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Britain's forgotten engineering genius: Charles Wallace Chapman and the development of the high speed diesel engine

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Introduction

The diesel engine is a type of internal combustion engine; more specifically, it is a compression ignition engine, in which the fuel is ignited solely by the high temperature created by compression of the air-fuel mixture, rather than by a separate source of ignition, such as a spark plug, as is the case in the petrol or gasoline engine. The engine is named after German engineer Rudolf Diesel, who invented it in 1892 based on the hot bulb engine and received the patent on 23 February 1893. Diesel intended the engine to use a variety of fuels including coal dust and hemp. He demonstrated it at the 1900 World's Fair using peanut oil. Diesels can be low speed, medium speed or high speed calibrated in revolutions per minute or rpm. Diesel died in mysterious circumstances in 1913.

The vast majority of modern heavy road vehicles (trucks, public service vehicles or PSVs, taxis, fire appliances etc), ships, industrial power generators, most farm and mining vehicles, and most long-distance rail locomotives have diesel engines. They are standard in all merchant ships and boats as there a naval advantage in the relative safety of diesel fuel in addition to the improved fuel efficiency over a gasoline engine. The German 'pocket battleships' were the largest diesel warships and the German torpedo-boat 'Schnellboot' of the Second World War was also a diesel craft. Conventional submarines have used them since before the First World War.

Rudolf Christian Karl Diesel, the son of German-born parents, was born in Paris in 1858 and grew up there until the family was deported to England in 1870 following the outbreak of the Franco-Prussian war. From London, Diesel was sent to Augsburg, his father's native town, to continue his schooling. There and at the Technische Hochschule in Munich he established his brilliance in various engineering disciplines. At Munich he was a protégé of the refrigeration engineer Carl von Linde, whose Paris firm he joined in 1880. During 1885 Diesel set up his first workshop-laboratory in Paris and began creating his distinctive engine. About 1890, in which year he moved to a new post with the Linde firm in Berlin, he conceived the idea for a compression ignition engine that became the diesel engine. He obtained a German development patent in 1892 and the following year published a description of his engine under the title *Theorie und Konstruktion eines rationellen Wärmotors (Theory and Construction of a Rational Heat Motor)*. At Augsburg on 10 August 1893, Diesel's prototype, a single 10-foot iron cylinder with a flywheel at its base, ran under its own power. Diesel spent two more years in improvements and on 31 December 1896 demonstrated another model with the spectacular, if theoretical, mechanical efficiency of 75.6 per cent, in contrast to the efficiency of the steam engine of 10 per cent or less. With support from the Maschinenfabrik, Augsburg and Krupp Gusstahlfabrik companies, Diesel produced a series of increasingly successful models, culminating in his demonstration in 1897 of a 25-horsepower, four-stroke, single vertical cylinder, compression ignition engine. The high efficiency of Diesel's engine,

together with its comparative simplicity of design, made it an immediate commercial success, and royalty fees brought great wealth to its inventor.

The Diesel is an engine in which air is compressed by a piston to a very high pressure, causing a high temperature. Fuel is then injected and auto-ignited by the compression temperature. Within a few years of its invention, Diesel's design became the worldwide standard for that type of engine and his name forever associated with his invention. By 1898 Diesel was a millionaire from franchise fees. His engines were used to power pipelines, electric and water plants, locomotives and trucks, and marine craft, and soon after were used in applications including mines, oil fields, factories, and trans-oceanic shipping. Diesel believed his engine would be powered by vegetable and seed oils (including hemp) rather than mineral oil. Diesel died in 1913, vanishing during an overnight crossing of the English Channel on the mail steamer *Dresden*. Diesel's death might have been suicide, accidental or an assassination. Proponents of the assassination theory point out that shortly after Diesel's death, a diesel-powered German submarine fleet became the scourge of the seas. Diesel had been friendly to France, Britain and the United States.¹

Chapman & Perkins

Charles Wallace Chapman was born to an ordinary working family in Lancaster in 1897² and educated at the Royal Lancaster Grammar School. After leaving school he was apprenticed to the Vickers engineering company at Barrow-in-Furness. During World War One, as a lieutenant in the Royal Naval Volunteer Reserve he was employed on anti-submarine projects. After the war he studied at the University of Liverpool and was awarded an M.Sc. in engineering. In the 1920s he became personal assistant to Sir Ernest Petter, the Chairman of Petters (Ipswich) Ltd, which made diesel agricultural engines. In 1929 Petters was on the verge of bankruptcy, and Chapman was interviewed for a new position by the Works Director³ of Aveling & Porter, Frank Perkins.

“I first met Frank Perkins in the late summer of 1929. At that time he was Works Director of Aveling & Porter Ltd of Rochester, and must have been about forty.⁴ I had heard that he wanted a personal assistant, and Petters (Ipswich) Ltd having finally succumbed, I wanted a job... I have only the faintest recollection of the interview but my impression is of a tall, erect, well-built man with a ginger moustache, dressed in a tweed suit.⁵ If I remember correctly there was a gun propped up against the wall near the door and perhaps that is why I picture tweeds.”⁶

Frank Perkins was the son of J.E.S. Perkins, the chairman of Barford & Perkins Ltd of Peterborough.⁷ After the end of the Great War, the British agricultural engineering industry was re-organised and

¹ Nitske W, and Wilson, C, *Rudolf Diesel*, Norman OK, 1965.

² He died at home in Winchelsea on 25 November 1979 aged 82.

³ This position would now be termed Production Director or Manufacturing Director.

⁴ He was born on 20 February 1889.

⁵ Frank Perkins remained an eccentric character always wearing a fresh flower in his lapel. One ex-Perkins employee told the author that at a street florist outside his hotel in town for the London motor show Perkins realised that his new suit had no such button hole for his flower and with a borrowed pen knife immediately cut a hole his lapel and placed in it his just purchased fresh carnation.

⁶ Chapman, C W, *The story of Perkins diesels*, unpublished typescript circa 1962-1963 in possession of the author, p19. Henceforth Chapman typescript. Former commercial director of Perkins Engines Ltd the late Mr Norman Collins presented the author with a photocopy of Chapman's draft memoirs in 1982 to enable him to write a brief history of the company.

⁷ Chapman implies this is why Perkins Engines was based in Peterborough. See below regarding the use of the former premises of Barlow & Perkins.

Agricultural and General Engineers Ltd (A.G.E.) was formed as a loose federation of Aveling & Porter, Barford & Perkins, Blackstones, Davy Paxman and Garretts amongst others. According to Chapman A.G.E. wasted a large amount of money by building itself an ‘imposing office building in London – Aldwych House’ that helped to ensure its eventual demise during the depression years of the 1930s. In 1929 Aveling & Porter made diesel engined road rollers and was developing a new diesel engine for its associated company Garretts of Leiston. Chapman recalls this as a four cylinder of 4¾ inch bore with a then good speed of 1,200 rpm. In 1930, George Dodds Perks, a solicitor who was the vice-chairman of A.G.E. and chairman of Aveling & Porter called Chapman into an Aveling board meeting and made him secretary to the board, the senior administrative manager.

“With Frank’s guidance and help I became an expert at paying wages out of an overdraft we weren’t allowed to have, and in persuading suppliers to let us have materials on three or six months credit, back by bills we hoped we could eventually meet.”⁸

This experience would prove very useful later when Chapman and Perkins started their own small company with very little capital. Later in 1930 Chapman was made chief engineer of Aveling’s diesel department in addition to his duties as company secretary. On 28 August 1930 Perkins told Chapman that A.G.E. required a six-cylinder diesel with either 90 or 100 hp for a modified Garret truck. On 30 October 1931 Chapman’s new engine completed a non-stop twenty-four hour test run, the last thirty minutes at full load. Chapman had gone from an original drawing to a fully operational prototype on a test bed in less than two months.

The depression following the Wall Street Crash of 1929 had caught up with and overwhelmed the British engineering industry. Ramsay MacDonald’s Labour government found itself in the difficult position of trying to maintain Britain’s economic position by maintaining the pound on the Gold Standard, balancing the budget and providing assistance and relief to tackle rising unemployment. In the summer of 1931 the situation deteriorated and there was much fear that the budget was unbalanced. That triggered a confidence crisis and a run on the pound. The Labour government agreed to make changes in taxation and expenditure in order to balance the budget and restore confidence, but the cabinet could not agree to either introduce tariffs or make twenty per cent cuts in unemployment benefit. When a final vote was taken the cabinet was split 12:9 with the minority threatening resignation rather than agreement. On the morning of 24 August 1931 the government resigned.

The political crisis generated concern and the leaders of the Conservative and Liberal parties met King George V and MacDonald at Buckingham Palace, to discuss support for the measures to be taken but later to discuss the shape of the next administration. Later on 24 August, MacDonald agreed to form a ‘National Government’ comprised of ‘men from all parties’ with the specific aim of balancing the budget and restoring confidence in the pound. The government would then dissolve itself and a general election would be held on normal party lines. A small cabinet of just ten ministers was formed to take emergency decisions, with ministerial posts divided proportionally between the three major parties, though relatively few Labour MPs actually supported the government.

Chapman recalled that due to the economic crisis his salary was cut by ten per cent from £800 per annum to £720 and the income tax he had to pay was ‘doubled or trebled.’ Early in 1932 A.G.E. collapsed and both Aveling & Porter and Barford & Perkins went into liquidation. Frank Perkins and Charles Chapman were now about to be unemployed and without prospects of obtaining alternative employment. For

⁸ Chapman typescript, p21.

several months Chapman, as company secretary, was involved in liquidating Aveling & Porter and ‘from time to time’ met with Perkins to discuss their future. Their prospects of obtaining new employment as agricultural engineers were bleak.

The birth of F Perkins Ltd

“Frank said we would have to make our own jobs – start a company ourselves... We both had faith in the future of high-speed diesels. We both felt that had not A.G.E. collapsed we could have got somewhere with the Aveling engine... It was one evening, I think in March of 1932 that the birth pangs of Perkins Engines⁹ started. Frank had come to visit me in our house in Strood. He was living at the time in Whitstable and came by train. We had come to the conclusion that if we could produce a really small diesel suitable for private cars, vans, and thirty-hundred weight trucks, then not only would we have no competition but we have an enormous and expanding market.”¹⁰

The new diesel would have to be a similar size to current petroleum engines in order to fit it in existing automobile body frames. It was also have to produce similar horsepower and reach similar speeds so it could be matched to existing transmission systems. Today this all seems relatively easy despite the extra weight of a diesel engine caused by the need to contain the increased stress and torque created by the auto ignition engine’s higher compression ratio and consequently much higher internal pressures. In 1932 it was thought to be impossible. Chapman’s immediate design problem was how to introduce, mix and burn the fuel in the fraction of a second that was available in an engine running at 3,000 to 4,000 rpm or twice the speed of any existing diesel engine. Put briefly, Chapman would have to introduce a drop of fuel at the start of each stroke of the piston, break it into atoms and completely mix it with the hot air contained in the cylinder in something like one thousandth of a second. In addition the cylinder bore could not be more than three inches or seventy-five per cent smaller than that any current diesel engine. He also had to solve the problem of heat loss caused by the relatively large surface area of the combustion chamber in relation to its volume. Whereas this is not a problem in spark ignition engines – the electrically generated spark is introduced to cause the combustion – in auto ignition engines where the pressure alone causes combustion, the greater the heat loss the greater the pressure (and therefore mass and weight, reducing fuel efficiency) is required to overcome it. Hence diesels engines are more prone to ignition failure in colder climates and in colder operating conditions. Working virtually alone and without any proper facilities, Chapman was not simply trying to improve the existing diesel engine he was attempting to invent a completely new type of machine.¹¹

At the former farmhouse in Strood that served as the Chapman family home,¹² Chapman and Perkins considered how they were going to solve this basic design issue of the injection system and the combustion chamber.

“As we sat there and made suggestions, using the arm of my chair as a desk, I made rough thumb nail sketches, illustrating them, on the back of one of my envelopes, and so, gradually, the system

⁹ After World War Two, F Perkins Ltd became known as Perkins Engines Ltd.

¹⁰ Chapman typescript, pp23-24.

¹¹ Chapman, C W, *Modern High-Speed Oil Engines*, 2nd edition, London, 1949.

¹² Chapman’s wife was expecting their second child.

later known as the ‘Perkins aeroflow system’ of combustion evolved. We settled on a four cylinder, three inch bore engine and hoped to get about forty horsepower out of it.”¹³

Having invented a pre-combustion chamber on the back of an envelope, the next issue was the question of finance. Perkins convinced Chapman to eliminate design trials with a single cylinder experimental engine (then normal industry practice) and start directly with a prototype four cylinder. This was a high risk strategy because every adjustment would have to be made to all four cylinders before re-testing could begin. They also required an office, a technical draughtsman, an office junior (the rather grand Frank Perkins could not be expected to make his own tea or buy his own tobacco), a typewriter and other office equipment and a covered space in which to build an engine. The parts could be ordered from precision engineering suppliers to Chapman’s specifications and technical drawings.

“Frank was confident he could raise £10,000 but was doubtful of more. We decided we would have to allow ourselves two years. If by then we had a promising engine it would be easy... to get more money to produce it, if we had nothing to show it would be just too bad for those who had provided the initial capital – and incidentally for us.”¹⁴

On 10 April 1932 Perkins carefully typed what he described as the ‘original prospectus’ of his new company.

“Perkins Ltd. Engineers. Peterborough. England.

It is proposed to form this company to develop and manufacture small high-speed diesel engines and to carry on such engineering work of an allied nature as may from time to time be deemed suitable by the board of directors. The company is to be a private company with an authorised capital of £12,000. It is proposed that £10,000 be subscribed in cash in one pound shares, by G D Perks, A J M Richardson,¹⁵ and F A Perkins (Chairman and Managing Director), and that 1,000 one pound shares to C W Chapman (Technical Director and Secretary) without payment... Offices have been secured from Mr J E S Perkins in Queen Street, Peterborough...”¹⁶

Chapman would in effect be given just ten per cent of the company (reducing to eight per cent if a further two thousand pounds was subscribed) for producing all the revolutionary new products and renouncing all patent rights to his future inventions. Whilst the venture was extremely risky and there was no guarantee of any financial return on the initial investment, the financial arrangements show the acuity of Perkins and the naivety of Chapman who would later come to realise that he had been unduly generous in the assignation of all intellectual property rights and even come to believe that Perkins had taken unfair advantage of his rather scholarly and trusting nature.¹⁷

On 11 April 1932 Chapman sent his formal letter of resignation to Avelings and started making rough sketches for the layout of the first engine. A former Avelings draughtsman, W F ‘Bill’ Pailing was hired, put a drawing board on his dining room table in Rochester, Kent and started laying down accurate sectional drawings of Chapman’s proposed new engine. In the dining room Chapman and Pailing

¹³ Chapman typescript, pp25-26.

¹⁴ Chapman typescript, p26.

¹⁵ Frank Perkins’ brother-in-law Captain Alan Richardson, an officer in the North Somerset Yeomanry in World War One. Perkins was married to Gwynneth Williams, Richardson to her sister Claudia.

¹⁶ Chapman typescript pp31-32. Barford & Perkins were originally based at Queen Street and Frank Perkins hoped that his new company could use the similarity in name and address to curry favour with potential customers and suppliers.

¹⁷ Chapman was small, about 5ft 4ins tall and 140lb in weight and studious unlike the larger than life and overbearing Perkins.

discussed how they could minimise the weight and dimensions of the prototype to enable it to fit into an automobile chassis whilst at the other end of the table, Pailing's wife acted as the first secretary-typist using a small portable machine lent by Frank Perkins. The first letters were sent to potential suppliers from the Pailing's home address until enough capital could be raised to rent the small workshop and offices in Peterborough. Crucially one such contact turned up at the house. He was Eric Dennis of the piston manufacturers Automotive Engineering Ltd of Twickenham. Dennis advised Chapman on the designs for the new small pistons and promised to supply prototypes as required. By the start of June, Chapman had completed all his designs for his new engine but as his wife was about to give birth to their second child he refused to move to Peterborough until the baby had been safely delivered.

The company, F Perkins Ltd, significantly Chapman did not get his name included in the title, was registered on Tuesday, 7 June 1932 with the registered address of 17 Queen Street, Peterborough.¹⁸ Perkins was to be paid £750 per year and Chapman £546. All the patents would be in the F Perkins Ltd name. The following Saturday, 11 June, the directors and staff moved into their premises. In addition to Perkins, Chapman and Pailing, the firm also employed Edward 'Ted' Marvill as apprentice draughtsman at £3 per week and Denis Hughes, an ex-navy and agricultural mechanic.¹⁹ A few weeks later two young women were hired, Muriel Andrews as typist and a Miss Elphee as tracer to operate an antique hand-powered copier for the blueprints, both were paid £1.10s per week. The first offices at 17 Queen Street consisted of two downstairs rooms and a lavatory at the top of the staircase leading to the upper storey. The front room measured 14 ft by 12 ft and housed Pailing, Marvill, Hughes and the two women. The second room measured about 12 ft by 10 ft and was shared by Perkins and Chapman. The total expenditure for the month of June 1932 excluding salaries and wages was just over £19. As there was no cash available at the time, Chapman paid the bills out of his own pocket and had to reimburse himself later in the year.

Despite these obvious financial limitations, the severe depression in the motor manufacture and engineering component industries in the early 1930s worked to the new company's advantage in several ways. Firstly, the dearth of jobs meant that like Chapman himself, staff could be hired relatively easily and more importantly, cheaply. Secondly, component manufacturers were suffering and working hard to find new customers. However fantastic Chapman's proposals must have seemed at the time, the vision of a completely new range of vehicle engines that might go into mass production was extremely attractive to desperate salesmen and their near bankrupt employers. In the summer of 1932 Chapman and Pailing went to see Standard Motors of Coventry to discuss using their cylinder blocks for the Perkins engine. Standard had several rows of the latest machine tools for manufacturing cylinder blocks. Not a single machine was working on the day of the visit.²⁰

The first engine goes into production

By October 1932 Frank Perkins had leased part of the old Barford & Perkins premises for his workshop and stores at £75 per annum and hired his first manual worker, Norman Burney (works employee Number 1) at £3.15s for a forty-seven hour week. Burney remained with the company until his death in

¹⁸ The street was razed to build the new Queensgate shopping centre in the 1980s. A blue plaque unveiled by Queen Beatrix of the Netherlands during the official opening in 1982 is the only reminder of the site where the world's first high-speed diesel engines were constructed. Peterborough's hinterland is a major flower growing region hence its connection to the Netherlands home to Europe's international flower market.

¹⁹ Marvill eventually became a very senior technical manager at Perkins Engines. When the author worked at Perkins in the mid 1980s many employees had stories about Marvill who had only recently retired.

²⁰ Chapman typescript, p37.

the summer of 1962.²¹ As his first task, Burney, an ex-Aveling employee, needed to prepare the workshop to build the engine. He acquired a workbench, a coke burning stove for heating, a Heenan hydraulic brake or dynamometer and an adjustable test stand. In November a second worker was hired, Edward 'Ted' Sell, at £1.10s per week and whose main task was milling machine parts and helping Burney construct the engine. They mounted a diesel fuel tank on a wall near the test bed and knocked a hole in the wall through which they pushed a length of exhaust pipe to allow the exhaust gases to escape from the building. Perhaps fortuitously, the pipe emitted the gases into the yard of the Peterborough central fire station next door. Electricity and water had been connected and the brake and test stand had been bolted to the floor using steel girders. On Saturday 3 December 1932, almost six months to the day since the company had been formed, Burney reported to Chapman that the first experimental engine was ready for testing.²²

The entire staff of the small company, from chairman Frank Perkins down, assembled in the workshop for the momentous occasion. Bill Pailing was given the honour of turning the starting handle. The engine had to be started from cold by hand with the aid of combustion caps heated to red hot in the coke stove and hurriedly fitted back into the combustion chamber. A piece of string was tied to the end of the pump rack so that if anything went wrong the string could be pulled and the fuel supply cut off. Pailing turned the handle and kept turning and finally the engine fired but failed to engage the flywheel. After some confusion and a hasty debate amongst the staff, the combustion caps and the nuts that secured them to the cylinder head were removed. These were then re-heated in the coke stove until they were white hot. They were then refitted using pliers and a screwdriver. Pailing returned to the starting handle and began heaving once more.

With a loud roar, all four cylinders fired and the flywheel engaged. There was cheering from the staff but in the excitement no one had remembered to turn on the water that acted as brake coolant and no one was closely monitoring the speed. The engine raced from 1,000 to 2,000 rpm and then to just under 3,000 rpm before Burney realised it was out of control and tugged on the string to bring the fuel rack to the stop position.²³ But the invention of the Perkins high-speed diesel engine had been achieved. Chapman's genius had made his idea, half technical vision, half wild dream, a living reality. Frank Perkins named the first engine type Vixen. The Wolf, Lynx and Leopard would follow it. It was by then early evening, sometime after 6pm, and Frank Perkins suggested a celebration. The workmen cleaned themselves up and the entire company adjourned to Bay's Wine Bar on the opposite side of Queen Street.

At the board meeting of 19 January 1933 the directors agreed to build twenty-four production engines to run at 3,000 rpm and to order one hundred sets of the less expensive parts for stock. Frank Perkins went out on a sales promotion tour, visiting amongst others Colonel Cole chairman of Humber Motors (the parent company of Commercial Cars Ltd known as Commers) and Thomas Keep, Managing Director of Commers of Luton. Perkins bought a Hillman Wizard without an engine to test the Vixen in an automobile and Keep sent a 30 cwt Commer chassis to test another engine in the much larger vehicle.

Commercial Cars Ltd had been founded in 1905 and after early trials in Clapham, London land was quickly acquired in Luton, Bedfordshire where the company was to stay for the next 50 years. A range of trucks was quickly developed and several export markets opened before the Great War intervened when military trucks were made. Some 3,000 were to be built by 1919, gaining a reputation for toughness and

²¹ Tales of Burney, a legendary figure amongst later Perkins manual workers, also abounded.

²² Chapman has 4 December in his draft memoir but that day was a Sunday. Chapman typescript, p40.

²³ Chapman typescript, p42.

reliability. The harsh economic conditions in post-war Britain saw the company's fortunes decline prompting several spells in receivership and Humber gained control in 1926, with both being integrated into the Rootes Group later. Commer would be the first UK vehicle manufacturer to offer Perkins diesel engines in its models. By March 1933 the world's first diesel engine car achieved 50 mph at 3,000 rpm on the flat fenland country roads around Peterborough.

The first vehicle application

In April 1933 Perkins and Chapman had enough confidence in their new invention to take the Hillman on a business trip to Perth in Scotland, approximately 360 miles from Peterborough. Setting off at 6am and stopping for meals on the way, they arrived safely the same evening. The engine ran smoothly throughout and averaged 50 mph. In Perth, with two additional passengers, friends of Perkins, they attempted their first hill climb even though the experimental engine had no cooling fan. By the time they had reached the top of a local hill with a one in four gradient the radiator was boiling furiously. They topped up the radiator with bottles of cold beer brought along to entertain the guests and returned to Perth safely.²⁴ The following day they drove to Balmoral, Blair Atholl and across the uninhabited Scottish countryside heading back to Perth. Eventually the engine began to labour and Chapman, becoming increasingly worried, moved down the gears from fourth, through third to second before the car came to a complete stop. It was then that Chapman realised they had climbed up the 'Devil's Elbow' pass, a steep rise of one in five. After allowing the engine to cool they again returned to Perth and few days later motored back to Peterborough.

The first Vixen was then transferred to the Commer van chassis and driven to the Commer headquarters in Luton for testing. The four cylinder Vixen proved too small for use by Commer who had been employing six cylinder petrol engines with fifty per cent greater capacity. This caused some anxiety in Queen Street as the van application was believed to be a key market for the new design. One of the team suggested boring the cylinders to increase them from 75mm to 80mm thus providing 14 per cent more torque. This amended design was incorporated into the second experimental engine and named the Fox. The Fox then replaced the Vixen in the Commer van and performed well enough to pass Tom Keep's inspection. However there was a problem. Commer used the same engine in their two tons Centaur truck as they used in their 30 cwt van. The Fox could not meet the necessary load capacity for the larger vehicle. The Perkins team agreed to try a 85mm bore, keeping all the other dimensions the same as the original Vixen so they could still use the 100 sets of parts they already had in stock. They estimated that this would increase the torque by another 13 per cent or almost 30 per cent more than the original design. At a board meeting of 12 April 1933 it was agreed to build two engines to the new design, to be called the Wolf, and order parts for a further 24. By the end of June a Wolf had run in a Commer truck and passed all the tests set by the customer. Commer's parent company Humber Motors signed an order with Perkins in October 1933 and agreed to display a Perkins engined truck at the next London motor show.²⁵

Meanwhile Frank Perkins had employed a part-time, Jewish sales manager called Greenberg who was based in the west end of London. Greenberg's job was to persuade car and van dealers to become Perkins' agents and offer a diesel version as an alternative to the standard petrol engine models on sale and to sell engine 'conversions' for installation in existing vehicles. The price of the Wolf was fixed at

²⁴ Chapman typescript, p46.

²⁵ Chapman typescript, p49.

£172 for main agents and somewhat less for OEM²⁶ manufacturers. The first conversion was performed for T Seymour Mead Ltd of Manchester.

The economics of diesel power: 1930s style

F Perkins Ltd now hit a common problem facing all new small enterprises. Only £1,000 of its initial capital was still available and it needed to order £8,000 of parts and equipment to fulfil its current and expected orders over the next few months. Mr Grimwade, manager of the local Barclays Bank, remained unimpressed with the proposition of lending such a sum against total company assets worth a few hundred pounds but was eventually persuaded to part with £3,000 on receiving the personal guarantees of G D Perks and Alan Richardson. In addition the company borrowed a further £3,900 from its directors and completed 1933 with £188 in the bank and petty cash of £14.5s.²⁷

Chapman having spent several years as the principal administrative manager for Aveling & Porter was experienced in making financial calculations and presenting accounts. In his draft memoirs he reproduces various sums he presented to Perkins and the other directors to give them some idea of the company's income and expenditure and to predict some kind of profit and loss account.

In 1933 Chapman calculated the materials cost of producing one engine as follows:

Components	£88
Labour	£ 2
Total	£90

He estimated that annual expenditure of the company was running at £7,000 so that if he produced 100 engines the fixed cost to be added to each engine was £70. The total cost before any addition for profit would, therefore, be $90 + 70 = £160$ per engine. If 200 engines could be produced with the same fixed costs the calculation would be $90 + 35 = £125$ per engine net. It was on this basis that they attempted to negotiate with Commer and begin large scale production.²⁸ Eventually after much negotiating Commer agreed that the standard OEM price for the Wolf should be £140 less a 10 per cent discount for them as the first major customer. Their first order was for a grand total of six engines

Chapman and Perkins were also counting on the large difference in road fuel tax between petrol and derv (diesel fuel for road vehicles such as road rollers) that would make diesel engined vehicles much cheaper to operate especially in high mileage commercial vehicles such as trucks, vans, PSVs²⁹ and taxis. In 1933 the cost of Derv was 5d a gallon including 1d tax. The cost of petrol was 1s 4d a gallon including 8d tax or over 300 per cent more expensive. This vast difference could be a major selling point assuming the Treasury did not adjust the price of Derv by increasing the tax once the new engines had become widespread. Chapman and Perkins tried to convince the manufacturers by pointing out the savings their customers could make by using a diesel version of the standard Commer van. If an average van covered 25,000 miles per annum and achieved 13 mpg it would consume about 1,925 gallons of fuel at 1s 4d per gallon or approximately £130 in a full year. A Perkins engined van would achieve 20 mpg at 5d a gallon

²⁶ Original Equipment Manufacturer, Perkins' main customers as a component maker.

²⁷ Chapman typescript, p50.

²⁸ Chapman typescript p52.

²⁹ Public service vehicles such as buses, coaches, dustcarts, ambulances, fire tenders etc. All these would become major applications for Perkins vehicle engines.

or $25,000 \div 20 \times 5d = \text{£}26$ per annum. This would produce a saving of over $\text{£}100$ per annum per vehicle in fuel alone. In eighteen months a diesel engine would have paid for itself.

Whilst Chapman and Perkins were struggling to interest the OEMs in the economics of high speed diesels, Albion Motors of Glasgow³⁰ and Dennis³¹ wanted engines for vehicles of three to four tons and above that the Wolf couldn't power, Greenberg was beginning to be successful in selling the idea of replacing worn out petrol engines with a Perkins 'conversion.' Greenberg was selling conversion engines for a retail price of $\text{£}172$ including the costs of fitting the new engine into the chassis. Chapman factored in the higher profit margin on conversions into his 1933 year end forecasts expecting to sell 40 engines to Commers at $\text{£}126$ and 60 conversions at $\text{£}172$ giving him an average income of $\text{£}154$ per engine. In reality the company sold only 45 engines for a total income of just over $\text{£}6,700$ and was $\text{£}7,500$ in deficit. To balance the formal company accounts Chapman used his creative powers to invent a 'development account' to which he attributed $\text{£}3,911$ of the excess of expenditure over income and was able to present a paper loss of only $\text{£}3,503$ on a turnover of $\text{£}17,096$. The formal directors' financial statement omitted any mention of this 'development account' and cheekily recommended that no dividend be paid to shareholders. Mr Grimwade the bank manager was thus kept in blissful ignorance.³²

In 1934 the Wolf found a new champion in a Mr Crawford of Welwyn Garden City, Hertfordshire who had invented a new lightweight commercial vehicle and proceeded to offer his product with a Perkins Wolf as standard. His 'Arran Deselet' proceeded to sell at the rate of one or two vehicles per month, a welcome boost to Perkins very slow sales growth. Greenberg also reported that his potential customers claimed that the Wolf was too small for their vehicles and that if they could produce a more powerful engine sales would rise dramatically. Chapman quickly devised a 100mm bore four cylinder engine but retaining virtually all the other parts of the Wolf to keep his component inventory under tight control. Once again financial necessity was the mother of engineering invention. Chapman kept producing relatively lightweight four cylinder engines with a fixed 120mm stroke and an ever increasing bore producing more torque, more fuel efficiency and more power for the same production cost. The new model was named the Leopard. The first 1934 edition Leopards soon interested Bedford, Dodge and Albion and after initial trials the bore was extended to 105mm and the new version named the Leopard Mark II.

The first marine application of a Perkins engine came when Birmal Boats, a subsidiary of the Birmingham Aluminium Company, ordered Wolf engines for conversion into marine operation. In order to boost sales on dry land, the company decided to spend $\text{£}550$ on advertising and to tune up a Wolf to be fitted into Reg Munday's 'flat-iron' Thomas special racing car. By the summer of 1935 the Wolf engined racing car had lapped Brooklands at an average speed of 92.3 mph, exceeding 100 mph over the 'railway straight' and set several world speed records for diesel engines. Frank Perkins' flair for publicity stunts was beginning to succeed in attracting attention to Chapman's revolutionary engines.

One important new customer was the fleet manager of J Lyons and Company Ltd. The Salmon and Gluckstein families had founded J Lyons in 1886 as a mass market catering business. The company

³⁰ Albion Motors, established in Glasgow in 1899, became Scotland's most successful motor-manufacturing company. Initially a car factory, it began to specialise in the production of trucks before the First World War and continued to build them until 1980. It merged with Leyland Motors in 1951, and from 1968 onwards it was part of the ill-fated British Leyland combine.

³¹ In 1901 former bicycle makers Dennis Bros. Ltd moved into a factory designed for the production of their motor vehicles on the corner of Onslow Street and Bridge Street, in Guildford. The brothers launched their first motorcar in 1902, buses in 1903, followed by vans and lorries, and fire appliances, the most famous of Dennis vehicles, from 1908.

³² F Perkins Ltd annual report 1933.

rapidly established a chain of teashops, corner houses and restaurants with the opening of the first Lyons teashop in 1894 in Piccadilly, the Trocadero restaurant in 1896 and the first Lyons corner house in 1909. The company maintained its own fleet of commercial vehicles to supply its outlets with food and other materials from its Greenford warehouses. Efficient and well-equipped depots with their own vehicle service manager and trained mechanics meant Lyons was an ideal customer for Perkins. Other customers were not so well organised and Chapman was forced to purchase, equip and staff a service truck (naturally Perkins powered) to attend breakdowns when customers who had overloaded their vans or raced the engine to excessive speed achieved the inevitable breakdown. By 1934 Chapman introduced engine governors and sealed fuel pumps in order to prevent some of the abuses perpetrated by reckless drivers on his defenceless new engines.³³

Success in selling engines to customers like J Lyons forced Perkins to expand their premises as early as July 1934. Additional space in the former Barford & Perkins works was rented and as it came with 6 ton and 10 ton cranes installed was used as the engine testing section. By April 1934 sales had reached 140 per annum but that still fell far short of the 200 Chapman estimated he required to 'break even.' J E S Perkins, G D Perks and Alan Richardson made further loans to the company and an additional £5,000 was secured from Barclays Bank against the personal guarantees of the directors much to Chapman's distress.³⁴ By the end of 1934 the company had sold 150 engines that year with another 45 on order, up from the total 45 of 1933, and had a turn over of £32,550.³⁵

The road to Moscow and worldwide distribution

Frank Perkins was a big man with very big ideas. Despite his rude and authoritarian disposition and rather ruthless business brain, he was the ideal marketing and public relations director, innovative, capable of great leaps of imagination and the employment of very un-English 'chutzpah.' He developed his UK sales network by employing agents in the motor industry on commission and then began to develop an overseas network to stimulate foreign sales. As early as March 1934 he had signed a contract for a distributor called Bercos Traders to market Perkins engines in the USSR³⁶ and the following month signed a short-term contract with Manfred Weiss, the Jewish owned engineering group of Hungary to manufacture Perkins engines under licence. Albion Motors ordered a Leopard for trials for the British army in India. India was to prove an extraordinarily successful market for Perkins after its first big order from Commers in March 1935. The telephone rang in Queen Street and an order for 80 Wolf engines placed by Commers' purchasing director. A Commer bus chassis with a Wolf had been delivered to the Gwalior and Northern India Transport Company and the customer was so pleased it decided to convert all its vehicles to diesel. Chapman was ecstatic.³⁷

In 1935 the first Perkins engined Commers were also sent to Argentina; Latin America would also become an important export market for British diesels. Senior service engineer Cyril Kent was sent to Argentina on a promotional and customer training tour and a young post-graduate called Barker was sent to Ceylon and India. Perkins and Chapman both realised that despite the slow continuous growth in the British economy from 1935 onwards the development of export markets might be the only method of rapid sales expansion and the saving of their company. This belief was strongly reinforced when Neville

³³ Chapman typescript, p60.

³⁴ He claims he took the first ever sleeping pill after signing his share of the guarantee. Chapman typescript, p61.

³⁵ F Perkins Ltd annual report 1934.

³⁶ The politically very right-wing Perkins had no problem in trading with the Soviet Union, business was business.

³⁷ Chapman typescript, p67.

Chamberlain, the Chancellor of the Exchequer, presented the government budget of 15 April 1935 and increased the tax on derv from 1d per gallon to 8d per gallon thereby reducing the margin between the retail price of derv and petrol. The savings in running costs for the average diesel engined van over its petrol engined equivalent was cut by a third overnight. Several UK orders were immediately cancelled by OEMs and by the domestic sales network. Very quickly another service engineer, Joe Hinch, was sent on a tour of South Africa, Rhodesia, Kenya and Uganda.

Chamberlain had not increased the diesel fuel tax for stationery, off-road applications and for agricultural machinery. Therefore, Perkins and Chapman decided to hire another part-time sales manager, Geoffrey Guest, to build up the industrial and agricultural applications business. His first sale was a Wolf to power a stone crusher in a quarry near Peterborough. Guest sold engines to companies such as Murex, which made welding sets, Broome and Wade for portable compressors and Wickhams for light railcars. Later Leopard engines with a special cast iron oil sump and brackets to house the front axle and radiator of a Fordson tractor were supplied through the good offices of Fordson's Peterborough area agent who allowed Chapman's staff to measure the appropriate parts without having to purchase a tractor. A Perkins engined Fordson was put to work on a local farm and in the years between 1935 and the outbreak of war in September 1939 a large number of Fordson conversions were completed; the main export market being New Zealand.

Automobile innovator Henry Ford had achieved his first success with his Model T Ford, but he was not content to limit himself to cars. He was the son of a farmer and started work on a tractor for farm use. A prototype was built in 1907 but did not lead to a production model in part due to opposition from the corporate board. As a result Henry Ford set up a separate company, Henry Ford and Son, referring to himself and his son Edsel to produce tractors under the 'Fordson' name. Later, when Ford assumed complete control of Ford Motor Company in 1920, the two companies were merged.

Mass production of the Fordson model F started in 1917. The Fordson came at the end of the First World War with its manpower shortages in agriculture, and utilizing Ford's assembly line techniques to produce a large number of inexpensive units, it quickly became the dominant model. Three-quarters of a million tractors were sold in the USA alone in its first ten years. Thousands were shipped to the United Kingdom and the Soviet Union where local production was soon started. European Fordsons were produced in Cork, Ireland between 1919 and 1932 before production was consolidated at the Dagenham, Greater London factory which built Fordsons between 1933 and 1964. The sales of industrial and agricultural application engines such as the Fordson conversions allowed F Perkins Ltd to double its annual turnover once again to £62,570 and it ended 1935 with its first notional profit of £3,386 8s 5d.³⁸

Frank Perkins had agreed with Automotive Products Ltd that their European sales executive Mr Mitchell would also represent F Perkins Ltd during his continental forays. Mitchell contacted Daimler-Benz of Stuttgart and in early 1936 negotiated a licence for D-B to produce Wolf engines in Germany. D-B had their own experimental diesels but these proving problematic. Instead D-B paid F Perkins £500 for an exclusive licence and sent a Daimler to Peterborough to be fitted with a Wolf. Chapman accompanied the Daimler back to Stuttgart and spent five weeks supervising the road trials. Eventually D-B rejected the Wolf, despite its superior performance, because its exhaust was visible whereas the D-B engine exhaust was not.³⁹

³⁸ F Perkins Ltd annual report 1935.

³⁹ Chapman typescript, p84.

The Soviet ministry of transport arranged for diesel engine road trials in 1936 and invited international entrants to compete. A Russian built Ford truck with a Perkins Wolf was to be one of the 'home grown' entrants. Frank Perkins and Alan Richardson realised there could be substantial publicity value in this if the Wolf powered Ford did well and decided to attend as observers. Never one to miss a public relations opportunity, Frank Perkins announced to the media that he would drive from Peterborough to Moscow in a diesel engined Hillman. The car was driven to the coast and put aboard a ferry to Helsinki in Finland. From there Perkins and Richardson drove it via Leningrad to Moscow and after the trials back to Helsinki, a round trip of over 1,200 miles. The Wolf engined truck completed the endurance trials and was awarded first prize but F Perkins Ltd was awarded no new Russian orders.⁴⁰ The Soviet leadership was conserving its hard currency.

Nearer to home, Frank Perkins and his new sales director L W 'Laurie' Hancock visited the General Motors plant in Antwerpen, Belgium where Europe's Dodge and Chevrolet trucks were manufactured. Diesel fuel tax was much lower in Belgium and the Netherlands than it was in the UK and therefore diesel was still much cheaper than petrol. General Motors were impressed with the Perkins products and were determined to achieve a successful launch of their new diesel powered truck range. They summoned all their sales representatives and service engineers in the two countries to Antwerpen where a Chevrolet had been fitted with a Leopard and a Wolf engined Vauxhall car shipped over from Peterborough. Chapman, Hancock and Kent attended and delivered a series of lectures and workshops on the design features, sales propositions and service issues.

Chapman and the general manager of the GM factories had a narrow escape from disaster during the visit that could have ended the Perkins Engines story there and then. The executive decided to test drive a truck himself and invited Chapman along for the ride. The fuel tank was almost empty so the manager instructed a worker to take the truck and fill the tank with 'gas-oil,' a term for light diesel fuel. However the American employee understood 'gas' to be petrol and filled the tank with petroleum. After a few miles the engine ran out of diesel and refused to inject petrol into the combustion chamber. Chapman left the pump vent ajar to allow the petrol fumes to escape and the truck limped back to the plant dripping highly volatile fuel onto the extremely hot exhaust pipes below. Chapman warned his companion to be ready to leap out should the engine burst into flames. A strong warning went out to the GM network to remind customers not to fill their diesel engined trucks with petrol.⁴¹

The General Motors deal boosted sales and production at Peterborough and a further 7,500 sq. ft. of factory space was leased at Queen Street together with an additional office. By the end of 1936 Chapman was forecasting annual production of 2,000 engines a year to his fellow directors. Turnover was up sixty per cent to almost £100,000 and a sales office had been opened in Birmingham, the heart of the British automotive industry.⁴²

The development of the P series and fame at last

F Perkins Ltd started 1937 with a healthy order book and in a far more secure financial position. The economic depression of the early part of the decade was finally over and the re-armament of several European countries and continued economic growth in North America was helping to boost world trade. The London and Birmingham sales offices were closed on the departure of Mr Greenberg and all UK

⁴⁰ Chapman typescript, pp84-85.

⁴¹ Chapman typescript, p89.

⁴² F Perkins Ltd annual report 1936.

sales were consolidated in Peterborough under the management of L W Hancock. Frank Perkins realised that the company would soon outgrow the old Barford & Perkins factories in Queen Street and started to look for a greenfield site on the edge of Peterborough on which to build a new factory and office complex. He found a farm of 33 acres whose owner had recently died and began negotiations with the executors.⁴³ Sales agents were appointed in Sydney and Melbourne, Australia and by the end of April Chapman had tested his new more powerful six cylinder engine later to be known as the Perkins P6. Sales of the Wolf were declining and the Leopard was facing increasing competition from rivals such as Cummins, Caterpillar and Mercedes Benz. Chapman gambled that his new design would be successful and ordered 500 sets of parts before he had even completed his initial testing of the prototype. He planned to build a complete series of three, four and six cylinder engines machined with exact precision to fit in the chassis of a Bedford or Commer truck. The new range would be launched at the commercial vehicle exhibition in the forthcoming November. Chapman was still working very long hours as company secretary, financial controller, chief designer and test engineer. He met his self-imposed November deadline and prepared to launch the series as the Panther, the Puma and the Python. However after the initial sales literature had been prepared, Phelon & Moore who made the Panther motorcycle claimed Perkins was infringing their copyright and the board decided to leave the world of zoology and simply call the new engines the P6, P4 and P3, P standing for Perkins.

The P series caused a major sensation at the commercial vehicle exhibition. For the first time a manufacturer was offering high speed diesel engines that looked like modern petrol engines and were absolutely comparable in power, size and weight. Perkins had arranged for the display of both a Commer truck and a American Studebaker car to be fitted with P6 engines and to be available for trial runs. The P series was widely admired by the industry and received very favourable critiques in the trade and technical press. It would remain in mainline manufacture at Peterborough and later at Perkins' subsidiary and affiliated factories around the world for over thirty years, one of the longest continuous production runs in engineering history.⁴⁴

Meanwhile Frank Perkins had bought the Newark farmhouse and its thirty three acres of land for £2,780. Mr Grimwade of Barclays, now reassured by the ever increasing sales order book, lent the money for the purchase and retained the deeds in his office safe as the bank's security. Plans were drawn up for a new factory and office block of 54,000 square feet, double the size of Queen Street, to be built at a cost of £12,000. However, Chapman had ordered new machine tools including plano-millers, six spindle cylinder bores, lathes, universal mills and radial and three spindle drills sufficient to machine 50 sets of P6 cylinder blocks, cylinder heads and connecting rods per week. This would greatly reduce the dependence on bought in components and reduce their cost but the bill for the new machinery was £13,300 a tremendous investment in capital equipment for a still relatively small company.⁴⁵ The board wisely decided that the machine tools were more essential than the new factory.

“All in all we came to the conclusion that the time was not quite ripe for us to spend money we hadn't got on a works we could do without. Instead we put the plans away and rented a further section of the old Bardford & Perkins works which was in due course rigged up as our machine shop.”⁴⁶

⁴³ Chapman typescript, p94.

⁴⁴ Chapman typescript, p96.

⁴⁵ Chapman typescript, pp96-97.

⁴⁶ Chapman typescript, p97.

Further financial support came from Frank Perkins' brother-in-law Alan Richardson who arranged a syndicate of his friends to buy the machine tools and resell them to F Perkins Ltd using a hire purchase agreement over three years. At the beginning of 1938 the company's financial situation was still precarious as although 760 engines had been sold in 1937 earning £135,000 and Chapman showed a paper profit of £11,000 in his financial statement, the development of the P series engines had absorbed over £30,000 in development and design costs, parts inventory and tooling.⁴⁷ Once again Chapman was authorising large expenditures on the hope that his new engines would produce sufficient income to cover the ever-increasing debt. He had equipped the factory to produce 50 P6 engines per week; in January 1938 he had a total order book of 40 P series engines. Mr Grimwade had to be persuaded to authorise an overdraft of £27,500 at interest one per cent above Bank Rate with a general charge on all the company's assets. Chapman was putting all his engineering eggs in a single basket. New marketing and sales ideas would be needed to boost the order book for the P series and ensure that the company's debt could be repaid. Senior sales manager Laurie Hancock came up with an idea that re-enforced the diesel engine's advantage in being more mechanically reliable than the equivalent petrol engine.

“Hancock introduced the ‘Perpetuity Plan’ whereby, like old soldiers, Perkins engines would never die. Owners of any Perkins engines could, for a fixed payment, at any time, exchange a worn or damaged engine for a reconditioned engine carrying the same guarantee as a new engine including any improvements incorporated in the new engines. The replacement could be ordered before the old one was returned so that the change over could be made in a few hours and the vehicle kept in service without a break.”⁴⁸

There was no limit set on the number of times an engine could be replaced presuming the customer paid the relatively modest Perpetuity Plan fee, in effect a type of warranty or insurance plan, so that the major repair costs and depreciation were, in effect, completely covered. Tens of thousands of these reconditioned engines would form a major part of the Perkins business over the next several decades. Eventually entire factory lines were devoted to supplying customers with ‘recon’ engines.

By the summer of June 1938 the P series was selling well and amounted to 80 per cent of all new engine sales. The P6 sold for £250, 20 per cent more than the Leopard, and because much of the machining and component manufacture was now done in house, the profit margins were far greater. Fifty to sixty P series sales a month would generate as much profit as 100 Wolf or Leopard sales. By the end of June, a little more than six months after it had been launched and brought to the market, Chapman's P6 was a standard power unit in Albion, Bedford, Commer, Dennis, Dodge, Garner, Guy and Thorneycroft trucks. This universal success so convinced Seddon Brothers Ltd that they immediately set to work to design a completely new four to five ton truck based on Chapman's engine. Eventually a new company, Seddon Diesel Vehicles, became a major Perkins customer.⁴⁹

Perkins Engines goes to war

1938 was a ‘year of the dictators,’ and Chapman describes Hitler and Mussolini as “screaming into the microphones.” A former neighbour of Chapman's when he lived in Rochester, Kent was now Captain W G Cowland, RN, director of the Admiralty Engineering Laboratory at West Drayton, Middlesex. Cowland arranged for a P6 to put through the standard admiralty engine tests so the Royal Navy could

⁴⁷ F Perkins Ltd financial report, 1937.

⁴⁸ Chapman typescript, pp98-99.

⁴⁹ Chapman typescript, pp99-100.

use it. The navy was rapidly expanding its fleet, now that the maverick Conservative MP Winston Churchill having finally convinced the government of Prime Minister Neville Chamberlain, that another war with Germany was an ever-increasing possibility. The P6 was eventually approved as a high-speed marine engine for use in light auxiliary craft, launches, tenders and pinnaces. As a result of this Royal Navy approval, the marine division of the Air Ministry approached Perkins. The RAF used a great number of boats and other marine craft. They performed a number of tasks including seaplane tenders, armoured target vehicles for bombing practice, air-sea rescue and allied operations. Chapman explains why the RAF preferred to use diesel engines in their 40ft tenders rather than the then current twin 100hp petrol engines:

“For marine work the diesel is to be greatly preferred over the petrol engine, for with the latter there is the ever present risk of fire, and fire at sea is a catastrophe to be dreaded. Moreover, in wartime, with incendiary bullets spraying down from attacking aircraft, the risk of fire is greatly increased. Again with its greater thermal efficiency and reduced fuel consumption the diesel engine boat has a much greater range of operation for a given weight of fuel, or for the same range needs less fuel allowing the craft to carry a greater useful load.”⁵⁰

Until the advent of the Perkins P series there had been no diesel engine small enough and light enough to power this type of craft. However the Air Ministry wanted a greater power output than the standard P6 could achieve and, of course, it had to be converted to marine use including the ability to use salt water as a cooling fluid. Chapman immediately began to design an improved version of the P6 to produce 125 - 130 hp at 2,250 rpm.⁵¹ The new model included a reverse gear and all necessary accessories and weighed approximately 1,300lbs. This gave an extremely low weight for a fully equipped marine diesel of only 10lb per horsepower at full speed. Chapman completed his test bed trials within five months and the engines were supplied for sea trials by the end of November 1938. They proved to be extremely successful.

Experimental diesel engines for aircraft had been produced earlier in the decade by the Bristol Aeroplane Company in Britain and by the Packard Motor Company in the USA. However these were too heavy and too low powered to meet the needs of modern warplanes. A gallon of imported mineral oil produces far more diesel than petrol so for a country at war, with the threat of a sea blockade by German U boats, a move to diesel engined aircraft seemed prudent if not essential. RAF intelligence had reported that the Germans using Mercedes-Benz technical expertise had already developed a diesel engined Junkers Jumo capable of producing a take-off output of 1,000hp comparable in 1938 with the latest Rolls Royce Merlin.⁵²

“Frank and I saw Mr Tweedie in the Engine Development Section at the Air Ministry and reported at the July [1938] board meeting that we had been promised a development contract to design and produce a single cylinder test engine of around six inches bore, to be fitted with a cylinder head

⁵⁰ Chapman typescript p101.

⁵¹ The modified engine was known as the S6M – Service 6 Marine – and would become a very popular model for lifeboat, commercial (fishing boats etc) and private yachting customers. It became one of the most widely used small marine diesel engines in the post-war world.

⁵² These details were communicated to Perkins and Chapman during their secret negotiations with the Air Ministry during which they presumably had to sign the Official Secrets Act. Chapman seemed to believe that by the time he was drafting his memoirs in the early 1960s most of this information was already in the public domain.

having a combustion design similar to the P6. This engine, after acceptance at a moderate rating, was to be then supercharged to see how much power we could get out of the cylinder.”⁵³

Without waiting for the written contract to arrive, Chapman asked his already overworked design and technical drawing staff to copy and formalise his rough designs for the new engine. He also ordered a special test bed and all the necessary specialist equipment to test an aeronautical diesel. The AMS (Air Ministry Single) was approved by the government in February 1939. It is unsurprising that the first time Chapman complains of tiredness caused by years of overwork was in the autumn of 1938 when he was testing commercial vehicle, marine and aeronautical engines simultaneously whilst still functioning as F Perkins’ company secretary and chief financial controller. He was now 45 years old and had been working continuously doing several stressful jobs (what we would now call multi-tasking) for almost ten years since his days as company secretary and senior diesel engineer at Aveling & Porter. He makes no mention of taking a vacation. All his journeys outside the Peterborough area whether in the UK or in Europe were on company business.

The outbreak of war in September 1939 caused Chapman more anxiety as many commercial and private customers cancelled their orders before he could replace their value with new orders from the armed services and other industries connected with the war effort. His continued trips to Mr Grimwade at the bank seemed to be distasteful and increased the drain on his energies. One can almost hear the cry of a Lancashire boy from a modest home, brought up to be careful with money, as he incurred yet another loan of £20,000 and signed his name as a personal guarantor to sums that, if there were ever demanded, would leave him homeless and financially ruined. By the end of 1939 F Perkins Ltd was showing a profit of over £12,000 on a turnover £206,000 with an overdraft of £57,846 (£2,000 more than the issued shares), creditors of £57,846 and debtors of just over £40,000.⁵⁴

Conclusion

By the start of 1940 F Perkins of Peterborough was expanding rapidly but was still greatly undercapitalised and financially speaking ‘flying by the seat of its pants.’ This was a situation that Chapman personally never learned to live with. He was not a natural entrepreneur from a comfortable old county family like Frank Perkins. He was not a wealthy, upper middle class, war hero like Alan Richardson. He was not even an astute and canny commercial solicitor like G D Perks. Alone of all the company directors Chapman was a grammar school boy from an ordinary working family who had by divine gift been granted the brain of an engineering genius. He was never a businessman and actually never really wanted to be one. He was studious, intuitive, meticulous, and fearful of incurring debts that he could never hope to repay.

By himself Chapman might have been able to invent and develop a high-speed diesel engine and patent it for others to manufacture and market. After several years he might have received royalties on his patents that probably would have exceeded all the income he ever earned from Perkins Engines Ltd, as it became known after the war, many times over. But without Frank Perkins and his insatiable thirst for commercial success and wealth there would have been no Perkins Engines Ltd and no world famous diesel engineering centre in Peterborough covering all 33 acres of the former farm with its ‘Eastfield’ factories, office blocks, sports and canteen facilities and its internationally renowned research and design facilities

⁵³ Chapman typescript, p103.

⁵⁴ F Perkins Ltd annual report, 1939.

and service training centre. No overseas subsidiary companies in the USA, Australia, France, Germany and Italy and no licensees in India, Brazil and South Africa.

Charles Wallace Chapman, unlike Watt, Stephenson, Telford, Marconi, Graham Bell and even Diesel himself never received either the recognition or the rewards that his inventions deserved. Diesel had become a sterling millionaire by the time of his death in 1913. Chapman was neither knighted nor made a fellow of the royal society. He was never nominated for the Nobel prize in physics even though he had single handed, on the back of some envelopes, solved the problems of the high speed compression ignition engine. No buildings or streets are name after him – not even a side road off Frank Perkins Way in Peterborough. Now almost totally forgotten except by retired Perkins employees with very long memories, even Chapman's later work on miniature submarines, and on automatic clutches and couplings, is rarely mentioned. Chapman was fated to be neither rich nor famous. Asked who invented the Perkins high-speed diesel almost every customer would answer 'Frank Perkins, of course.' The irony remains that the man who could neither invent an engine nor even construct one from existing parts has had his name eternally associated with another man's genius whilst the inventor himself has been virtually erased from history.

In November 1942 Chapman resigned as a director of F Perkins Ltd and devoted his energies solely to war work. In 1951 Perkins Engines became a public company with a capitalisation of £3.5 million. Chapman then still owned his original £1,001 in ordinary 1s shares in the private company or 0.46 per cent of the value. The Perkins family owned 11.05 per cent and the Richardson family 11.27 per cent. Chapman's total return for his inventions, the Wolf, the Leopard, the P Series, the marine, agricultural, industrial and aeronautical applications and over ten years devoted effort as company secretary, financial controller and chief test engineer was worth no more than £16,100. Frank Perkins and his family received £386,750 and Alan Richardson and family £394,450. Chapman severed his connection with Perkins Engines although occasionally acting as a design consultant when young, university trained engineers came up against an insuperable problem. He made significant contributions to the concept of turbo-charging diesels in the 1960s based on his work for the Air Ministry during the war. In 1959, shortly after Perkins Engines Ltd was sold to its then largest customer, the Canadian farm machinery manufacturer Massey Ferguson, Frank Perkins, the only remaining original director of F Perkins Ltd stepped down as chairman and became 'honorary president' of the division that still bore his name. It was the end of an era in diesel engineering. Perkins Engines Group produced its two millionth engine in 1960, almost half of which had been exported. In 1984 Perkins Engines bought Rolls Royce Diesels and in 2002 the group was sold once again, this time to a major competitor, the Caterpillar Corporation.

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