GAS, GASOLINE, AND OIL VAPOR ENGINES: A NEW BOOK DESCRIPTIVE OF THEIR THEORY AND POWER. ILLUSTRATING THEIR DESIGN, CONSTRUCTION, AND OPERATION, FOR STATIONARY, MARINE, AND VEHICLE MOTIVE POWER

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GARDNER D. HISCOX

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FOR

STATIONARY, MARINE AND VEHICLE MOTIVE POWER

BY

GARDNER D. HISCOX, M.E.

A WORK DESIGNED FOR THE GENERAL INFORMATION OF EVERY ONE INTERESTED IN THIS NEW AND POPULAR PRIME-MOVER, AND ITS ADAPTATION TO THE INCREASING DEMAND FOR A CHEAP, SAFE AND EASILY MANAGED MOTIVE POWER

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GAS, GASOLINE, AND OIL ENGINES.

CHAPTER I.

INTRODUCTORY.

MUCH attention is now being given by mechanical engineers to the economical results developed in the working of gas, gasoline, and oil engines for higher powers from producer and other cheap gases. In an economical sense, for small powers steam has been left far behind.

It now becomes a question as to how to adapt the design of the new prime-movers to a wider range of usefulness.

The best steam engines now made run with a consumption of about one and three-fourth pounds of coal per horse-power per hour; while from two and one-half to seven pounds is the cost of power per horse-power per hour in the various kinds of engines now in use. This only covers the cost of fuel; the attendance required in the use of small steam power is often far greater in cost than the fuel.

When we come to require the larger powers by steam, in which economy may be obtained by compounding and condensing, the facility for obtaining the requisite water-supply is often a bar to its use. The direction in which lies the line of improvement for larger powers with the utmost economy is as yet a mooted point of discussion in explosive motor engineering.

The expansion of single-cylinder dimensions involves practical problems in the progress of ignition of the charge, as well as the thoroughness of mixture of the combustibles, and the interference of the products of the previous combustion by producing areas of imperfect or non-combustion or "stratification," as treated in foreign publications.

The enlargement of cylinder area is a source of engine-friction economy, while, on the contrary, the multiplication of cylinders involves numbers and complexity of moving parts, which go to make disparity between the indicated and brake horse-power, which is the measure of machine efficiency.

An impulse at every stroke, so desirable in an explosive motor and so satisfactorily carried out in the steam engine in connection with the compound system, seems to have as yet no counterpart in the explosive motor. Condensation is impossible, and the trials of explosion at every stroke in European engines have not proved satisfactory in service, and in order to accomplish the desired result resort has been had to duplicating single-acting cylinders. This class of explosive engines seems to fill the bill in effect; yet the complication of a two-cylinder engine as a moving mechanism must compete with a single-cylinder steam engine.

The principal types of explosive motors seem to have gone through a series of practical trials during the past thirty years, which have finally reduced the principles of action to a few permanent forms in the design of motors, that show by long-continued use the prospect of their staying qualities and their efficiency; for these will no doubt be the principal points in the final judgment of purchasers in the selection of motive power. For a gas, gasoline, or oil explosive power to approximate an ideal standard as a prime-mover, it should be simple in design, not liable to get out of order, the parts must be readily accessible, the ignition of the charge must be positive, the governing close, the engine must run quietly, and must be durable and economical in the use of fuel. These points of excellence have been striven for by many designers and builders, with varying success. But to get the entire combination without the sacrifice of some good point is not an easy matter.

But for all, the internal combustion engine has come seemingly like an avalanche of a decade; but it has come to stay, to take its well-deserved position among the powers for aiding labor.

HISTORICAL.

Although the ideal principle of explosive power was conceived some two hundred years since, and experiments made with gunpowder as the explosive element, it was not until the last years of the eighteenth century that the idea took a patentable shape, and not until about 1826 (Brown's gas-vacuum engine) that a further progress was made in England by condensing the products of combustion by a jet of water, thus creating a partial vacuum.

Brown's was probably the first explosive engine that did real work. It was clumsy and unwieldy and was soon relegated to its place among the failures of previous experiments. No approach to active explosive effect in a cylinder was reached in practice, although many ingenious designs were described, until about 1838 and the following years. Barnett's engine in England was the first attempt to compress the charge before exploding. From this time on to about 1860 many patents were issued in Europe and a few in the United States for gas engines, but the progress was slow, and its practical introduction for ordinary power purposes came with spasmodic effect and low efficiency.

From 1860 on, practical improvement seems to have been made and the Lenoir motor was produced in France and brought to the United States. It failed to meet expectations, and was soon followed by further improvements in the Hugon motor in France (1862) followed by Beau de Rocha's four-cycle idea, which has been slowly developed through a long series of experimental trials by different inventors. In the hands of Otto and Langdon a further progress was made, and numerous patents were issued in England, France, and Germany, and followed up by an increasing interest in the United States with a few patents.

From 1870 on, improvements seem to have advanced at a steady rate, and largely in the valve gear and precision of governing for variable load.

The early idea of the necessity of slow combustion was a great drawback in the advancement of efficiency, and the suggestions of de Rocha, in 1862, did not take root as a prophetic truth until many failures and years of experience had taught the fundamental axiom that rapidity of action in both combustion and expansion was the basis of success in explosive motors.

With this truth and the demand for small and safe prime-movers, the manufacture of gas engines increased in Europe and America at a more rapid rate, and improvements in perfecting the details of this cheap and efficient prime-mover have finally raised it to the dignity of a standard motor and a rival of the steam engine for small and intermediate powers, with a prospect of largely increasing its individual units to the hundred, if not to the thousand, horse-power in a single engine. The efforts of Otto, in Germany, in developing the four-cycle type, have given his name to the compression engine, which is a well-deserved tribute to genius.

The eight hundred patents issued during the past thirty years in the United States have had a simplifying tendency in construction, and have brought the efficiency of the gas, gasoline, and oil explosive engines to their present high degree of economy and widespread adoption as a prime-mover.

In this work the various changes that the gas engine has undergone in design in its European development are not considered essential to American readers, as the best European ideas have been adapted here with the spirit of American enterprise in perfecting details of construction and the application of the best material for wear in all its parts; so that in representing as many engines of American manufacture as can be obtained, the whole range of practical design will be sufficiently illustrated and described as to give a fairly good explanation of their operation to the general reader and to the users of American gas, gasoline, and oil engines.

The intense interest manifested by American engineers and inventors in the new motive power is well shown in the progress of patents issued during the past twenty years. In 1875 3 patents were issued in the United States for gas engines; 1876, 3 patents; 1877, 5 patents; 1878, 1 patent; 1879, 6 patents; 1880-81, 7 each year; 1882, 14 patents; 1883 was a booming year in gas-engine invention—no less than 40 patents were issued that year, followed by 36 patents in 1884 and 40 patents in 1885, 46 in 1886, 25 in 1887, 31 in 1888, and 58 in 1889, with an average of about 80 patents per annum during the past seven years.

The application of the gasoline motor to marine propulsion and to the horseless vehicle, the tricycle and bicycle, has had a most stimulating effect in adapting ways and means for applying this power to so many uses. Even aerial navigation has come in for its share in motor patents.

Although the denser population of Europe claims a very large representation of explosive motors in use for all purposes, the manufacture in the United States is fast forging ahead in its output of explosive motor power, for there are now no less than one hundred establishments in the United States engaged in their manufacture, and the motors in operation number many thousands. Their safety and easy management as well as their economy have made in their adoption as agricultural helpers a marvellous inroad on the old-fashioned hand and horse-power. Their later developed adaptability as a means for generating electricity for electric lighting and transmission of power is fast expanding the use of lighting and power in fields that the higher cost of small steam power had precluded. Thus the incentive to invention has been the father to a fast-growing industry, that has and will continue to ameliorate the