GAS ENGINES.*

BY PROF. AIME WITZ.

Among the merits of gas motors there is one which should be specially mentioned, and that is that they will accommodate themselves to all kinds of gas and may be fed by the richest as well as the poorest products, whose scale extends from acetylene down to the blast-furnace gases. For this it is only necessary to modify the proportions of the explosive mixture, and to regulate properly the degree of compression and the ignition period. When an appropriate carburetor is used it is possible to use hydrocarbon liquids whose density and volatility are quite different, comprised between gasolines and ordinary petroleum. It is owing to this great elasticity that the gas motor has reached such a wide development and has been put to such varied uses, its power ranging from one or two up to a thousand horse power.

The gas engine of 1,000 horse power was a brilliant dream whose realization haunted the minds of many workers, and the foremost among these; it has now a tangible realization, for it suffices to couple in tandem or otherwise two cylinders like that of the great motor shown at the Exposition by the John Cockerill Company to obtain this result. This engine is of the single cylinder type, measuring 52 inches diameter with 56-inch stroke. It has developed, under the inspection of a commission of prominent engineers, 560 to 670 effective horse power, consuming blast-furnace gas of but 27 calories per cubic foot. It absorbed about 88,440 cubic feet of gas per hour while developing 670 horse power. According to the remark of an eminent engineer, the cast iron is henceforth only a secondary product of the blast furnace, which assumes the rôle of a powerful gas generator, furnishing, on the one hand, 150 tons of cast iron per day and on the other 21 million cubic feet of gas. Even discounting one-half of this volume for heating the air-blast of the furnace and for other uses, there remains a quantity of gas sufficient to produce 3,500 effective horse power by the use of gas engines. If the same gases were used to heat the boilers of steam engines not more than 1,000 horse power could be obtained. The gas engine has thus found a new sphere of action, and a like success is in store for the engineers who will utilize the gases of coke furnaces.

The gas generators of Dowson, Gardie, Deutz, Bénier and others have been essential in the progress of the gas motor. At first they required choice coal, anthracite of the best quality, carefully separated from dust and otherwise possessing exceptional qualities which corresponded to a high price, but at present ordinary anthracite is used of a relatively low price, and this has multiplied the applications of the gas generators; among these may be mentioned electric light plants, tramway stations, pumping works, mills, printing establishments, and even in the spinning and weaving industries gas engines have been used with successful results. A motor of 100 horse power working 3,000 hours per year, whose generator is fed by anthracite at $5 per ton, gives the effective horse power hour at less than $0.008 (allowing for interest, etc.), with a gain of $0.001 over a good steam engine burning coal at $4 per ton, and the first cost of the plant is somewhat less. These results are certain at present. The energy of the generator gas ranges from 30 to 40 calories per cubic foot. The generators accommodate themselves to the use of coke, but the high price of this combustible is an obstacle to its use. Mr. Mond has put in service in the chemical works of Brunner, Mond & Company, in England, a remarkable form of generator which permits the use of fine bituminous coal, with the formation of sub-products which are quite remunerative. The ensemble of the apparatus resembles a small gas works, but the cost per kilowatt hour is only $0.008, with Crossley engines of 25 horse power, and this figure has justified a complete installation of this kind. The Riché generator, in which wood is used, gives gas of a relatively high quality at 80 calories per cubic foot, which has been used with Charon engines quite successfully. This process may find useful applications in localities where wood is plentiful, and thus the domain of the gas motor will be increased.

The use of water gas for motors has not been attended with the results which were hoped for; this may cause some surprise, but the necessity of using coke and the alternative phases of working may perhaps explain the fact. The Delwick generators, which furnish a gas of 70 calories per cubic foot, have had a certain success in Germany, and in America the Lowe generators, transformed by Merrifield, are used. But few experiments have been made as to the supply of motors by water gas, but these have been sufficient to give new proof of the great adaptability of the motor, which works as well with water gas as with mixed or with Siemens gases. Biedermann and Harvey have proposed a novel process, this being to supply the generators with carbonic oxide gas which would be reduced to carbon monoxide by contact with incandescent carbon. If this idea becomes practicable it would give rise to an interesting regeneration of the burned gases of the motors. In fact, the cycle could be closed by reviving these gases by causing them to pass through a layer of carbon at a red heat. The high temperature of the exhaust would no doubt suffice to keep up the reaction and the heat would thus be recuperated. Unfortunately, there would be an accumulation of nitrogen on account of the introduction of air into the motor cylinder to form the explosive mixture.

The gases of distillation may now be considered, these constituting the gases of high quality. Their energy varies from 100 calories per foot (gas from dry wood) to 140 from coal and 200 from schist. These are average figures, and we find 130 to 160 calories for the gas of the city gas-works. This latter has been the first gas used for the motors, and for which they were invented and built, from the time of Philippe Lebon to Lenoir and Otto. With gas at $0.54, $0.81, $1.08 and $1.35 per 1,000 feet, and for motors of 4, 10 and 30 horse power, working 3,000 hours per year, the price per horse power hour is shown in the following table:

COST PER HORSE POWER HOUR.

Motor.	Gas at $0.54	Gas at $0.81	Gas $1.08	Gas at $1.35
4 horse power	$0.022	$0.028	$0.034	$0.040
10 " "	.019	.025	.031	.037
30 " "	.017	.023	.029	.035

These figures, which, of course, are subject to variations, show at least that up to 10 horse power the gas engine need not fear the competition of any motor, even with city gas at $1.08 per thousand, but for 30 horse power the price should not exceed $0.81. It is true that the gas engine, fed from the city mains, has such great practical advantages that it will be used even if the price per unit of work is somewhat higher. It needs no accessory apparatus, no grate nor supply of combustible; it can be set working instantly by operating a valve and consumes nothing during the hours of rest.

The application of gas engines in cities has not received the development which might be expected by reason of the great improvements made during the last ten years. Now that an effective horse power hour can be guaranteed by the consumption of 18 cubic feet of gas of 135 calories (city gas) the use of these motors should be advantageous and economical in many industries. In Paris, the gas company supplies only 3 per cent of its output for gas engines; however, in Germany some of the gas-works supply as high as 17 per cent for this purpose.

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THE CLOTHING OF THE ANCIENT ROMANS.

At the December meeting of the Archæological Institute of America, Prof. Myron R. Sanford, of Middlebury College, read a most interesting paper upon "The Material of the Tunica and Toga," and we extract the following from the Journal of the Institute:

With the passing of the simple toga and tunica of the early years to the more ornate and complicated forms of dress there came to Rome many new fabrics to vie with wool. Many Latin writers tell of the use of linen, cotton, silk and various mixed stuffs. The idea students gain from the perusal of classical literature is that rarely did the newer materials actually supplant wool in making up the various articles of cloth. No one seems to have undertaken the formidable task of an elaborate study of the existing paintings and statuary representing the Roman dress, to determine how far the artists intended to suggest various materials in their drapery. In some of the portrait statues in Pompeii it is unreasonable to believe that the clumsy, thick folds do not represent some form of wool, and the lighter and sometimes diaphanous folds the finer fabrics. Frequently in painting, and not rarely in statuary, different materials are to be seen in the clothing belonging to the same figure. The Latin department at Middlebury College has been interested in experimenting with a considerable variety of materials in imitation of some of the well-known figures. Besides coming to certain conclusions regarding the graceful and stiff folding of different cloths, the students had realized a fact insufficiently emphasized in the manuals, namely, that no material from the heaviest wool to the most delicate silk will of itself take the beautiful folding shown in the ordinary statue or painting. The drapery in the latter is always one of two results; it is either taken from the plaits and foldings of the clothing of the model draped beforehand with the most painstaking care, or it is the conventionalizing of the artist. Not until a trial is made will one realize how elaborate the process must have been to produce the appearance of the toga of Hortensius, for the accidental disarrangement of which on the crowded street he sent a challenge to his friend. Often the simplicity of certain effects is, after all, an elaborate effort. For example, the Commodus of the Vatican collection seems to have the drapery hanging from the body in the most natural manner, while an attempt to imitate it will show that it is a case of art concealing art. The simplicity is only apparent, and occasionally no imitation with material of any part whatsoever can follow the contortions in the drapery of certain classic figures.

SCIENCE NOTES.

A comet which was first seen in South America about the first part of May has reappeared, according to a dispatch from Lima, Peru, dated May 12, says The New York Tribune. It apparently has two tails, one of which is longer than when it was first seen.

At Carracross, on the west coast of Ireland, the only building in the place is the residence of the priest. Seventeen old fishing boats, one of which is said to have been built between 1740 and 1750, form the rest of the quaint little village. There is not a tree of sufficient size to furnish timber within eight miles.

A new process now used in Germany of imitating wood carvings, etc., in plaster, bronze and other materials, is said to supersede the old way of painting and lacquering, in so far as it reproduces perfectly the fibers and pores of the wood models. The model, which is best made from porous oak, is covered pretty thickly with a solution of two per cent collodion, and when this is dried up it leaves the usual dull and porous appearance of the wood unaltered, but the model is perfectly oil proof, and the casting is proceeded with in the usual way.

The approaching millenary of Alfred the Great lends special interest to the estate of Winklebury, in Hampshire, now in the market. It contains the well-known circular camp of that name, said to have formed a stronghold of Alfred. Excavations just made by Reginald Smith, of the British Museum, have brought to light fragments of ancient British pottery. An examination was also made in the autumn of last year, and on both occasions bones of extinct animals have been discovered, showing traces of fire, probably sacrificial. The camp is believed to have existed before the Roman invasion. It was occupied as late as the seventeenth century by the Parliamentary forces when besieging Basing House.

The London Lancet in an article on nicotine inverts the order of injuriousness usually associated with cigarettes, cigars and pipes. It states that nicotine itself has been proved to be practically guiltless of evil effects in smoking, but pyridine and its derivatives are responsible for headaches, trembling and giddiness. The degree of toxicity in smoke depends largely upon the completeness of combustion. The combustion of a cigarette is more complete than that of a pipe or cigar. A pipe acts as a condenser, but the condensed products do not reach the mouth, while considerable condensation must occur in a cigar, the products reaching the mouth and being absorbed. Therefore The Lancet places the cigar first in the order of injuriousness, then the pipe and lastly the cigarette.

John D. Rockefeller has given $200,000 to found "The Rockefeller Institution for Medical Research." The gift is not intended for an endowment fund, but is for immediate expenditure. Mr. Rockefeller has for some time been consulting with eminent medical men as to the need of such an institution, and he has had the best advice. Facilities for original investigation are to be provided, especially in such problems in medicine and hygiene as have a practical bearing on the prevention and treatment of disease. The first work of those connected with the institution will be that of co-operating with the New York Board of Health in studying its work and the problems confronting it, and particularly that of milk supply. Researches of a more ambitious nature will be begun in the fall under the guidance of experienced investigators.

There is a movement in Great Britain to secure a photographic record of historic events, and homes in the country which are rapidly disappearing before the advance of progress. The work is being carried out by the National Photographic Record Association. It was founded in 1897 by several well-known gentlemen, anxious to preserve photographic records of objects of interest, scenery, life, customs, and history of the time. Such a faithful picture as that secured by means of the camera conveys a much more comprehensive idea of the subject than columns of written description can convey. The pictures are being preserved in the British Museum as they are collected, and they will constitute a valuable work of reference to the chroniclers of future generations. Several members of the association are enthusiastic photographers, and many valuable pictures have been secured by this means. The society also commissions pictures of important events or historic spots to be secured in all parts of the country. The work is of exceptional value in connection with London, since many of the old, historic and interesting landmarks are rapidly vanishing, so that within a few years there will be very little of ancient London in preservation, with the exception of the national buildings and monuments.