fuel-oil service tank adjacent to engine, sufficient for a continuous run of 10 hours at full load, subject to a maximum storage capacity of 50 gallons, with strainers, oil-control cock and piping to engine ; (e) starting lamp for each cylinder (for surface-ignition engines only) ; (f) exhaust box.

Unless specifically included, the following two items will not form part of the standard equipment : (1) Cock for each cylinder so that the maximum operating pressures can be measured, or an indicator cock ; (2) indicator gear for engines having a bore of not less than 10 ins. (25.4 cm.) and running at a speed of not more than 450 revolutions per minute (indicators excluded).

In the case of vertical oil engines a platform, with hand rails and ladder, must be provided (where necessary) for inspection and maintenance.

For gas engines the requirements are the same, except that items (d) and (e) are omitted, and the equipment must include a gas bag or expansion box on the inlet.

Cyclic Irregularity of Generator-driving Engines

Unless otherwise specified, the cyclic irregularity of an engine directly coupled to a generator shall not be worse than the following : (a) One- or two-cylinder engine, 1/75 ; (b) an engine having more than two cylinders :—

Cyclic Irregularity

Engine impulses per sec.	Cyclic irregularity not worse than
Fewer than 10	1/150
10 to 20	$\frac{\text{Engine impulses per sec.}}{1,500}$
Above 20	1/75

Extracted from B.S. No. 649—1949, by permission of the British Standards Institution, 28, Victoria Street, London, S.W. 1, from whom official copies of the specifications can be obtained, price 2s., post free.

FUEL STANDARDS

SINCE the first edition of this Catalogue the British Standard governing fuels has been revised ; it is B.S. 209 of 1947, entitled, " Fuels for Oil Engines," and is a revision of that dated 10 years previously.

It covers petroleum and shale fuel oils for oil engines, with and without additives. These fuels are not necessarily suitable for combustion turbines. Oil fuels derived from coal have not been included, because there is insufficient evidence available for the correlation of specification characteristics with engine performance of such fuels.

The fuels are divided into two classes, and limiting values are given for all the important characteristics of each class, together with full descriptions of the methods of test and guidance upon points which must be borne in mind by users of the oils.

The fuels shall be wholly hydrocarbon oils derived from petroleum or shale with which, however, small amounts of hydrocarbon or non-hydrocarbon additives may have been incorporated for the improvement of ignition or other characteristics. Fuels of Class A shall not contain any residuum oil. Fuels of Class B shall not contain any cracked residuum.

The properties of any fuel purporting to comply with this British Standard shall be within the limits laid down, when determined by the methods described in the appendices. The user should satisfy himself, by test or consultation, which of the classes of oil specified he can most satisfactorily utilize in any given engine.

In view of the wide range of climatic conditions under which these fuels may be used, it is considered undesirable to specify pour-point limits, because such limitations might be unduly restrictive on supplies.

The methods of test given in the appendices are those laid down by the Institute of Petroleum. For further information regarding the testing of oils, reference should be made to the current edition of " Standard Methods for Testing Petroleum and Its Products," published by the Institute of Petroleum.

The table given on this page formulates test requirements for two classes of fuels for oil engines.

For some large, slow-speed engines, where means can be provided for heating and cleaning the fuel, the user may be able to employ satisfactorily a heavier oil, such as the fuel oils E, F or G of B.S. 742, " Fuel Oils for Burners." In such cases the user should satisfy himself that his whole equipment is capable of dealing with the fuel at the lowest temperature to which the oil will be exposed and that the oil meets his requirements in other respects.

Fuel Specifications

Test	Specification limits			
	Class A		Class B	
	Min.	Max.	Min.	Max.
Cetane number	45	—	23	—
Viscosity, centistokes at 100 degrees F.	2.0	7.5	—	24
Carbon residue, Conradson per cent. by weight	—	0.1	—	2.0
Distillation, per cent. by volume recovered at 350 degrees C. ..	85	—	—	—
Flash point (closed) degrees F. ..	150	—	150	—
Calorific value, *gross* B.Th.U. lb. ..	19,000	—	18,500	—
Water, per cent. by volume ..	—	0.1	—	0.25
Ash, per cent. by weight	—	0.01	—	0.03
Sediment, per cent. by weight ..	—	0.01	—	0.1
Sulphur, per cent. by weight ..	—	1.5	—	2.0
Acidity, inorganic	nil		nil	
Corrosion, copper strip at 212 degrees F.	negative		—	—

Extracted from B.S. 209—1947, by permission of the British Standards Institution, 28, Victoria Street, London, S.W.1, from whom official copies of the specifications can be obtained, price 7s. 6d., post free.

DIESEL FUEL TERMS AND TESTS

Simple Explanations of Terminology for Those Concerned With Oil Engine Utilization.

IN succeeding paragraphs those terms are given which affect the engine user, as distinct from the petroleum technologist. The appropriate tests are given in simple form, not because the user is likely to apply them, but because they give a wider understanding of the subject.

From the storage safety point of view the **closed flash point** of a fuel is important ; it is the lowest temperature of any particular oil at which inflammable vapour is given off. A minimum figure of 150 degrees F. is specified in British Standard 209 of 1947, for which see page xv in this Catalogue. The term " closed " is due to the oil being heated in a closed vessel ; at frequent intervals a shutter is moved and a test flame passed over the oil. When the flash point is reached the vapour will burn momentarily. The **open flash point** is usually about 20 degrees F. higher than the closed figure, whilst the **fire test,** or steady burning of the vapour, does not take place until the temperature is raised by about 50 degrees F. beyond the open flash point.

Purity of the fuel is usefully indicated by the **hard asphalt, ash and water content figures.**

One of the most important characteristics of an oil is its **viscosity;** this affects the ease of flow through pipes, the hydraulics of injection pumping and atomization in the combustion chamber. Viscosity is the resistance of the oil to shear, to flow or to change of shape ; for fuel-supply purposes it may be defined as " pumpability." This quality is measured by the Redwood system in this country, by the Saybolt in U.S.A., and by Engler in Europe. The measuring instruments are similar in working principle, providing means for maintaining the oil at various temperatures while quantities of 50 c.c., 60 c.c. and 200 c.c. respectively pass through standardized orifices. Redwood and Saybolt results are expressed in seconds, but the Engler figure is termed " specific viscosity," being obtained by dividing the 200 c.c. oil-flow time by that for 200 c.c. of distilled water at 20 degrees C.

Obviously it is essential to state the temperature : the Redwood figures at 70 degrees F. and 100 degrees F. are those which more closely concern engine users in temperate and sub-tropical climates. A Redwood number higher than 250 at 70 degrees F. usually means that the fuel will have to be heated.

To convert from one system to another, the following figures are useful :—

$$\frac{\text{Redwood}}{29} = \text{Engler} \qquad \frac{\text{Redwood}}{0.85} = \text{Saybolt}$$

$$\text{Engler} \times 29 = \text{Redwood}. \qquad \text{Saybolt} \times 0.85 = \text{Redwood}.$$

Those working in very cold climates are most likely to be interested in the **pour point.** This is the temperature at which oil will just flow when its containing vessel is tilted for five seconds. At the **setting point** oil is no longer fluid.

To indicate how much carbon deposit one may expect to find in an engine after consuming a given quantity of fuel is the object of the **Conradson carbon residue** test. A quantity of the oil is heated until all volatile matter has disappeared ; the residue is weighed and the result expressed as a percentage of the weight of the quantity of oil tested.

The sulphur content of a fuel is principally of interest in connection with the tendency to form corrosive acid when combined with condensate in exhaust gases. Such acid atttack may occur in very low-temperature operation, or in special exhaust systems which bring the gas temperature to really low levels.

No characteristic of Diesel fuel has been the subject of so much controversy as **ignition quality.** It determines the ease of cold starting, and is related to combustion shock which affects smoothness and silence of running. To determine whether an oil is of good, indifferent or poor ignition value is a matter of great difficulty, on account of the large number of variables in engine design, which may affect the suitability of any fuel to any engine.

The quality has no apparent connection with the ignitability of the fuel at atmospheric temperature and pressure. It is, therefore, determined by running or starting trials in standard test engines, comparing results on any particular fuel with reference fuels, the behaviour of which is a known quantity.

In the running tests at full loads the **delay angle** is measured by means of an indicator ; this angle is the number of degrees of crank movement between the start of injection and the start of rapid pressure rise. The fuels giving the easiest starting and quietest running have the smallest ignition delay, i.e., give the smallest delay angle.

Now the angle varies with speed and engine design ; to express fuel behaviour in a universally understandable manner, the fuel sample is compared with a reference fuel in the test engine. Actually the reference fuel is a blend of two, one of high-ignition quality and one of low quality.

The former is cetane ($C_{16}H_{34}$) and the latter alpha-methyl-naphthalene ($C_{11}H_{10}$). The **cetane number** is the percentage of cetane in the blend which has the same ignition quality as the fuel tested. The **cetene number** is obtained in the same way, but using cetene ($C_{16}H_{32}$). An easily ignitable fuel has a cetane number of 60 or more, whilst 30 denotes a low-ignition quality fuel.

There is often confusion between cetane and cetene, owing to the marked similarity of the words. Cetene has a slightly lower ignition quality than cetane, and one should not regard the terms as interchangeable. Cetene was used in the earlier days in many countries, but it proved to be unstable when stored. From this point of view cetane is a good deal better, and it has therefore been widely used as the standard reference fuel in preference to the other.

Another form of trial for determining the ignition quality is the Ricardo throttling test. The engine is run on the fuels to be tried, at not above 25 per cent. load, and at normal speed, or not less than half speed if the unit is intended for variable-speed working. Keeping these conditions constant, the air is gradually throttled, so reducing compression and charge temperature until misfiring begins. This is the **critical induction pressure.** The test is repeated with reference fuels of known cetane or cetene number ; the fuel to be examined can then be assigned its appropriate number, when the results correspond.

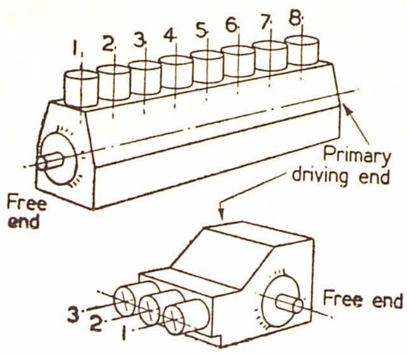
A similar test, for **critical compression ratio,** is often made as an engine-starting trial ; the unit is motored and compression varied until that ratio is found at which the fuel is on the verge of misfiring.

Variations of quality naturally occur as between fuel from one source and from another, therefore it is useful to know the **calorific value** (or heat value) of an oil. The fuel supplier determines, usually by a bomb calorimeter test, the **gross calorific value,** which includes the heat energy of the water vapour occasioned by burning of the hydrogen. In an engine, however, the water vapour passes out in the exhaust and is not of service in power production, therefore the engine user requires to know the **net calorific value.** These values are expressed in British thermal units per pound, the net figure being from 1,000 to 1,500 B.Th.U.s lower than the gross.

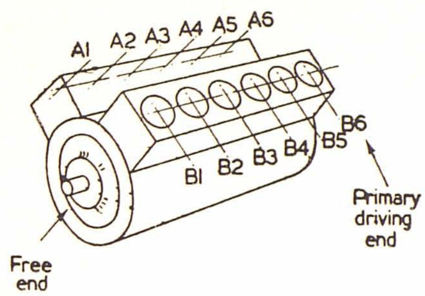
The **specific gravity** of a fuel is primarily of use in calculating the weight of a given volume, for operational statistics. The usual temperature is 60 degrees F. The specific gravity figure is the ratio of weight of a fuel volume to an equal water volume. The weight of an imperial gallon of oil is obtained by multiplying the specific gravity by 10—i.e., moving the decimal point one place to the right. For example, a gallon of fuel of 0.84 specific gravity weighs 8.4 lb.

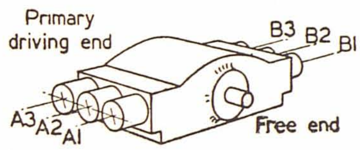
STANDARDIZED CYLINDER IDENTIFICATION SYSTEM

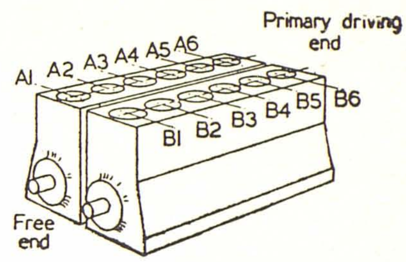
A Specification Covering all Design Forms



Single-bank in-line engines, of either vertical or horizontal form.







Double-bank in-line engine.

(Centre, upper) Vee-form unit.

(Centre, lower) Opposed cylinder engine (vis-à-vis).

IN the past there has been some degree of diversity of practice in regard to the numbering of engine cylinders, and the identification of banks of cylinders in certain forms of design. This situation is now abolished, in that British Standard 1,599 of 1949 clarifies the whole position. It applies to internal-combustion engines for marine, stationary and vehicular use, but not to aircraft units.

The specification contains 11 diagrams, which cover every form of engine at present made—even the most uncommon—and the definitions and principles laid down could be extended to deal with other variants. Here we illustrate four examples which cover the range of oil engines referred to in this Catalogue.

The following are important definitions :—

Primary driving end.—The end connected to the principal power off-take—e.g., the generator, propeller, clutch. Where engines drive from either or both ends, the manufacturer shall decide which is the primary driving end.

Free end or secondary driving end.—The end opposite to the primary driving end.

Bank.—A group of cylinders arranged in a common plane *parallel* to the axis of the crankshaft.

Row.—A group of cylinders arranged in a common plane *at right angles* to the axis of the crankshaft.

Cylinders shall be numbered from the free or secondary driving end, the cylinder nearest that end being numbered 1 and the others 2, 3, 4, etc., consecutively.

In multi-bank engines, the letters A, B, C are applied according to the number of banks concerned, and all the individual cylinders of that bank have the same letter—i.e., A1, A2 and so on. Cylinders having similar numbers form a row, that is to say, that A1 and B1 constitute a row.

The order of the lettering of the banks shall be clockwise, as viewed from the free end. In single-crankshaft engines, the centre of the " clock " shall be the crankshaft, or in multi-crankshaft engines it shall be the central point between all the crankshafts. The "A" bank shall be that at or first after 9 o'clock.

Where the 9 o'clock position is indefinable, e.g., in engines having a vertical crankshaft, the banks shall be lettered clockwise (as viewed from the free end) starting from the position of any readily identifiable component.

The direction of rotation of the crankshaft does not affect lettering and numbering, and it is recommended that identification letters and numbers be marked on the cylinders.

Copies of this Standard are obtainable at 2s. net each, post free, from British Standards Institution, 24/28, Victoria Street, London, S.W.1.

POWER REQUIRED FOR VARIOUS DRIVES

Basic Information for the Use of Those Who May Not Know Exactly the Power Output of the Engine Required for their Particular Tasks

FOR the benefit of those who may not be familiar with the methods of estimating the particular power rating of engine required for any specified duty, general information is given in succeeding paragraphs.

It is most important to remember, in all cases, power losses due to the effects of site altitude and humidity of the air; for guidance in these matters see p. xiv. Another factor in the ratio of engine power developed to power required by driven unit is the condition of that engine. If any prime mover be allowed to get into indifferent condition, it can hardly be expected to deliver its full rated output; should maintenance circumstances be likely to occasion difficulties, it is prudent to allow a power margin for safety.

Before ordering an engine, check the total power required; do not work on the basis " same as last time " until this check has been made. The addition of one or two new items of load sometimes is overlooked. If in doubt the services of a consulting engineer are desirable.

Engine for Electricity Generator Drive

First work out the generator's continuous maximum rating in kilowatts. If the machine generates direct current, the pressure in volts should be multiplied by the output in amperes, which gives the result in watts. The wattage figure divided by 1,000 gives the results in kilowatts. For example, 5,250 watts equals 5.25 kilowatts.

For a single-phase alternator, find the wattage, multiply by the power factor, and divide by 1,000. If the watts total 8,750 and the power factor is 0.8, the answer is 7.0 kilowatts. For a three-phase alternator, first find the kilovolt-ampere figure; the formula is :—

$$\frac{\text{Volts} \times \text{amperes} \times 1.73}{1{,}000} = \text{kVA}.$$

Then kVA $\times$ power factor $=$ kilowatt. If the power factor is not known, 0.8 may reasonably be assumed.

Armed with this information in kilowatts, one can work out the engine horse-power needed. For each kilowatt a directly coupled engine should develop at least 1.5 b.h.p., assuming a generator efficiency of 89.5 per cent. If higher or lower than that value the rated output of the engine will be proportionately lower or higher.

This figure of 1.5 b.h.p. per kW does not allow for drive losses. The latter occur in belts, chains, ropes or gearing which may be used to connect a generator to the engine. For safety's sake, one should allow at least 5 per cent. greater power if such an indirect drive is adopted.

At this point it is well to mention that, until the introduction of a wartime standard (B.S. 1,084 of 1942), there were different bases for rating engines and generators. This fact may account for permissible overload differences as between the engine and generator. For instance, an engine rated as standard at 100 b.h.p. is expected to be capable of a temporary overload up to 110 b.h.p. or 10 per cent., whereas the electrical machine which it drives, rated at, say, 65 kW, may be able to deliver up to 25 per cent. greater output, that is to say, a total of about 81 kW. On the actual maximum capacity of the dynamo, the engine would have to develop about 121 b.h.p. The real limiting factor of the set is, of course, the engine power. If a generator will have to carry more than a 10 per cent. overload for any period, the rated output of the engine should be increased accordingly.

Engine for Pump Drive

If an engine is to drive a pump, it is necessary to know the water horse-power and efficiency of that pump. The formula for calculating water horse-power is simple. Multiply by 10 the number of gallons per minute which the pump is capable of delivering, also by the total gauge head in feet. Divide the resulting figure by 33,000, and thus obtain the water horse-power. The water horse-power is then divided by the pump efficiency, and the answer is the horse-power of the engine needed for the pump.

It is customary to add about 30 per cent. to the horse-power figure obtained in this way to provide for various losses, especially where the pump is not directly coupled to the engine, and to give a margin of safety for loss of " tune " of the power unit.

It is quite probable that the efficiency of the particular pump may be an unknown quantity. In the case of the modern centrifugal pump, the following figures may be useful guides :—

Gallons per minute	Efficiencies, per cent.
Up to 250	60 to 75
Up to 900	75 to 80
Up to 3,000	80 to 82.5
Up to 6,000	82.5 to 85

The composition of the total gauge head is as follows: (a) The suction losses from the end of the pump suction to the water level; (b) the suction head from water level to the pump; (c) the delivery head from the pump to the tank (or outlet); and (d) delivery losses.

Engine for Air-compressor Drive

Where the driven machine is an air compressor, the calculation of horse-power required to drive any such machine is a rather complicated matter. For the sake of simplicity, the required information is set out as a table. It covers most of the pressure conditions which oil engine users are likely to encounter, ranging from 25 lb. per sq. in., which is found in sewage stations, up to 400 lb. per sq. in., which is a pressure more than covering air requirements for the starting of modern solid-injection oil engines. The table deals with single-stage and two-stage reciprocating compressors, which are those most likely to be found in industrial practice.

Approximation of engine brake horse-power required per 100 cubic ft. of free air compressed.

Press., lb. per sq. in.	Single-stage compressor	Two-stage compressor
25	7.50	—
50	12.00	10.75
60	13.50	11.80
70	14.75	12.90
80	16.00	13.75
90	17.10	14.70
100	18.20	15.40
125	20.40	17.20
150	22.50	18.70
200	26.00	21.10
300	31.70	25.00
400	36.20	27.70

Transmission, friction and cooling losses ignored. Air at 60 degrees F. and atmospheric pressure at 14.7 lb. per sq. in.

Again, there are certain losses to be considered in the drive, in internal friction in the compressor, and in heat losses. For safety's sake, additions ranging between 15 per cent. and 20 per cent. should be made to the power required, which is indicated in the table.

DERATING AN ENGINE

Decrease of Power by Speed Reduction and/or Fuel-injection-pump Setting.

ALTHOUGH an engine-maker designates a particular model by a specified power at a given speed, a customer can vary this output in a downward direction by the simple process of running the engine at a lower speed ; when an engine is intended for use in this way, the maker should be advised at the time of placing the order, so that the correct settings for the fuel-injection pumps and governor may be made.

There is an economic limit to this practice. For example, if a 400 b.h.p. engine be slowed down, so that it gives only 250 b.h.p., it will probably cost the user far more than would be the case if he purchased an engine designed to give a 12-hour rating of 250 b.h.p.

How this de-rating takes place is shown by the following example: If an engine of 360 b.h.p. is required, and a convenient model rated at 400 b.h.p. at 500 r.p.m. is obtainable, the 360 b.h.p. output can be achieved by running the engine at 450 r.p.m. This procedure reduces the maximum mean piston speed, but not necessarily the brake mean effective pressure.

Optionally, a user may ask an engine builder so to set the fuel-injection pumps that a somewhat lower power than standard is obtained without reduction of the crankshaft speed. For instance, an engine rated as standard at 425 b.h.p. at 500 r.p.m. may be adjusted to develop 400 b.h.p. on the 12-hour basis at the same 500 r.p.m. This procedure reduces the brake mean effective pressure, but does not affect the maximum mean piston speed.

DETAXAGE D'UN MOTEUR

Diminution de puissance par la rēduction de la vitesse et/ou par rēglage de la pompe d'injection du combustible.

BIEN QUE les fabricants de moteur désignent un modèle particulier par une puissance spécifiée à une vitesse donnée, le client peut modifier cette puissance dans le sens d'une réduction par un simple procédé qui consiste à faire tourner le moteur à une vitesse moindre. Quand le lecteur a l'intention de se servir du moteur de cette façon, il faut qu'il en avertisse le fabricant, au moment ou il place sa commande, afin de permettre celui-ci d'effectuer les réglages nécessaires aux pompes d'injection de combustible et au régulateur.

Il y a pourtant une limite économique à cette pratique. Par exemple si on réduit la vitesse d'un moteur de 400 ch. de façon à ce qu'il ne donne seulement que 250 ch., il est fort probable qu'il coûtera beaucoup plus cher à l'acquiéreur que s'il achète un moteur établi pour donner une puissance de 250 ch. pendant douze heures.

L'exemple suivant va nous montrer comment ce détaxage de puissance est réalisé. Si on a besoin d'un moteur de 360 ch. et que l'on trouve un moteur disponible de 400 ch. à 500 tours/minute, on peut obtenir un rendement de 360 ch. en faisant tourner le moteur à 450 tours/minute. Ce procédé réduit la vitesse moyenne des pistons, mais pas nécessairement la pression moyenne effective.

L'utilisateur a la faculté de demander au constructeur du moteur de régler les pompes d'injection de combustible de façon à ce qu'elles soient à même de donner une puissance légèrement inférieure au standard sans que pour cela il y ait réduction de la vitesse de l'arbre vilebrequin. Par exemple, un moteur taxé à la puissance standard de 425 ch. à 500 tours/minute peut être réglé pour développer 400 ch. sur une base de 12 heures, à la même vitesse de 500 tours/minute. Ce procédé réduit la pression moyenne effective, mais n'affecte pas la vitesse moyenne maximum des pistons.

REDUCCIÓN DE POTENCIA DE REGIMEN DE UN MOTOR

Reducción de Potencia mediante Reducción de Velocidad y/o Reglaje de la Bomba de Inyección de Combustible.

AUNQUE un fabricante de motores designe un modelo denominado como teniendo una potencia especificada a una velocidad determinada, el cliente puede variar este rendimiento en escala descendente mediante el sencillo procedimiento de hacer marchar el motor a una velocidad más baja. Cuando hay intención de usar el motor de esta manera se le debe avisar al fabricante de dicha intención en el momento de colocar el pedido, para que se puedan fijar los reglajes exactos para las bombas de inyección de combustible y para el regulador.

Con todo, esta práctica tiene su límite económico. Por ejemplo, si se reduce la velocidad de un motor de 400 H.P. al freno, de modo que sólo rinda 250 H.P. al freno, probablemente le costará más al dueño que lo que sería el caso comprando un motor diseñado para ofrecer un regimen de 12 horas de 250 H.P. al freno.

El siguiente ejemplo demostrará como tiene lugar esta reducción de potencia de regimen :—Si se exige un motor de 360 H.P. al freno, y hay disponible un modelo conveniente con potencia de regimen de 400 H.P. al freno a 500 r.p.m., se puede alcanzar el rendimiento de 360 H.P. al freno, corriendo el motor a 450 r.p.m. Este procedimiento reduce la velocidad media máxima del pistón, pero no necesariamente la presión media efectiva al freno.

A opción, el interesado puede pedir a un fabricante de motores que haga el reglaje de las bombas de inyección de combustible de tal forma que se obtenga una potencia un poco más baja que la normal, sin reducción de la velocidad del árbol cigüeñal. Por ejemplo, un motor clasificado como normal a 425 H.P. al freno a 500 r.p.m. puede ser ajustado para desarrollar 400 H.P. al freno sobre la base de 12 horas a las mismas 500 r.p.m. Este procedimiento reduce la presión media efectiva de freno, pero no afecta la velocidad media máxima de pistón.

REDUÇAO DA POTENCIA DE REGIMEN DUM MOTOR

por meio da redução da velocidade e/ou o ajustamento da bomba de injeção de combustivel.

EMBORA um fabricante de motores designe um determinado modêlo por uma potência específica a uma velocidade dada, o cliente pode variar êsse rendimento em sentido para baixo pelo simples processo de operar o motor a uma velocidade inferior. Quando se pretende utilizar um motor dessa maneira, é conveniente que o fabricante seja avisado disso com antecedência por ocasião de se fazer o pedido, de modo a que possam ser feitos os ajustamentos para as bombas de injecção de combustível e o regulador.

Existe, todavia, um limite economico a essa prática. Por exemplo, se um motor de 400 cav. ef. fôr retardado, para que dê apenas 250 cav. ef., provàvelmente custará ao dono muito mais do que seria o caso se êle tivesse comprado um motor classificado como sendo para 250 cav. ef.

A maneira pela qual se consegue isso é demonstrada pelo seguinte exemplo : Se se precisar de um motor de 360 cav. ef., e houver um de 400 ou 500 disponível, o rendimento desejado de 360 cav. ef. pode conseguir-se com o motor funcionando a 450 rev./min. Esse processo reduz a velocidade máxima média do êmbolo, porém, não necessàriamente, a pressão efetiva média ao freio.

Facultativamente, um utilizador pode solicitar a um fabricante de motores que regule as bombas de injecção de combustível de maneira a conseguir uma potência um tanto mais baixa do que a normal sem redução da velocidade do meio das manivelas. Por exemplo, um motor classificado como para 425 cav. ef. a 500 rev./min. pode ser ajustado para que desenvolva 400 cav. ef. na base de 12 horas à mesma base de 500 rev./min. Esse processo reduz a pressão efetiva média ao freio, porém não afeta a velocidade máxima média do êmbolo.

Index of Participating Members

Make names, where not immediately recognizable from the maker's title, are given in parentheses after the address.

ENGINE MAKES BY CLASSES

VERTICAL AND VEE-FORM INDUSTRIAL (STATIONARY AND TRANSPORTABLE) ENGINES

HORIZONTAL INDUSTRIAL ENGINES

RAILWAY TRACTION ENGINES

MARINE PROPULSION ENGINES

MARINE AUXILIARY ENGINES

SPECIAL ENGINE TYPES

Dual-fuel Engines

Engine-compressor Sets

Gas Engines (including alternative-fuel types)

USE OF THE LIGHTNING INDEX

Simple, Time-Saving Reference Scheme for Study of Descriptive Pages in this Work (pages 2-277).

READERS of this Catalogue should employ the special Lightning Index which follows to assist them in selecting suitable power units. It has been evolved to make as easy as possible the task of finding out which makers' products will fulfil specific requirements in regard to power and speed. It is the key to speedy reference.

A separate section of this Lightning Index is provided for each of the three duty categories :—

(1) Industrial (stationary and transportable) engines, sub-divided into two parts : (a) Vertical and vee form (pages xxiv to xxvii) ; (b) horizontal (page xxviii).

(2) Engines for railway traction purposes (page xxix).

(3) Marine engines, sub-divided into : (a) Propulsion (pages xxx to xxxii) ; (b) auxiliary (pages xxxiii to xxxvi).

Thus readers are referred directly to the types which are suited to the service they have in mind ; there is no need to study complete makers' programmes.

If an inquirer is not sure of the horse-power he needs for any particular service, he should read the item entitled " Power Required for Various Drives," on page xviii.

Search Procedure

In the search for a suitable power unit these are the steps to take :

(1) Consult the Lightning Index of the appropriate engine service category ; limits of horse-power dealt with on any particular page are given at the top of that page.

(2) Run down the b.h.p. column (printed in heavy type) until the desired value is found.

(3) The choice of available crankshaft speeds is seen by referring to the next column on the right ; speeds are given in ascending order.

(4) When the reader has selected entries of suitable speed, the make name, page number and column letter will be found in immediately adjoining columns (to right). The column letter makes for speedy and certain identification, particularly when the b.h.p. figure in question is supplementary to the usual catalogue figure, such as in the case of a derated model.

Detailed Study

Having thus located columns in various tables which are of specific interest, the reader can compare one model with another as regards fundamentals, and prepare a " short list " for further consideration, using the appropriate text for the purpose.

Power Required

In certain instances there may be a variation of a few b.h.p. between the power required by the reader and the figure given in the b.h.p. column ; say, for instance, an engine of 357 b.h.p. is required, and no models are listed at that exact figure, one should take the power rating next higher than the reader's selected figure, say, 360 b.h.p.

The horse-power " steps " in the Lightning Index are determined by the various models available. For instance, a jump from, say, 950 b.h.p. to 980 b.h.p. indicates that there is no model of intervening power at the standard rating.

EMPLOI DE L'INDEX ECLAIR

Une méthode de référence simple et faisant gagner du temps, pour l'étude des pages descriptives contenues dans cet ouvrage (pages 2-277).

LES LECTEURS de ce catalogue auront tout avantage à employer l'Index Eclair spécial suivant, puisque cela les aidera à sélectionner les Unités de force motrice convenables. Cet index a été conçu dans le but de faciliter autant que possible la tâche de découvrir quel est le fabricant du moteur qui remplira les besoins spécifiques envisagés, en ce qui concerne la puissance et la vitesse. C'est la clé pour trouver rapidement une référence.

Une section séparée de cet Index Eclair est réservée à chacune des trois catégories d'emploi :

(1) La Catégorie industrielle (Moteurs fixes et transportables), subdivisée en deux séries (a) Moteurs verticaux ou en Vé (pages xxiv à xxvii) (b) Moteurs horizontaux (page xxviii).

(2) Les moteurs pour chemins de fer et service de traction (page xxix).

(3) Les moteurs marins, subdivisée en : (a) Propulseurs (page xxx à xxxii) ; (b) auxiliaires (pages xxxiii à xxxvi).

Ainsi les lecteurs sont dirigés directement aux types convenant aux services qu'ils ont en vue et sans qu'il soit necessaire d'étudier le programme complet d'un fabricant.

Si le lecteur n'était pas sûr de la puissance en chevaux qui lui est nécessaire pour n'importe quel usage particulier, il n'aurait qu' à se reporter au Chapitre " Puissance requise pour différentes Commandes." Page xviii.

Methode de recherche

Voici ce qu'il y a à faire pour chercher une unité de puissance convenable :

(1) Consulter l'Index Eclair de la catégorie d'emploi appropriée ; les limites en chevaux, traitées dans la page, sont indiquées à la partie supérieure de celle-ci.

(2) Parcourir en descendant la colonne des puissances en chevaux (imprimées en caractères gras) jusqu' à ce qu'on ait trouvé la valeur désirée.

(3) On trouvera le choix des vitesses d'arbre vilebrequin en se reportant à droite à la colonne suivante ; les vitesses sont données dans l'ordre ascendant.

(4) Quand le lecteur aura trouvé les entrées correspondantes à la vitesse désirée, il trouvera le nom du fabricant, le numéro de la page et la lettre indicatrice de la colonne dans les colonnes adjacentes immédiatement à droite. La lettre de la colonne permet de faire une identification rapide et sûre, surtout quand la puissance en chevaux dont il est question est donnée en supplément de la force nominale du catalogue, comme par exemple dans le cas d' un moteur " à puissance détaxée."

Etude detaillee

Après avoir situé les colonnes des différentes tables qui l'intéressent particulièrement, le lecteur peut alors comparer un modèle avec un autre par rapport aux caractéristiques fondamentales et en préparer un résumé pour un examen ultérieur, en faisant usage du texte approprié pour cet usage.

Puissance requise

Dans certain cas il peut y avoir une différence de quelques chevaux entre la puissance requise par le lecteur et le chiffre donné dans la colonne des puissances ; c'est-à-dire, par exemple on a besoin d' un moteur de 357 Ch. effectifs et qu'il n'existe pas sur la liste de moteurs de cette puissance, on devra choisir un moteur de puissance nominale immédiatement au-dessus de ce chiffre, soit 360 Ch.

Les " échelons " de puissance en Ch. de l'Index Eclair sont déterminés par les différents modèles disponibles. Par exemple, un saut de 950 ch. à 980 ch. indique qu'il n'y a pas de modèles intermédiaires de puissance nominale standard.

EMPLEO DEL "INDICE RELAMPAGO"

Sistema de Referencia Sencillo y Economizador de Tiempo para Estudio de las Páginas Descriptivas en esta Obra (páginas 2-277).

LOS LECTORES de este Catálogo deberán usar el " Indice-Relámpago " especial que va a continuación para ayudarles en la selección de unidades de potencia adecuadas. Ha sido ideado con el objeto de conseguir que el trabajo de investigar cuales son los fabricantes de los productos que satisfarán exigencias específicas con relación a potencia y velocidad. Es la clave de una referencia rápida.

Hay una sección separada de este Indice-Relámpago para cada una de las siguientes categorías de servicios :—

(1) Motores industriales (estacionarios y portátiles), sub-divididos en dos partes : (a) Forma Vertical y en " V " (páginas xxiv a xxvii) ; (b) Forma Horizontal (página xxviii).

(2) Motores para servicios de tracción en ferrocarril (página xxix).

(3) Motores Marítimos, sub-dividos en : (a) Propulsión (páginas xxx a xxxii) ; (b) Auxiliares (páginas xxxiii a xxxvi).

Así a los lectores se les refiere directamente a los tipos que más corresponden al servicio que tienen en mente, y no hay necesidad de estudiar los programas completos del fabricante.

Si un indagador no está seguro de la fuerza que necesita para cualquier servicio determinado, debe leer el item entitulado " Power Required for Various Drives " (Potencia Necesaria para Diversas Transmisiones) en la página xviii.

Modo de Hacer la Indagacion

Para buscar una unidad de potencia adecuada, estos son los pasos que deben darse :—

(1) Consúltese el Indice-Relámpago de la categoria apropiada de servicio de motor. Los límites de H.P. que son tratados en cualquier página determinada aparecen a la cabeza de dicha página.

(2) Búsquese en la columna b.h.p. (H.P. al freno), que está impresa en carácteres gruesos, hasta que se encuentre el valor deseado.

(3) La selección de velocidades disponibles de árbol cigüeñal se ve, haciéndose referencia a la columna inmediata a la derecha. Las velocidades se señalan en orden ascendente.

(4) Cuando el lector haya seleccionado partidas de velocidad conveniente, el nombre del fabricante, número de página y letra de column se hallarán en columnas inmediatamente adyacentes (a la derecha). La letra de columna hace que la identificación sea rápida y segura, particularmente cuando la cifra de H.P. al freno en cuestión es suplementaria a la cifra de catálogo usual, tal como es el caso con un modelo de regimen reducido.

Estudio Detallado

Haviendo localizado de esta manera las columnas en los diversos cuadros que le son de interés específico, el lector puede comparar un modelo con otro, en relación a los requisitos fundamentales y puede preparar una " lista corta " ó resumen para estudio posterior, usando el texto apropiado para este objeto.

Potencia Requerida

En ciertos casos, puede haber una variación de unos cuantos H.P. al freno entre la potencia requerida por el lector y la cifra que se da en la columna de H.P. al freno. Por ejemplo, digamos que se requiere un motor de 357 H.P. al freno, y que no hay ningún modelo indicado de la cifra exacta. En ese caso se debe tomar el regimen de potencia más próximo en escala ascendente al de la cifra seleccionada por el lector, por ejemplo, 360 H.P. al freno.

Los " escalones " de H.P. en el Indice-Relámpago son determinados por los varios modelos disponibles. Así, un salto desde, digamos, 950 H.P. al freno hasta 980 H.P. al freno, indica que no hay ningún modelo disponible en el regimen normal entre una y otra cifra.

COMO SE EMPREGA O ÍNDICE RELÂMPAGO

Plano de referência simples e economizador de tempo paro estudo das páginas descriptivas desta obra (páginas 2-277).

OS SRES. LEITORES deste Catálogo devem empregar o Índice Relâmpago especial que se segue, para maior facilidade na escolha dos grupos de forca elétrica mais adequados. Foi o mesmo elaborado a fim de tornar mais fácil a tarefa de descobrir o fabricante cujos produtos satisfarão as exigências específicas no que diz respeito a força e velocidade. Esta é a chave à referência rápida.

Uma secção separada deste Índice Relâmpago está reservada para cada uma das três categorias de serviço :—

(1) Motores industriais (estacionários e transportáveis), subdivididos em duas partes : (a) Formas verticais e em " V " (páginas xxiv a xxvii ; (b) horizontais (página xxviii).

(2) Motores para fins de tracção ferroviária (página xxix).

(3) Motores marítimos, subdivididos em : (a) de propulsão (páginas xxx a xxxii) ; (b) auxiliares (páginas xxxiii a xxxvi).

Dessa maneira os Sres. leitores têm uma referência direta aos tipos que melhor se adaptam ao gênero de serviço que têm em mente ; não há motivo para estudarem o programa completo de cada fabricante.

Se um interessado não tiver certeza do HP que precisa para um determinado serviço, basta ler o item intitulado " Power Required for Various Drives " (Força requerida para diferentes transmissões), na página xviii.

Processo de busca

Na busca de um grupo de força adequado, são estas as normas a seguir :

(1) Consultar o Índice Relâmpago relativo à categoria apropriada de motor. As limites de HP a que se faz referência numa determinada página acham-se indicados no alto da respectiva página.

(2) Procurar de cima para baixo na coluna de b.h.p. (cav. ef.) (impressa em tipo grosso) até descobrir o valor desejado.

(3) A variedade das velocidades de veio de manivelas disponíveis acha-se na próxima coluna à direita ; as velocidades estão indicadas na ordem ascendente.

(4) Quando o leitor tiver escolhido as unidades de velocidade apropriada, encontrará o nome do fabricante, o número da página e a letra correspondente à coluna nas colunas contíguas (à direita). A letra da coluna proporciona uma identificação rápida e segura, especialmente quando a cifra de cav. ef. em apreço é suplementar à cifra usual de catálogo, tal como no caso de um modêlo cuja carga assinalada tiver sido reduzida.

Estudo detalhado

Tendo assim localizado as colunas nos diferentes quadros que oferecem interesse específico, o leitor pode comparar um modêlo com outro no que diz respeito a elementos fundamentais, e preparar uma " lista resumida " para futura consideração, utilizando-se, para esse fim, do texto apropriado.

Forca requerida

Em certos casos poderá existir uma variação de alguns cav. ef. entre a força exigida pelo leitor e a cifra indicada na coluna de b.h.p. (cav. ef.) ; digamos, por exemplo, que se deseje um motor de 357 cav. ef. e que na lista não conste nenhum modêlo daquele algarismo exato. Nesse caso deve-se tomar a cifra justamente acima daquela escolhida pelo leitor, digamos, 360 cav. ef.

Os intervalos entre os HHPP indicados no Indice Relâmpago são determinados pelos diferentes modelos disponíveis. Por exemplo, um pulo de, digamos, 950 a 980 cav. ef. indica que não existe um modêlo de força intermediária na classificacão padrão.

VERTICAL AND VEE-FORM INDUSTRIAL ENGINES

(2.5 b.h.p. to 82 b.h.p.) Horse-power ratings on 12-hr. basis, except where otherwise indicated in tables concerned.

B.h.p.	Speed r.p.m.	Make	Page and column
2.5	780	Tangye	254 (A)
3	1,000	Petter	193 (A)
	1,000	Petter	193 (C)
	1,500	Stuart	240 (A)
3.32	650	Lister	128 (A)
3.5	600	Bamford	14 (A)
4	715	Tangye	254 (B)
	1,250	Enfield	75 (B)
4.5	600	Bamford	14 (B)
	1,500	Petter	193 (C)
5	1,000	Pelapone	184 (A)
	1,500	Petter	193 (A)
5.5	1,500	Coventry Diesel	31 (A)
5.75	650	Lister	128 (B)
6	600	Bamford	14 (C)
	670	Tangye	254 (C)
	1,000	Petter	193 (B)
	1,000	Petter	193 (D)
	1,800	Enfield	75 (B)
7	1,500	Pelapone	184 (A)
7.5	1,500	Ruston	208 (A)
7.75	1,200	Lister	128 (D)
8	650	Bamford	14 (D)
8.5	1,500	Turner	266 (A)
8.8	1,000	Lister	128 (F)
9	1,500	Petter	193 (D)
10	650	Bamford	14 (E)
	1,000	Pelapone	184 (B)
	1,200	Ailsa Craig	4 (A)
	1,200	Thornycroft	258 (A)
	1,500	Crossley	63 (A)
	1,500	Petter	193 (B)
10.5	1,000	Tangye	254 (D)
	1,200	R.N.	200 (A)
11	1,500	Ruston	208 (C)
11.4	650	Lister	128 (C)
12	650	Bamford	14 (F)
	800	Crossley	63 (B)
	1,000	Petter	194 (A)
	1,200	Tangye	254 (D)
13	1,500	R.N.	200 (J)
13.5	750	National	159 (A)
14	1,500	Pelapone	184 (B)
15	1,500	Ruston	208 (B)
	2,000	Coventry Diesel	31 (B)
15.4	1,200	Lister	128 (E)
16	650	Bamford	14 (G)
17	1,500	Turner	266 (B)
18	1,000	Petter	194 (B)
	1,200	Crossley	63 (B)
	1,500	Petter	194 (A)
20	750	National	159 (B)
	1,000	Pelapone	184 (C)
	1,200	Ailsa Craig	4 (B)
20.5	1,200	Lister	128 (G)
21	1,000	Tangye	254 (E)
	1,200	R.N.	200 (B)
22	1,250	National	159 (A)
22.5	1,500	Ruston	208 (D)
	2,000	Coventry Diesel	31 (C)
23.5	1,300	National	159 (A)
24	1,000	Petter	194 (C)
	1,200	Pelapone	184 (C)
	1,200	Tangye	254 (E)
25	800	Crossley	63 (C)
25.5	1,000	Tangye	254 (F)
26	1,000	Sentinel-Ganz	232 (A)
	1,500	R.N.	200 (K)
27	750	National	159 (C)
	1,500	Petter	194 (B)
28	1,700	Thornycroft	258 (B)
30	1,000	Pelapone	184 (D)
	1,200	Ailsa Craig	4 (C)
	1,200	Lister	128 (H)
	1,200	Tangye	254 (F)
	1,500	Pelapone	186 (A)
	2,000	Coventry Diesel	31 (D)
31	1,800	National	159 (A)
31.5	1,200	R.N.	200 (C)
33	1,250	National	159 (B)
34	750	National	159 (D)
	1,000	Tangye	254 (G)
	1,500	Ruston	208 (E)
	1,500	Turner	266 (C)
35	1,300	National	159 (B)
36	1,500	Petter	194 (C)
37	800	Crossley	63 (D)
37.5	1,250	Ruston	208 (G)
38.7	1,200	Lister	128 (J)
39	1,500	R.N.	200 (L)
40	750	National	159 (E)
	1,000	Pelapone	184 (E)
	1,200	Ailsa Craig	4 (D)
	1,200	Tangye	254 (G)
	1,350	Crossley	63 (C)
31	1,800	National	159 (A)
31.5	1,200	R.N.	200 (C)
33	1,250	National	159 (B)
34	750	National	159 (D)
	1,000	Tangye	254 (G)
	1,500	Ruston	208 (E)
	1,500	Turner	266 (C)
35	1,300	National	159 (B)
36	1,500	Petter	194 (C)
37	800	Crossley	63 (D)
37.5	1,250	Ruston	208 (G)
38.7	1,200	Lister	128 (J)
39	1,500	R.N.	200 (L)
40	750	National	159 (E)
	1,000	Pelapone	184 (E)
	1,200	Ailsa Craig	4 (D)
	1,200	Tangye	254 (G)
	1,350	Crossley	63 (C)
42	1,500	Pelapone	184 (D)
	1,200	R.N.	200 (D)
42.5	1,000	Tangye	254 (H)
44	1,000	McLaren	135 (A)
	1,000	Sentinel-Ganz	232 (C)
	1,250	National	159 (C)
45	1,500	Ruston	208 (F)
	1,700	Thornycroft	258 (C)
46	1,800	National	159 (B)
	2,200	Pelapone	186 (A)
47	1,300	National	159 (C)
48	1,200	Pelapone	184 (E)
	1,200	R.N.	200 (E)
50	800	Crossley	63 (E)
	1,000	R.N.	200 (F)
	1,200	Tangye	254 (H)
	1,250	Ruston	208 (H)
	2,000	Coventry Diesel	31 (E)
51	1,000	Tangye	254 (J)
52	1,000	Sentinel-Ganz	232 (B)
	1,500	R.N.	200 (M)
56	1,250	National	159 (D)
58.5	1,300	National	159 (D)
60	1,000	Pelapone	184 (F)
	1,000	Wilson	277 (A)
	1,200	Ailsa Craig	4 (E)
	1,200	Lister	128 (K)
	1,200	Tangye	254 (J)
61	1,800	National	159 (C)
62	750	National	160 (A)
	800	Crossley	63 (F)
63	1,500	Meadows	143 (A)
65	1,500	Sentinel	229 (A)
66	1,000	McLaren	135 (B)
	1,000	R.N.	200 (G)
	1,250	National	159 (E)
	1,500	Crossley	63 (D)
70	1,200	Pelapone	184 (F)
	1,300	National	159 (E)
75	800	Crossley	63 (G)
77	1,800	National	159 (D)
80	600	Blackstone	27 (A)
	1,350	Crossley	63 (E)
	1,500	Thornycroft	258 (D)
82	750	National	160 (B)
	1,000	National	160 (A)

Horse-power values less than the makers' figures above are obtainable by de-rating; please see page xix.

VERTICAL AND VEE-FORM INDUSTRIAL ENGINES (Continued)

Horse-power ratings on 12-hr. basis, except where otherwise indicated in tables concerned. (88 b.h.p. to 367 b.h.p.)

B.h.p.	Speed r.p.m.	Make	Page and column
88	1,000	McLaren	135 (C)
	1,000	Sentinel-Ganz	232 (D)
90	1,000	Wilson	277 (B)
	1,100	National	160 (A)
	1,500	Ruston	208 (J)
	2,000	Sentinel	229 (A)
92	1,800	National	159 (E)
93	1,250	Paxman	175 (A)
96	1,500	Meadows	143 (F)
	1,500	Sentinel	229 (B)
100	500	Crossley	60 (A)
	1,000	R.N.	200 (H)
	1,200	National	160 (A)
	1,250	Ruston	208 (K)
102	600	Ruston	210 (A)
	750	National	160 (C)
110	1,000	McLaren	135 (D)
	1,000	National	160 (B)
	1,500	Thornycroft	258 (E)
115	1,750	Crossley	63 (F)
116	1,250	Paxman	175 (B)
120	600	Belliss	21 (A)
	600	Blackstone	27 (B)
	1,100	National	160 (B)
123	750	National	160 (D)
125	500	National	162 (A)
	1,250	Ruston	208 (L)
132	1,000	McLaren	135 (E)
	1,000	Sentinel-Ganz	232 (E)
133	500	Crossley	60 (B)
	600	Allen	7 (A)
135	2,000	Sentinel	229 (B)
136	600	Ruston	210 (B)
137	1,000	National	160 (C)
140	500	H & W	116 (A)
	1,250	Paxman	175 (C)
	1,750	Crossley	63 (G)
144	750	National	160 (E)
150	500	Crossley	61 (A)
	600	National	162 (A)
	750	Crossley	60 (A)
	1,100	National	160 (C)
	1,250	Ruston	208 (M)
157	600	Mirrlees	154 (A)
160	600	Belliss	21 (B)
	600	Blackstone	27 (C)
	1,500	National	160 (B)
162	650	National	162 (A)
164	750	National	160 (F)
165	600	Crossley	61 (A)
	600	English Electric	81 (A)
	1,000	National	160 (D)
166	500	Crossley	60 (C)
	500	National	162 (B)
170	600	H & W	116 (A)
	600	Ruston	210 (C)
176	1,000	Sentinel-Ganz	232 (F)
178	600	Allen	7 (B)
180	1,100	National	160 (D)
	1,650	Meadows	143 (L)
188	500	National	162 (G)
192	1,000	National	160 (E)
200	300	Uniporn	273 (A)
	500	Crossley	60 (D)
	500	Crossley	61 (B)
	500	Crossley	62 (A)
	600	Belliss	21 (C)
	600	Blackstone	27 (D)
	600	National	162 (B)
	600	Petter	188 (A)
	750	Crossley	60 (B)
	750	English Electric	81 (A)
	900	Brotherhood	28 (A)
	1,300	English Electric	79 (A)
	1,500	National	160 (C)
204	600	Ruston	210 (D)
208	500	National	162 (C)
210	600	Mirrlees	154 (B)
	1,100	National	160 (E)
216	650	National	162 (B)
219	900	National	162 (A)
220	600	English Electric	81 (B)
	1,000	National	160 (F)
	1,500	English Electric	79 (A)
222	600	Allen	7 (C)
225	375	Belliss	21 (N)
	375	Crossley	60 (E)
	500	Belliss	21 (G)
	600	Crossley	62 (A)
	600	National	162 (G)
230	500	H & W	116 (B)
240	450	Allen	8 (A)
	500	Ruston	211 (A)
	600	Belliss	21 (D)
	600	Blackstone	27 (E)
	1,100	National	160 (F)
	1,250	Sentinel-Ganz	232 (G)
	1,500	National	160 (D)
243	650	Paxman	176 (A)
244	428	National	163 (A)
	650	National	162 (G)
250	500	Crossley	61 (C)
	500	National	162 (D)
	500	National	162 (H)
	600	National	162 (C)
	750	Crossley	60 (C)
	900	Brotherhood	28 (B)
	1,250	Paxman	175 (D)
262	600	Mirrlees	154 (C)
265	500	Crossley	62 (B)
266	600	Allen	7 (D)
267	750	English Electric	81 (B)
270	400	Uniporn	273 (A)
	650	National	162 (C)
275	600	Crossley	61 (C)
	600	English Electric	81 (C)
	1,500	English Electric	79 (B)
280	500	H & W	116 (C)
	600	Belliss	21 (E)
	600	H & W	116 (B)
	600	Sulzer	249 (M)
	1,500	National	160 (E)
285	500	National	163 (A)
291	500	National	162 (E)
292	900	National	162 (B)
300	300	Uniporn	273 (B)
	375	Belliss	21 (O)
	375	Crossley	60 (F)
	500	Belliss	21 (H)
	500	Crossley	60 (E)
	500	Crossley	61 (D)
	500	H & W	119 (A)
	500	Ruston	211 (B)
	600	Belliss	21 (C)
	600	National	162 (D)
	600	National	162 (H)
	600	Petter	188 (B)
	750	Crossley	60 (D)
	900	Brotherhood	28 (C)
311	600	Allen	7 (E)
312	1,250	Paxman	175 (E)
313	500	National	162 (J)
315	600	Mirrlees	154 (D)
320	450	Allen	8 (B)
	600	Belliss	21 (F)
	600	Blackstone	27 (F)
	1,250	Sentinel-Ganz	232 (H)
	1,500	National	160 (F)
324	650	National	162 (D)
325	428	National	163 (B)
	650	National	162 (H)
327	900	National	162 (G)
330	500	Crossley	62 (C)
	500	H & W	116 (D)
	600	Crossley	61 (D)
	600	English Electric	81 (D)
	600	English Electric	82 (A)
	600	English Electric	86 (A)
	375	Belliss	23 (A)
333	500	National	162 (F)
	750	English Electric	81 (C)
334	428	National	163 (G)
337.5	500	Belliss	21 (G)
340	600	H & W	116 (C)
350	600	National	162 (E)
	750	Paxman	176 (B)
	900	Brotherhood	28 (D)
355	600	Allen	7 (F)
360	500	Ruston	211 (C)
	600	Belliss	21 (D)
	600	H & W	119 (A)
365	900	National	162 (C)
367	600	Mirrlees	154 (E)

Horse-power values less than the makers' figures above are obtainable by de-rating ; please see page xix.

VERTICAL AND VEE-FORM INDUSTRIAL ENGINES (Continued)

(375 b.h.p. to 806 b.h.p.) Horse-power ratings on 12-hr. basis, except where otherwise indicated in tables concerned.

B.h.p.	Speed r.p.m.	Make	Page and column
375	375	Belliss	21 (P)
	375	Crossley	60 (G)
	500	Belliss	21 (J)
	500	H & W	116 (E)
	500	National	162 (K)
	500	Sulzer	249 (O)
	600	Crossley	62 (C)
	600	National	162 (J)
	600	Sulzer	249 (N)
	800	Brotherhood	28 (F)
378	650	National	162 (E)
380	500	National	163 (B)
385	600	English Electric	81 (E)
	600	English Electric	86 (B)
390	500	National	163 (G)
400	300	Uniporn	273 (C)
	400	Uniporn	273 (B)
	428	H & W	117 (A)
	450	Allen	8 (C)
	500	Crossley	60 (F)
	500	Crossley	61 (E)
	500	Crossley	62 (D)
	500	H & W	119 (B)
	600	H & W	116 (D)
	600	National	162 (F)
	600	Petter	188 (C)
	750	English Electric	81 (D)
	750	English Electric	82 (A)
	800	Sentinel-Ganz	232 (K)
	900	Brotherhood	28 (E)
	1,000	Paxman	175 (F)
405	375	Allen	9 (A)
	600	Mirrlees	154 (G)
406	428	National	163 (C)
	650	National	162 (J)
413	600	English Electric	82 (B)
420	500	Ruston	211 (D)
	600	Belliss	21 (E)
	600	Mirrlees	154 (F)
	750	Paxman	176 (C)
425	500	H & W	119 (C)
432	650	National	162 (F)
436	900	National	162 (H)
438	500	National	162 (L)
	900	National	162 (D)
440	600	Crossley	61 (E)
	600	English Electric	81 (F)
	600	English Electric	86 (C)
	800	Brotherhood	28 (G)
445	428	National	163 (H)
450	375	Belliss	21 (C)
	375	Crossley	60 (H)
	500	Belliss	21 (H)
	500	Belliss	21 (K)
	500	H & W	117 (A)
	500	Sulzer	249 (P)
	600	Crossley	62 (D)
	600	H & W	116 (E)
	600	National	162 (K)
	600	Sulzer	249 (M)
467	750	English Electric	81 (E)
475	500	National	163 (C)
480	375	H & W	122 (A)
	428	H & W	117 (B)
	428	Ruston	211 (J)
	450	Allen	8 (D)
	500	Ruston	211 (E)
	600	Belliss	21 (F)
487	650	National	162 (K)
488	428	National	163 (D)
495	375	Belliss	23 (A)
	600	English Electric	82 (C)
	600	English Electric	86 (D)
500	375	Crossley	61 (F)
	500	Crossley	60 (G)
	500	National	162 (M)
	600	Petter	188 (D)
	750	English Electric	82 (B)
	800	Brotherhood	28 (H)
	1,000	Paxman	175 (G)
510	600	H & W	119 (C)
	900	National	162 (E)
515	500	H & W	119 (D)
520	428	H & W	122 (A)
	500	National	163 (H)
525	375	Belliss	21 (R)
	500	Belliss	21 (L)
	600	National	162 (L)
530	500	Crossley	62 (E)
532	750	Paxman	176 (D)
533	750	English Electric	81 (F)
540	375	Allen	9 (B)
	400	Uniporn	273 (C)
	500	H & W	117 (B)
	500	Ruston	211 (F)
545	900	National	162 (J)
550	375	Belliss	23 (B)
	375	Mirrlees	154 (O)
	428	H & W	118 (A)
556	428	National	163 (J)
560	428	H & W	117 (C)
	428	Ruston	211 (K)
	750	Paxman	176 (E)
562.5	500	Belliss	21 (J)
570	428	National	163 (E)
	500	National	163 (D)
	650	National	162 (L)
578	600	English Electric	82 (D)
	600	English Electric	86 (E)
580	500	Sulzer	249 (O)
584	900	National	162 (F)
600	375	Crossley	60 (J)
	375	Crossley	61 (G)
	375	H & W	122 (B)
	500	Belliss	21 (M)
	500	Crossley	60 (H)
	500	Sulzer	249 (Q)
	600	Crossley	62 (E)
	600	National	162 (M)
	600	Petter	188 (E)
	600	Sulzer	249 (N)
	750	English Electric	82 (C)
620	600	H & W	119 (D)
625	375	Belliss	23 (F)
	375	English Electric	91 (A)
630	375	Sulzer	249 (R)
	500	H & W	117 (C)
	500	H & W	118 (A)
	500	Ruston	211 (G)
640	428	H & W	117 (D)
	428	Ruston	211 (L)
	450	Allen	8 (E)
650	428	H & W	122 (B)
	428	National	163 (F)
	500	National	163 (J)
	650	National	162 (M)
654	900	National	162 (K)
660	375	Belliss	23 (C)
	375	Mirrlees	154 (P)
	600	English Electric	82 (E)
	600	English Electric	86 (F)
665	375	Crossley	62 (F)
	500	National	163 (E)
667	1,000	Paxman	175 (H)
668	428	National	163 (K)
670	300	H & W	117 (E)
675	375	Allen	9 (C)
	500	Belliss	21 (K)
683	273	National	165 (A)
690	428	H & W	118 (B)
700	500	Sulzer	249 (P)
	750	English Electric	82 (D)
710	750	Paxman	176 (F)
715	428	English Electric	91 (A)
720	333	H & W	117 (E)
	375	H & W	122 (C)
	428	Ruston	211 (M)
	500	H & W	117 (D)
	500	Ruston	211 (H)
	750	Mirrlees	154 (H)
750	375	Belliss	23 (G)
	375	English Electric	91 (B)
760	500	National	163 (F)
763	900	National	162 (L)
770	375	Belliss	23 (D)
	375	Mirrlees	154 (Q)
	428	H & W	118 (C)
780	428	H & W	122 (C)
	428	National	163 (L)
	500	H & W	118 (B)
	500	National	163 (K)
787.5	500	Belliss	21 (L)
800	300	H & W	117 (F)
	375	Crossley	61 (H)
	375	Crossley	62 (G)
	500	Crossley	60 (J)
	750	English Electric	82 (E)
806	720	Paxman	177 (A)

Horse-power values less than the makers' figures above are obtainable by de-rating ; please see page xix.

VERTICAL AND VEE-FORM INDUSTRIAL ENGINES (Continued)

Horse-power ratings on 12-hr. basis, except where otherwise indicated in tables concerned. (810 b.h.p. to 4,800 b.h.p.)

B.h.p.	Speed r.p.m.	Make	Page and column
810	375	Allen	9 (D)
812	273	National	165 (B)
825	375	Belliss	23 (B)
833	333	National	165 (A)
840	375 428	Sulzer Ruston	249 (S) 211 (N)
845	300	H & W	118 (E)
858	428	English Electric	91 (B)
870	333	H & W	117 (F)
872	900	National	162 (M)
875	375 375	Belliss English Electric	23 (H) 91 (C)
880	375 375 500	Belliss Mirrlees H & W	23 (E) 154 (R) 118 (C)
890	428	National	163 (M)
900	500	Belliss	21 (M)
910	500	National	163 (L)
920	428	H & W	118 (D)
937	375	English Electric	91 (E)
937.5	375	Belliss	23 (F)
940	300 333	H & W H & W	117 (G) 118 (E)
950	375 500	Sulzer Sulzer	249 (R) 249 (Q)
956	273	National	165 (C)
960	428	Ruston	211 (O)
975	375	Ruston	212 (B)
980	300	English Electric	93 (A)
983	273	National	165 (E)
990	375 375	Belliss Mirrlees	23 (C) 154 (S)
998	333	National	165 (B)
1,000	333 375 375 428	H & W Belliss English Electric English Electric	117 (G) 23 (J) 91 (D) 91 (C)
1,030	720	Paxman	177 (B)
1,040	375 500 500	Ruston H & W National	212 (A) 118 (D) 163 (M)
1,050	750	Mirrlees	154 (J)
1,065	375	Crossley	62 (H)

B.h.p.	Speed r.p.m.	Make	Page and column
1,070	300 428	H & W English Electric	117 (H) 91 (E)
1,075	720	Paxman	177 (C)
1,080	375	Allen	9 (E)
1,091	273	National	165 (D)
1,110	300	H & W	118 (F)
1,125	375 375	Belliss English Electric	23 (G) 91 (F)
1,140	300	Sulzer	249 (H)
1,144	428	English Electric	91 (D)
1,150	333	H & W	117 (H)
1,155	375 375	Belliss Mirrlees	23 (D) 154 (T)
1,160	300	H & W	123 (A)
1,167	333	National	165 (C)
1,170	375	Ruston	212 (C)
1,180	273	National	165 (F)
1,190	300	H & W	118 (G)
1,200	333 750	National English Electric	165 (E) 84 (A)
1,230	333	H & W	118 (F)
1,250	375	Sulzer	249 (S)
1,280	333	H & W	123 (A)
1,287	428	English Electric	91 (F)
1,310	375	Belliss	23 (H)
1,312	375	English Electric	91 (G)
1,320	333 375 375	H & W Belliss Mirrlees	118 (G) 23 (E) 154 (U)
1,330	300	Sulzer	249 (J)
1,332	333	National	165 (D)
1,340	435	Ruston	212 (F)
1,365	375	Ruston	212 (D)
1,370	720	Paxman	177 (D)
1,376	273	National	165 (G)
1,400	250	Sulzer	249 (A)
1,420	300	H & W	118 (H)
1,440	333	National	165 (F)
1,450	300	H & W	123 (B)

B.h.p.	Speed r.p.m.	Make	Page and column
1,470	300	English Electric	93 (B)
1,500	375 375 428	Belliss English Electric English Electric	23 (J) 91 (H) 91 (G)
1,520	300	Sulzer	249 (K)
1,560	375	Ruston	212 (E)
1,572	273	National	165 (H)
1,580	333	H & W	118 (H)
1,600	333 750	H & W English Electric	123 (B) 84 (B)
1,610	435	Ruston	212 (G)
1,680	333	National	165 (G)
1,716	428	English Electric	91 (H)
1,740	300	H & W	123 (C)
1,750	250	Sulzer	249 (B)
1,880	435	Ruston	212 (H)
1,900	300	Sulzer	249 (L)
1,920	333 333	H & W National	123 (C) 165 (H)
1,960	300	English Electric	93 (C)
2,100	250	Sulzer	249 (C)
2,150	435	Ruston	212 (J)
2,400	200	H & W	123 (D)
2,410	435	Ruston	212 (K)
2,450	250	Sulzer	249 (D)
2,750	231	H & W	123 (D)
2,800	250	Sulzer	249 (E)
3,000	200	H & W	123 (E)
3,450	231	H & W	123 (E)
3,500	250	Sulzer	249 (F)
3,600	200	H & W	123 (F)
3,800	180	H & W	123 (G)
4,150	231	H & W	123 (F)
4,200	200 250	H & W Sulzer	123 (G) 249 (G)
4,300	180	H & W	123 (H)
4,800	200	H & W	123 (H)

Horse-power values less than the makers' figures above are obtainable by de-rating ; please see page xix.

HORIZONTAL INDUSTRIAL ENGINES

(5.5 b.h.p. to 2,400 b.h.p.)

Horse-power ratings on 12-hr. basis, except where otherwise indicated in tables concerned.

B.h.p.	Speed r.p.m.	Make	Page and column
5.5	550	Ruston	214 (A)
7	650	Tangye	251 (F)
	1,500	R.N.	200 (P)
8	500	Ruston	214 (B)
9	800	Tangye	251 (F)
10	475	Ruston	214 (C)
	1,000	Uniporn	272 (A)
	1,250	Enfield	75 (A)
12	475	Crossley	59 (A)
	600	National	166 (A)
	1,000	Uniporn	272 (B)
	1,500	R.N.	200 (N)
13	450	Ruston	214 (D)
13.25	1,800	Enfield	75 (A)
13.5	675	National	166 (A)
14.5	515	Tangye	251 (A)
15	430	Ruston	214 (E)
16	400	Crossley	59 (B)
	400	National	166 (B)
	450	Wilson	275 (A)
	800	Blackstone	26 (A)
16.5	1,000	R.N.	200 (O)
17	370	Ruston	214 (F)
	470	Tangye	251 (B)
20	360	Ruston	214 (G)
	375	National	166 (C)
	400	Crossley	59 (C)
	430	Tangye	251 (C)
	500	National	166 (B)
	570	Tangye	251 (G)
21	500	Petter-Fielding	192 (A)
22	350	Ruston	214 (A)
23	345	Robey	197 (A)
	380	Wilson	275 (B)
	400	Tangye	251 (D)
24	350	Ruston	214 (J)
	650	Blackstone	26 (B)
25	375	Crossley	59 (D)
25.5	370	Tangye	251 (E)
26	340	Robey	197 (B)
	450	National	166 (C)
27	350	National	166 (D)
	650	Petter-Fielding	192 (A)
28	320	Ruston	214 (K)
	330	Tangye	251 (H)
	360	Wilson	275 (C)
30	330	Robey	197 (C)
	400	National	166 (D)
31	340	Crossley	59 (E)

B.h.p.	Speed r.p.m.	Make	Page and column
32	300	National	166 (E)
	400	Petter-Fielding	192 (C)
33	330	Wilson	275 (D)
34	310	Ruston	214 (L)
	310	Tangye	251 (J)
35	325	Robey	197 (D)
37	350	National	166 (E)
	500	Blackstone	26 (C)
38	275	National	166 (F)
	330	Crossley	59 (F)
40	300	Ruston	214 (M)
	310	Wilson	275 (E)
	315	Robey	197 (E)
	500	Petter-Fielding	192 (C)
42	295	Tangye	251 (K)
45	310	Wilson	275 (F)
	330	National	166 (F)
46	310	Crossley	59 (G)
47	290	Ruston	214 (N)
50	270	National	167 (A)
	280	Tangye	251 (L)
	290	Robey	197 (F)
	450	Blackstone	26 (D)
57	275	Ruston	214 (O)
	290	Wilson	275 (G)
60	270	National	167 (B)
	330	Robey	198 (A)
64	280	Wilson	275 (H)
	400	Petter-Fielding	192 (D)
65	1,500	Sentinel	229 (C)
66	265	Ruston	214 (P)
67	270	Crossley	59 (H)
67	280	Tangye	251 (M)
70	260	National	167 (C)
	420	Blackstone	26 (E)
78	260	Ruston	214 (Q)
80	220	National	167 (D)
	260	Crossley	59 (J)
	265	Tangye	251 (N)
	315	Robey	199 (B)
	500	Petter-Fielding	192 (D)
90	310	Wilson	275 (J)
	2,000	Sentinel	229 (C)
94	290	Ruston	215 (A)
95	250	Tangye	251 (O)
96	1,500	Sentinel	229 (D)
100	240	Crossley	59 (K)
	290	Robey	198 (C)
110	280	Tangye	251 (P)

B.h.p.	Speed r.p.m.	Make	Page and column
114	275	Ruston	215 (B)
	290	Wilson	275 (K)
128	280	Wilson	275 (L)
132	265	Ruston	215 (C)
134	270	Crossley	59 (L)
	280	Tangye	251 (Q)
135	500	Robey	199 (A)
	2,000	Sentinel	229 (D)
140	420	Blackstone	26 (F)
150	230	Robey	198 (D)
156	260	Ruston	215 (D)
160	260	Crossley	59 (M)
	265	Tangye	251 (R)
170	290	Wilson	275 (M)
	500	Robey	199 (B)
190	250	Tangye	251 (S)
	280	Wilson	275 (N)
200	220	Robey	198 (E)
	240	Crossley	59 (N)
210	300	Ruston	215 (E)
	428	Robey	199 (C)
226	290	Wilson	275 (O)
255	285	Ruston	215 (F)
256	280	Wilson	275 (P)
280	428	Robey	199 (D)
295	275	Ruston	215 (G)
310	428	Robey	199 (E)
350	375	Robey	199 (F)
400	375	Robey	199 (G)
450	333	Robey	199 (H)
560	428	Robey	199 (J)
620	428	Robey	199 (K)
700	375	Robey	199 (L)
800	375	Robey	199 (M)
900	333	Robey	199 (N)
1,050	250	Crossley-Premier	68 (A)
1,200	214	Crossley-Premier	66 (A)
1,575	250	Crossley-Premier	68 (B)
1,800	214	Crossley-Premier	66 (B)
2,100	250	Crossley-Premier	68 (C)
2,400	214	Crossley-Premier	66 (C)

Horse-power values less than the makers' figures above are obtainable by de-rating; please see page xix.

RAILWAY TRACTION ENGINES

(11 b.h.p. to 2,400 b.h.p.)

Horse-power ratings on maximum output basis, except where otherwise indicated in tables concerned.

B.h.p.	Speed r.p.m.	Make	Page and column
11	1,200	Ailsa Craig	5 (A)
18	1,100	Crossley	65 (A)
20	1,200	Ruston	216 (A)
22	1,200	Ailsa Craig	5 (B)
30	1,200	Ruston	216 (B)
31	1,800	National	168 (A)
33	1,200	Ailsa Craig	5 (C)
40	1,200	Crossley	65 (B)
	1,200	Ruston	216 (C)
44	1,200	Ailsa Craig	5 (D)
46	1,800	National	168 (B)
48	1,100	Ruston	216 (D)
61	1,800	National	168 (C)
65	1,350	Crossley	65 (C)
66	1,200	Ailsa Craig	5 (E)
66	1,600	Meadows	143 (D)
77	1,800	National	168 (D)
88	1,000	Ruston	216 (F)
	1,350	Crossley	65 (D)
92	1,800	National	168 (E)
100	1,200	National	168 (F)
	1,500	Ruston	216 (E)
	1,600	Meadows	143 (J)
130	1,750	Crossley	65 (E)
150	1,750	Crossley	65 (F)
160	1,500	National	168 (G)
165	1,250	Ruston	216 (G)
200	1,500	National	168 (H)
219	900	National	168 (M)
220	750	Crossley	64 (G)
	900	Brotherhood	29 (A)
240	1,250	Sentinel-Ganz	232 (G)
	1,500	National	168 (J)
266	750	English Electric	96 (A)
275	750	Crossley	64 (H)
	900	Brotherhood	29 (B)
	1,000	H & W	126 (C)
280	1,500	National	168 (K)
292	900	National	168 (N)
320	1,250	Sentinel-Ganz	232 (H)
	1,500	National	168 (L)
327	900	National	169 (A)
330	750	Crossley	64 (J)
	900	Brotherhood	29 (C)
	1,200	H & W	126 (C)
350	680	English Electric	96 (E)
354	720	Mirrlees	154 (K)
365	900	National	168 (O)
	1,000	H & W	126 (D)
380	600	H & W	126 (A)
385	900	Brotherhood	29 (D)
400	750	English Electric	96 (B)
	800	Sentinel-Ganz	232 (K)
412.5	800	Brotherhood	29 (F)
420	1,100	Sulzer	243 (F)
436	900	National	169 (B)
438	900	National	168 (P)
440	700	H & W	126 (A)
	750	Crossley	64 (K)
	900	Brotherhood	29 (E)
	1,200	H & W	126 (D)
450	650	H & W	126 (E)
	1,150	Sentinel-Ganz	232 (L)
480	720	Mirrlees	154 (L)
484	800	Brotherhood	29 (G)
500	600	H & W	126 (B)
510	900	National	168 (Q)
545	900	National	169 (C)
550	750	Crossley	64 (L)
	800	Brotherhood	29 (H)
	800	H & W	126 (E)
570	950	Sulzer	243 (A)
580	650	H & W	126 (F)
	700	H & W	126 (B)
584	900	National	168 (R)
600	750	English Electric	96 (C)
	1,150	Sentinel-Ganz	232 (M)
616	700	H & W	126 (A)
654	900	National	169 (D)
660	750	Crossley	64 (F)
	750	Crossley	64 (M)
715	800	H & W	126 (F)
720	750	Mirrlees	154 (M)
735	850	Sulzer	243 (G)
750	950	Sulzer	243 (B)
763	900	National	169 (E)
800	750	English Electric	96 (D)
	750	English Electric	97 (A)
812	700	H & W	126 (B)
872	900	National	169 (F)
880	750	Crossley	64 (N)
900	600	Crossley	64 (A)
915	750	Sulzer	243 (C)
960	850	Sulzer	243 (H)
1,050	750	Mirrlees	154 (N)
1,135	700	Sulzer	243 (K)
1,200	600	Crossley	64 (B)
	750	English Electric	97 (B)
	750	Sulzer	243 (D)
1,450	850	Sulzer	243 (J)
1,500	600	Crossley	64 (C)
	600	H & W	126 (G)
	700	Sulzer	243 (L)
1,600	750	English Electric	97 (C)
1,760	700	H & W	126 (G)
1,800	600	Crossley	64 (D)
	750	Sulzer	243 (E)
2,000	600	H & W	126 (H)
2,250	700	Sulzer	243 (M)
2,340	700	H & W	126 (H)
2,400	600	Crossley	64 (E)

Horse-power values less than the makers' figures above are obtainable by de-rating ; please see page xix.

Paxman railway traction engines range from 60 b.h.p. to 2,000 b.h.p., page 178.

In addition to the power units indicated above some of the makes of industrial engine, in variable-speed form, are suitable for railway work, particularly those in the lower horse-power groups.