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THE COMMERCIAL MOTOR VEHICLE.

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It is difficult for anyone not having been in Europe, particularly England, during the last five years, to realise the enormous uses to which commercial Motor Vehicles are now put. Such strides have been made in industry, that no business of any standing which could employ such machines is to-day without them, and they can be found not only employed in hauling passengers and goods in towns, but in the most isolated places, and in some cases competing successfully with railway branch lines as well as with tramway undertakings. Further, it is no uncommon sight to see such cars on the land hauling 4 and 6 furrow ploughs, and later towing the whole agricultural implements back to the barn.

The limitations of a paper on the subject make it impossible to deal with the three sources of power employed for this work—electricity, steam and petroleum spirit—with any degree of satisfaction, and, much as steam warrants careful consideration, the author is reluctantly compelled to limit his observations principally to that type of machine which first made the industrial motor a commercial success, namely the internal combustion engine.

In turning to the earliest records of mechanical road vehicles, one is struck by two facts—firstly, that they appeared before the railway engine; and secondly, that the earliest efforts appear to have been directed towards the production of omnibuses rather than private conveyances. Thus we find that the efforts of Hancock, Gurney and other engineers resulted in the establishment of motor omnibus services in England in the early thirties, London having several such vehicles from the year 1833, until the Turnpikes Act came into force in 1840 and drove them off the road. Of these early machines three designed by Hancock deserve special mention, as they actually ran in public service for some time. The "Autopsy" and the "Era" appeared in 1833, and ran between Paddington and the Bank. The latter, we are told, consumed 100 lbs. of water and 10 lbs. of coke per mile, and ran at the rate of 10 miles an hour. In 1835, after two years' experience with these 'buses, the "Automaton" was designed and built for a speed of 13 miles per hour, carrying 22 passengers. Its fastest run was along the Bow Road with 20 people up, when 21 miles per hour was maintained. The enforcing of the Turnpike Act drove it off the streets and effectually stopped the development of motor transport until the "Act of Emancipation" in 1896 again permitted further experiment.

The development of the motor for goods carrying purposes is so wrapped up with the early efforts of the firm now known as Leyland Motors Ltd., that those particularly interested cannot do better than study the history of the first steam lorries produced by that firm. Trials were held in 1897 and 1898 respectively by "The Engineer" and the "Liverpool Self-propelled Traffic Association," and in 1899 the Royal Automobile Club held trials for all classes of Motor Vehicles prior to the memorable show in the Old Deer Park at Richmond in Surrey.

During the early period under review steam was regarded as the only factor to be considered in mechanical traction, but in 1885 the present era dawned with the invention by Gottlieb Daimler, at Cannstatt, in Germany, of his famous internal combustion engine driven by petroleum spirit. During the next eleven years engineers in Germany and France—Daimler and Benz in the former and Levassor and De Dion in the latter—did much to improve and establish the petrol engine that we know to-day, English Engineers being forbidden the while to move on account of grandmotherly legislation.

Coming next to the modern development and improvement of the petrol commercial vehicle, it is convenient to deal principally with the motor omnibus, as these machines came forward first as an industrial proposition, have been subjected to more searching and trying work, and being in the hands of public companies (some under the author's own control) more data of their running and tribulations are available.

It was not long after the Act of 1896 came into force before a motor omnibus appeared on the streets of London. It was a Daimler from the German works, and ran intermittently for nearly two years before being removed from service in London. Only a few months later a steam omnibus was purchased by the London Road Car Company, and ran satisfactorily for six months, when it was returned to the makers, who had refused to undertake a maintenance contract. In 1902 the London Power Omnibus Company came into being and commenced work with some 16 h.p. single-decked omnibuses in the West End, these vehicles remaining at work for nearly four years.

The Heavy Motor Car Order, 1904, ultimately permitted the use of the motor omnibus as it is known to-day by increasing the maximum unladen weight from 3 to 5 tons, and this was promptly taken advantage of by London's old-established concerns, the race being easily won by Messrs Thomas Tilling, who started a 34-seated 'bus to work between Peckham and the West End. These were quickly added to, and the directors confidently announced that the cars had undoubtedly come to stay, and that they would buy no more horses, and that they anticipated paying large dividends. Two other companies started work with 14-seated single decked steam cars, but these soon disappeared after too short a trial, in favour of double-deckers, provided with petrol engines. Large orders followed, and during the succeeding twelve months anybody who owned a motor omnibus could sell it at a good price, irrespective of its merits or design. Of those which appeared during the ensuing year one can only say that they included almost every device produced up to that date by the fertile brain of the automobile engineer. Horizontal and vertical engines, high speed and low speed, chain driven and gear driven, were all tried and found wanting. That some of the monstrosities would quickly disappear was obvious to every engineer from the first, and one really wonders how some of the devices came to be tried at all. Of these the high-speed engine seemed the most ludicrous, but there was a reason for its existence and use, and that was the phenomenal success of the De Dion engine when it first appeared, running as it did from 1500-2500 revolutions per minute. The motor car upset many established theories, and this appeared to be one too many for the so-called motor engineers, who, to hide their own deficiencies, endeavoured to copy what appeared to succeed, with doubtful results. As an example of this, the author was employed in the early days to supervise the manufacture under contract of certain motor omnibuses, one of his duties being to test them on the road and to see that the speed of sixteen miles per hour was maintained on the level at an engine speed of 2700 revolutions. In some respects these particular cars were good, but it wasn't long before they had to be re-engined! The modern De Dion omnibus runs only at a speed slightly above 1000 revolutions. All other high-speed engine 'buses disappeared, after only a short life in service. Others which have been withdrawn are those fitted with horizontal engines—certain types of gear-drive being also eliminated.

Twelve months ago a bold experiment was made by the London General Omnibus Company, who had a Clarkson steam engine built into a De Dion chassis, which had been denuded of everything except its frame, radiator, steering gear and back axle. The reason for the experiment was to ascertain what the effect would be of running a lighter kind of frame with one of the new and very successful Clarkson boilers. For this reason the De Dion was chosen, and when the re-build was effected the vehicle weighed 3 tons 18 cwt. instead of 4 tons 18 cwt. of the original Clarkson type. The cost of fuel per mile was reduced from 2.3 pence on the most economical of the complete Clarksons to 1.6 pence on the "experiment," a saving of some 30 per cent.

Before proceeding to discuss current problems affecting the operation of commercial motor vehicles, one may shortly consider the development of the types generally from their earliest day down to the present time. For the three years from 1896-1899 attention was devoted almost exclusively to the development of the steam lorry for loads from 5-10 tons, but about the latter year attempts were made to adapt the petrol engine to van and omnibus work. Those manufacturers who did so almost without exception did it with a praiseworthy desire to increase the sale of their cars generally, and consequently pressed upon an ignorant public touring car chassis to carry goods, merely tendering a higher powered engine for increased loads. The idea was about as sensible as harnessing a racehorse to a lorry, and the result about the same, only it took three years (until 1901) for it to become thoroughly realised. This brought about a dead period, during which special firms entered the field for the manufacture of commercial motor vehicles exclusively. At the same time, it must be noted that the lesson had not been entirely learned, and even to-day firms exist who manufacture van and 'bus chassis and fit in them such standard engines as Aster and White and Woolfe, designed and intended for use in touring cars with the result that troubles are frequent.

Coming to modern conditions, the author does not propose to waste time in a lengthy description of a petrol chassis, but, premising that those present are acquainted with the principles on which it works, intends to deal with particular points and conditions, which deserve earnest consideration at the hands of engineers.

Engines.—Starting with the source of power—the engine—one is promptly faced with a variety of questions, such as power, engine speed, lubrication, ignition and cooling, on all of which much yet remains to be said.

Engine Power.—Before dealing with Engine speed, it will be well to consider what power is desirable and what has been in practice up to now. For van work the question is easily answered. It must depend on the roads. Where easy roads are alone concerned, for loads up to 2½ tons a two-cylinder engine, developing from 12-16 h.p., is desirable, whilst for heavy loads quite 16 h.p. should be demanded. Long journeys (of over 100 miles) are best undertaken with a four cylinder engine. For all these continual starting and stopping play no part, but as soon as they do,—in 'bus work, for example—the question of flexibility in relation to petrol and oil consumption and wear and tear on tyres arises, and is not easily answered.

The earliest motor omnibuses were fitted with engines varying in power between 16 and 24 h.p., and this was soon increased to 28 and 30. The discussion then arose as to whether higher powers would not prove ruinous in petrol consumption, etc., although it was recognised that such engines would prove more flexible; at the same time, exponents of the six-cylinder engine asserted that its use would do away with the gear-box, but its application to the pleasure car did not encourage motor omnibus engineers to experiment with it. However, new cars delivered from the makers towards the close of 1906 were fitted with engines of 35-40 h.p., and these proved more flexible and silent, and as they made no appreciable difference in the fuel bill, owners were encouraged to rebuild some of their earlier cars with these higher-powered engines, but developing their power at lower engine speeds, with astonishing results—so much so, in fact, that towards the close of 1908 one company ordered the rebuilding of all its earlier cars with the high-powered engine. Thus it will be seen that 35 to 40 h.p. has come to be regarded as the economical power for such omnibus work as London calls for.

Engine Speed.—Reference has already been made to the high-speed engine, running up to nearly 3000 revolutions per minute, and its disappearance in favour of those of more moderate speed. Even now it runs much faster than any other type of engine with which it can reasonably be compared, but on account of its only providing one useful impulse in four cycles, this must continue to be the case. Perhaps another cause of the continued use of engines of normal speeds of 1100-1200 r.p.m. is the fact that many manufacturers employed touring car engines but geared them much lower, thereby inducing faster engine running. During the five years of motor omnibuses in London engines have been made to run normally from 750-1800 revolutions per minute with a maximum speed of 1200-2700 r.p.m., but now only the medium speed engines remain. The temporary disappearance of the low speed engine has been due to the failure of the horizontal type, even well-built engines of this type having proved uncommercial owing to popular prejudice, which requires a vertical type.

There can be no doubt that the long stroke low-speed engine has been insufficiently tried, and the author is convinced that such a one, with a normal speed of 650 to 700 revolutions per minute, a maximum speed of 1000-1100 revolutions per minute, and a stroke of 6-7 inches, would yield more satisfactory results and prove more flexible, both in starting and in traffic. The horizontal engine, too, deserves further attention, both from the point of view of correct practice and from that of space economy, but it is to be feared that several years will elapse before serious attention is again devoted to it.

Big Ends.—These bearings are without doubt the most costly of upkeep on commercial motor vehicles, yet engineers fear to face the careful consideration of their construction.

For one thing, few makers provide a bearing surface large enough for the work that has to be done, but the real question is what metal ought to be used for lining the brasses? With very few exceptions white metal is employed, and that notwithstanding the speed and particularly hammering action of the thrust. Many opinions were held on the subject, but London 'bus companies adopted white metal throughout on account of its relative cheapness in upkeep. The use by one manufacturer of a bronze alloy containing 25 per cent. of lead was very satisfactory, but was more expensive to maintain. The crux of the matter, without doubt, is lubrication, and so long as that continues to be as inefficient and costly as at present, large users who are able to keep special men for metalling and "bedding" brasses will probably continue to use white metal for that purpose. While it lasts it certainly makes the engine run more sweetly, and does not wear or damage the crank-shaft, whilst little or no damage ensues when lubrication fails. On the other hand, in heavy work, when the bearing begins to run hot, the engine will "labour" so severely that all except the most ignorant will realise that something is amiss, and stop before any damage has resulted, so that the author contends that phosphor bronze might safely be employed. It is commonly stated that drivers are so careless that overheating would be of a daily occurrence, but the writer's experience of "heavy" car drivers is that they are not happy unless they are wasting more oil than they use in lubrication. With improving lubrication, less and less excuse should exist for the use of white metal.

On one particular service for which the author was responsible, a severe hill had to be negotiated twice a week, and whatever 'bus was used gave forth that metallic tap of a big end knock before the top was reached, although oil was literally poured over the bearings during the ascent. The use of phosphor bronze obviated this although it was not used for sufficiently long to provide a useful comparison. One can't help feeling that the tendency with big end bearings, notwithstanding lubrication, is for the temperature to slowly but steadily rise, until, after some hours' continuous running, that point is reached where the metal runs. Experience has shown that where really long runs over easy country are undertaken without stop, it is almost invariable for at least one bearing to start, even if it does not go altogether.

Thus practice seems to show that although white metal bearings are practicable for light work, or where the engine can be stopped to cool off every ten or fifteen miles, bronze must be employed for very heavy roads or for long continuous running.

Lubrication.—Practically no efficient means of lubricating the modern internal combustion engine exist. The difficulty arises out of the speed of the engine and heat generated. Until about two years ago all makes nearly relied on what is termed splash lubrication, where a quantity of oil is poured into the base chamber and splashed on to the bearings, gudgeon pins and walls of the cylinder by the big ends at each revolution, the big ends lubricating themselves by means of scoops arranged underneath. Various devices existed for introducing the oil to the base chamber, some being automatic, but most relied either on the hand pump or sight feed. About 75 per cent. of the oil goes to waste, some as blue smoke through the exhaust, and some through the end bearings and valve spindles, leaving a trail on the road. During the last two years, however, what is known as forced lubrication has come into vogue, although several ways exist of effecting it. The main principle on which it works is a bored-out crank-shaft and force pump, with a pipe leading from the big ends to the gudgeon pins and cylinder walls. Apart from the danger of pipes getting choked, the difficulty of getting a sufficient supply for the cylinder-walls without waste will be readily seen. The enormous waste of oil described has led to a huge demand for cheap oils, most operating companies being unable to afford good oil on account of the great cost when compared with work done. Companies in which the author was interested paid from 9½d. to 10½d. per gallon for oil, and although its lubricating powers were very low it was hydro-carbon and consequently free from acid!

Ignition.—However much ignition systems may have warranted the anathema heaped on them a few years ago, the problem of ignition is well on the way to being solved, although much may be said as to the respective merits of different systems, and some years must surely elapse before the last word is spoken. Ten years ago there were two systems of ignition, tube and accumulator; to-day there are three, accumulator and high and low tension magneto. It is quite eight years since the old tube ignition finally disappeared as far as motor engines were concerned, and at the same time magneto ignition began to be used. Although to-day it is the invariable type used for private cars, the same cannot be said of commercial vehicles. Of the three systems each has its advantages and disadvantages, and commercial cars exist in numbers provided with each. If anything, the low tension magneto is most used for this work, although the high tension is the most favoured for private cars. The absence of coil and simplicity of the low tension magneto make it appear very ideal at a glance, and it is rarely that it ceases to appear so perfect until one has practical experience of it in the hands of somewhat ignorant drivers. The magneto itself rarely gives trouble, but the machanical part of the cylinder makes up for it, in every way. In the first place, tappet springs jump off or break in the most mysterious manner, and there is not one driver in ten who can fathom at once the loss of power due to the failure of the offending cylinder, when the next hill is met. He will probably finish his day's work and report his car as "pulling badly" when he goes off duty, leaving the engineer in charge to replace the spring and dream of broken crank-shafts! The 'bus bars, too, have a way of getting covered with oil and setting up a short circuit, which stops the engine and necessitates the use of a temporary distributor while the regular insulated bar is carefully dried and cleaned. The same thing happens when an ignition plug blows, either through the burning of the mica washers or the breaking of a soapstone, and many drivers persist in believing that it is impossible to get home until a repair has been effected. The author has painful recollections of a case where a driver "blew" a plug in a particularly narrow